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Abstract

This research employs two alternatively framed but formally equivalent discrete choice experiments that examine UK consumer preferences regarding chlorine washed chicken. One is framed in a common purchase format, the other employs a format that endows respondents with a voucher that they can use to redeem for a chicken product, or exchange, in part, for an alternative chicken product or cash. We find that the difference in our value estimates is small regardless of how we implement our choice experiment. Our analysis also differentiates the value estimates by respondent attitude to Brexit. The results reveal that being positively disposed toward Brexit means that respondents are less likely to value chlorine washed chicken negatively. Yet, of equal or greater significance, those respondents who hold positive attitudes with regard to Brexit still value EU food safety standards and quality assurance schemes such as Red Tractor highly. This suggests that attitudes to Brexit and preferences regarding food do not necessarily align in support of trade agreements that may require the UK to lower existing food safety and animal welfare standards. Potential policy solutions to ensure consumer preferences are satisfied are discussed.

Key Words: Chlorinated Chicken; Willingness to Pay; Discrete Choice Experiment; Brexit; Trade Policy; Red Tractor.

JEL: Q18, Q17, I18.

1. Introduction

In 2016 as a consequence of the Brexit vote the UK decided to leave the EU. This decision has meant that UK needs to reconsider how it relates to the world with respect to trade. In particular, since the vote there has been a great deal of attention given to how the UK will position itself with regard to the international trade of food and whether or not it will continue to align with EU regulations. One specific issue that has acted as a focal point for this discussion is what type of Free Trade Agreement (FTA) the UK will strike with the United States (US) and as such allow the importation of chlorine washed chicken (Millstone et al., 2019). The prospect of chlorine washed chicken being imported into the UK has been the subject of numerous newspaper articles and opinion polls. For example, Which? (2018) reports that 93 percent of respondents to a survey wanted to retain current food standards with 72 percent opposed to allowing the importation of chlorine washed chicken. Savanta ComRes (2020) report similar results in research carried out for the RSPCA. The level of negative feeling being expressed in the UK regarding the potential imports of chlorine washed chicken has led to several UK supermarkets vowing not to sell chlorine washed chicken (The Business Insider, 2020). At the same time the position of the UK government on future food standards and the likely importation of chlorine washed chicken remains unclear. Apart from surveys eliciting general attitudes towards chlorine washed chicken, there is currently no economic research examining consumer preferences and this would seem to be an oversight given the high profile nature of the subject and its potential importance in how future FTAs might be implemented.

In this paper, we present research that examines consumer preferences for chlorine washed chicken whilst also taking account of attitudes to Brexit, food production and food safety. Specifically, we examine the extent to which positive or negative attitudes to Brexit manifest in terms of attitudes to chlorine washed chicken. To undertake our analysis, we employed two formally equivalent but differently framed discrete choice experiments (DCEs). The first DCE (DCE1) required survey participants to complete a sequence of choice tasks over fresh chicken products indicating which one they would buy. As such, the values that were elicited can be characterised as willingness-to-pay (WTP).

The second DCE (DCE2) endowed participants with a voucher that entitled them to a specific fresh chicken product. Respondents could then either exchange the voucher for cash or exchange it for their preferred chicken product costing more or less than the value of the voucher. Although this is a non-standard way to frame a DCE, the availability of vouchers is now relatively common in many retail contexts. For example, many supermarkets offer loyalty card holders money off vouchers for specific products, there are also smartphone apps, such as Shopmium, as well as website such as Coupons.com, that offer vouchers plus cash back on specific product purchases.

Within the existing DCE literature, especially that examining varied aspects of food choice, the DCE offers a range of possible purchases as is the case for DCE1 (e.g., Balcombe et al, 2010; Lewis et al., 2017; Grebitus et al., 2018). This partly stems from the fact that researchers are interested in the purchase decision for a particular product, but also because framing choices as potential purchases is thought to be easily understood by respondents. However, it is frequently argued that respondents may struggle to make decisions. As a result, it is common place to include a "reference point" within the choice task to help respondents make decisions. The reference point in a DCE can take the form of an opt-out (eg, a no choice option, a dual response design) and/or the inclusion of a status quo option. In general, it is regarded as good practice in most cases to include an opt-out (no choice) for a number of other reasons, including that it provides a reference point (i.e., opting out preserves the respondents current utility) (Hensher et al., 2015; Johnston et al., 2017, Campbell and Erdem, 2019).¹

The approach we propose, that is providing individuals with a voucher in DCE2, adds to a growing literature that have modified the reference point. For example, some researchers have used a pre-set opt-out as the default option (e.g., Löfgren et al., 2012; Penn and Hu, 2021; Robinson et al., 2021). Like List (2003), these studies indicate that "experienced" respondents are not affected by the use of a default reference point.² Another variation on how the opt-out is employed is the use of a repeated statement explaining the purpose of the opt-out (Alemu and Olsen, 2018). There is also the approach discussed by Ladenburg and Olsen (2014) that relates to the dual process approach of Brazell et al. (2006). Another facet of the literature that relates to the reference point is the way in which it interacts with choice task complexity. As noted by Boxall et al. (2009), Balcombe and Fraser (2011) and Oehlmann et al. (2017) increased task complexity can lead to an increased selection of the status quo. In contrast,

¹There can be situations in which a forced choice is appropriate. See Campbell and Erdem (2019) for a discussion. Penn et al. (2019) empirically examine the issue of including and excluding the opt-out option.

²DellaVigna (2009) has an extended discussion around the issue of experience and behavioural anomalies including an overview of reasons why experience might not reduce the likelihood of making irrational choices.

Borger et al. (2021) suggest that lower than expected selection of the status quo option, might reflect a cultural variation in how respondents react.

With our experimental design, following List (2003), we contend that as our DCEs employ a food product that is familiar to all respondents, the framing of the reference point should not impact our results. However, if we do observe differences in the results generated by DCE1 and DCE2, then one explanation for this phenomena might be the "endowment effect". Thus, we consider how a variation in the reference point may help the respondent make decisions, although it may impart bias on our value estimates. Indeed, the endowment effect has itself been partly rationalised as a reference point effect (see Kogler et al., 2013). We are therefore interested to see whether our DCE design substantively changes the preferences elicited, with a particular focus on the whether there was a stronger tendency to opt for the endowed option in DCE2 and if this subsequently resulted in differences in the value estimates derived. If the change of frame drove a large wedge between the two DCE estimates, then this would cause us to be more circumspect about our conclusions. Conversely, if the designs did not have a substantive effect on the estimates, we could have greater confidence in our results.

This research also contributes to the literature on novel food production and consumer attitudes and values. Although there are a large number existing DCEs that have examined issues such as hormone in beef (e.g., Lewis et al., 2017) or genetically modified organisms (e.g., Grebitus et al., 2018) there is virtually no literature that has examined chlorinated chicken. Typically, the literature has been concerned with food safety and the use of a chlorine wash to reduce *Campylobacter* (MacRitchie et al., 2014). There are only two economic studies that have examined chlorine washed chicken using stated preference methods. First, Kawata and Watanabe (2018) undertook a DCE study in Japan examining food related illness and how a chlorine wash could reduce food related illness. Second, there is Balcombe et al. (2021) who examined consumer preferences for food produced using production methods, including chlorine washed chicken, that are currently banned in the UK. The chlorine washed chicken results reported in Balcombe et al. (2021) are partly based on the survey data we employ in our DCE1. However, the focus of Balcombe et al. (2021) is very different to that we report here, specifically the comparison of the two DCE, the Brexit related analysis and the resulting implications for trade policy.

Specifically, the research we present examines how our respondents' attitudes to food and Brexit are reflected in differences in preferences. We condition our econometric results on whether respondents hold positive (Leave), negative (Remain) or neutral views with regard to food following the Brexit vote. This aspect of our research is important given that there has been a lot of controversy surrounding the form that any new FTAs might take and if they will embody the preferences of UK consumers.

Our results reveal that being positively disposed towards Brexit does not mean that respondents are strongly in favour of buying chlorine washed chicken although they are more positive than those who are negatively disposed to Brexit. We find that being positively disposed toward Brexit means that respondents are less negative about the value they attribute to chlorine washed chicken, but value EU food safety standards and food quality assurance schemes such as Red Tractor positively. Importantly, the food standards were framed as EU standards, not just

as standards which the UK was adopting at the time of the survey. Given that popular criticisms of EU membership has often been framed around the UK being forced to adopt excessive regulation, it is interesting to note that this does not largely seem to spill over when it comes to food standards. These results suggest that attitudes to Brexit and preferences regarding food do not necessarily align in support of FTAs that simply introduce trade rules with, for example the USA, that would require the UK to significantly lower existing food safety and animal welfare standards. Overall, our results shed further light on the dilemma confronting the UK trade negotiators who need to balance demands for free trade with the US and all it entails while also attempting to satisfy consumer preferences about food.

The structure of our paper is as follows. In section 2, we describe in detail the design of DCE. Then in section 3, we explain our econometric strategy and in section 4 we present our results. Then in section 5, we discuss the policy implications of our analysis and finally in section 6 we conclude.

2. DCE Survey Design

Our DCEs were designed to examine UK consumer preferences with regard to chlorine washed chicken. Currently, a chlorine wash is used in certain countries (e.g., USA) to rinse whole chickens with the objective of removing micro-organisms (i.e., bacteria) on the surface of the bird. Although the use of chlorine is not considered to be a danger to human health, serious concerns have been raised about the practice in relation to how it compensates for poor animal welfare practice during production. Thus, the supply side economic rationale for employing a chlorine wash is that it can reduce costs of production as less effort is expended to control bacteria within the food supply chain while ensuring food safety.

2.1. DCE Attributes: Description and Levels

In both DCEs, we employ 500 grams of fresh chicken boneless breast as the food item of interest. The choice of the quantity and specific cut (as opposed to other cuts of chicken) was taken because it would be a familiar product to the vast majority of consumers in the UK and can be used in a variety dishes. It is well documented that UK consumers prefer this specific cut which have an impact on carcass balance and the existing trade in chicken products (Cowen and Morrin, 2018).

In total, we employed six attributes for both DCE, including price and chlorine wash, which we believe struck an appropriate balance between giving respondents sufficient information about the attributes that they are likely to care about, but without creating an overly complex task. The attributes and the levels employed are summarised in Table 1:

Table 1: DCE Attributes and Levels

Attribute	Levels
Price (£)	2.00, 3.00, 3.99, 4.75, 6.50, 9.25
Country of Origin	UK, EU, Non-EU
Organic Production	Yes/No
Food Standards	Meets EU Standards, Does not meet EU Standards
Quality Assurance	None, RSPCA, QAI, Red Tractor
Chlorine Washed	Yes/No

Note: RSPCA - Royal Society Prevention of Cruelty to Animals; QAI - Quality Assurance International

The levels of the attributes shown in Table 1, were selected based on existing studies in the literature and label types that are found on fresh chicken. The only attribute which is unfamiliar to survey respondents was the Chlorine Washed. The specific text we employed in both DCE to explain what chlorine washed chicken means is as follows:

"If chicken is labelled as chlorine washed this means that the carcass has been treated with a chlorine solution to prevent the meat from carrying bacteria such as Campylobacter and Salmonella. Alternatively, a 'farm to fork' approach can be employed which concentrates on reducing the risks of contamination at all stages of the food supply chain as well as being viewed as positive for animal welfare. So we have either: Chlorine Washed or Not Chlorine Washed"

In terms of the two DCE employed in this paper, the only difference in how the attributes were employed relates to how the Price attribute was used. For the DCE1, the Price attribute was described as:

"For the product you are shown the prices presented are based on those currently found in food retail outlets in the UK."

In contrast, for DCE2, the Price attribute was described as follows:

"Before you go shopping your usual supermarket has given you a voucher that can be used to buy the product of interest. You can either:

Exchange the voucher for the specific form of the product offered

or

You can select another option that may require you to pay a bit more or receive some cash back as the product you select costs less than the value of the voucher

or

You can exchange the voucher for cash."

The difference in how the two DCE are implemented is clear from how the Price attribute is framed. The provision of the voucher for DCE2 means that we have "endowed" survey participants with a good that has a monetary value that can be selected if none of the options offered on a specific choice card are considered attractive by the respondents. In this way, the no choice (opt-out) option simply obtains the cash value of the voucher.

For DCE1, we asked respondents to make a selection first before we then allowed them to indicate if they would reject this option and as such select the no choice option. The benefit

of designing the choice cards (i.e., dual response mode (Brazell et al., 2006)) in this way is that we get a full set of conditional choice data as well as data including the no choice (opt-out) option as well. In the analysis we present in this paper, we do not use "enforced choices" data, meaning that if somebody made a choice then said they would not buy any of the products we treated their choice simply as an opt-out.

For the given the number of attributes and levels, a balanced design required that we generated multiples of 12 choice tasks. We generated 48 cards each with three product choices plus a no choice (opt-out) for DCE1 and the cash back for DCE2. So as to keep the choice task manageable in terms of time to complete and so as to avoid fatigue on the part of respondents, we employed a four block design yielding 12 cards per respondent. All designs were generated using Ngene 1.1.2 (ChoiceMetrics, 2012) assuming a Multinomial Logit utility specification assessed using D-error with uninformative priors D-error (Scarpa and Rose, 2008). Given that we developed a common set of attributes and associated levels, we were able to keep our DCE design generic for both DCE, such that the experimental design on a card by card basis employed for the DCE2 is identical to DCE1.

Examples of both DCE choice cards are shown in Figures 1 and 2 respectively.

Figure 1: DCE1 Choice Card

ConjointExample
An Example Choice Card is Shown Below

You are undertaking your weekly shop. You are provided with three options of the product you are considering buying - 500grams of chicken breast

Which option (A, B or C) would you select?

	Option A	Option B	Option C
Price (£)	2.00	9.25	3.00
Country of Origin	Non-EU	EU	UK
Organically Produced	No	Yes	Yes
Meets EU Food Standards	Yes	Yes	No
Quality Assurance	None	Red Tractor	RSPCA Assured
Chlorine Washed	Yes	Yes	No

Please tick your preferred option

You must select one option A, B, C.

You first tick your preferred option.

And then after each choice card, you will be able to indicate if you would not actually choose A, B or C

Figure 2: DCE2 Choice Card

ConjointExample
An Example Choice Card is Shown Below

You are undertaking your weekly shop and have a Voucher which you can exchange 500grams of chicken breast described below as Option A.

Alternatively, you can use the Voucher to buy either option B or C or exchange for cash by selection option D.

Which option (A, B, C or D) would you select?

	Option A	Option B	Option C	Option D
Payment Choice	Use Voucher	Use Voucher & pay £7.25 extra	Use Voucher & pay £1.00 extra	Cash in Voucher for £2.00
Country of Origin	Non-EU	EU	UK	
Organically Produced	No	Yes	Yes	
Meets EU Food Standards	Yes	Yes	No	
Quality Assurance	None	Red Tractor	RSPCA Assured	
Chlorine Washed	Yes	Yes	No	

Please tick your preferred option

All you need to do is tick your preferred option.

Remember, the voucher allows you to select option A without spending any cash.

As can be seen by inspecting Figures 1 and 2, the main difference between the DCE cards is how we have framed the Price attribute. It is also worth noting that the value of voucher varied in each choice task in DCE2, always taking the value of option A. This means that on some cards the voucher has a value greater than the other two product options B and C. In Figure 2, there is an example where the voucher is worth less than the other two options and in this case if a respondents wants to select option B or C then they must also make an additional payment.

2.2. Survey Implementation

Our survey implementation began by devising an initial version of both DCE and asking for feedback from a small group of participants. We then undertook pilot studies with both DCE online. We collected 35 responses for DCE1 and 51 for DCE2. The pilot data revealed that the survey instruments and DCEs had worked appropriately. Model results in terms of attributes and associated values all appeared plausible.

Next we moved to full implementation online. This involved collecting 338 responses for DCE2 and 385 for DCE1. The survey data was collected to ensure that our samples could be considered nationally representative. Specific details of the sample compositions are reported in Table A1 in the Appendix A. As can be seen from the sample data shown in Table A1 the composition of both samples is very similar with no obvious reasons to assume that sample mix would bias results.³

2.3. Brexit Question

A key feature of the survey data we employ in this research relates to respondents attitudes to food and Brexit. Specifically, we asked respondents the following question:

"Do you think the recent vote to leave the European Union will have a positive, neutral or negative effect on food over the next two to three years?"

For the DCE2 sample of respondents we found that 25 percent consider the vote to leave would have a positive effect on food, 26 percent neutral, 34 percent negative and 16 percent responded "don't know". For the DCE1 sample, the respective results are 25 percent, 24 percent, 32 percent and 18 percent respectively. Thus, there are very similar responses both in terms of attitudes to the Brexit vote and its impact on food. Overall, the responses indicate that more respondents think that Brexit will have a negative effect than a positive effect. The variation in attitudes to Brexit captured by this question are used to examine differences in responses to both DCE. We subsequently label those who view the impact of Brexit on food as being positive as "Leave", those with a negative view as "Remain" and we combine and label the neutral and don't know respondents as "Neutral".

3. Model Estimation, Specification and Selection

To analyse our DCE data, we employed a Hierarchical Bayesian Logit (Balcombe et al. 2016). Our model specification is formally defined as follows. Let x_{ijs} denote a $k \times 1$ vector of

³See Appendix B for a copy of the DCE2 survey instrument.

attributes from the DCE presented to individual j ($j = 1, \dots, J$) in the i th option ($i = 1, \dots, I$) of the s th choice set ($s = 1, \dots, S$). Next, let U_{ijs} be the utility that individual j attains from x_{ijs} . Given these definitions, it then follows that an individual j is assumed to receive linear utility from the i th choice in the s th choice set. Consequently, the utility function is of the form:

$$U_{ijs} = V_j(x_{ijs}) + e_{ijs} \quad (1)$$

where $V_j(x_{ijs})$ is the systematic utility that individual j obtains from the vector x_{ijs} . The error term e_{ijs} is assumed to be extreme value (Gumbel) distributed, independent of x_{ijs} and uncorrelated across individuals or choices. It then follows that the probability of choosing option i for the j th person from the s th choice set is:

$$p_{ijs} = \frac{e^{V_j(x_{ijs})}}{\sum_i e^{V_j(x_{ijs})}} \quad (2)$$

As is becoming common in the DCE literature, we estimate our models in what has been termed WTP space. The reason for adopting this approach is that it can significantly reduce the instability associated with WTP estimates recovered from preference space (Balcombe et al., 2010). It also means that model parameters are directly interpretable as WTPs. From a Bayesian perspective, DCE models usually require some level of informativeness in the priors. Having the parameters representing WTPs means that formulating sensible priors is far easier in WTP space since very often we will have some prior idea of the likely values of these parameters, even if this it is somewhat vague.

The systematic utility component we employ in this paper is as follows:

$$V_j(x_{ijs}) = \exp(\beta_{1,j}) \left[\begin{array}{l} -price_{ijs} + \beta_{2j}Chlorwash_{ijs} + \beta_{3j}EUFS_{ijs} + \beta_{4j}Organic_{ijs} \\ + \beta_{5j}CoOEUE_{ijs} + \beta_{6j}CoOUK_{ijs} + \beta_{7j}QSRedTrac_{ijs} \\ + \beta_{8j}QSRSPCA_{ijs} + \beta_{9j}QSQAI_{ijs} + \beta_{10j}OptOut_{ijs} + \beta_{11j}Endow \end{array} \right] \quad (3)$$

where $\beta_{2j}, \dots, \beta_{11j}$ represent WTP parameters for the j th individual for the associated attributes; Chlorwash is a dummy for whether the chicken has been chlorine washed; EUFS is a dummy indicating that the food meets EU food safety standards; CoOUK and CoOEUE are dummy variables relative to the excluded level non-EU; Organic is the type of farm production system with the reference level being Conventional; QSRedTrac, QSQAI and QSRSPCA are dummies for the quality standard relative to the excluded level of no quality assurance; and OptOut captures the no choice option. Finally, the Endow variable only enters into the model for the data for DCE2, and is an option specific dummy variable for the endowed product.

The WTP parameters can be estimated as normals or be conditioned on explanatory variables, in this case the attitudes toward brexit. That is:

$$\beta_{kj} = \sum_{i=1}^3 \alpha_{i,k} z_{i,j} + u_{kj} \quad (4)$$

where $z_{i,j}$ is 1 if individual j replied "Yes" to the i th Brexit attitudinal question (positive,

negative, neutral in Section 2.3) above and u_{kj} is a normally distributed variable with zero mean and a variance that is estimated.

The priors used were a standard normal for the prior means for the $\alpha_{i,k}$ along with a Gamma(1,1) distributions for the precision parameters for the variance of u_{kj} . Additionally for the parameters $\beta_{k,j}$ $k > 1$ which represent WTP, we imposed the condition that the absolute size must be less than or equal to the total difference to maximum and minimum price for the DCE. i.e., no one attribute can be worth more than the total price variation in the DCE to an individual. For the means, we imposed the condition that this must be less than 75 percent of this amount.

Estimation for this study was conducted using the software STAN, (<https://mc-stan.org/>) which employs Hamiltonian Monte Carlo Markov Chain algorithms to simulate the posterior distribution for both the individual parameters and mean and variances of these parameters. For further details about these algorithms and software, readers are referred to the User Guide in the link above. For all the models we ran, we employed a “Warm-up” of 5,000 iterations followed by 2,000 draws from 5 independent chains (10,000 draws in total). Convergence was monitored visually using trace-plots, and using the Rhat (Vehtari et al., 2019) diagnostic.

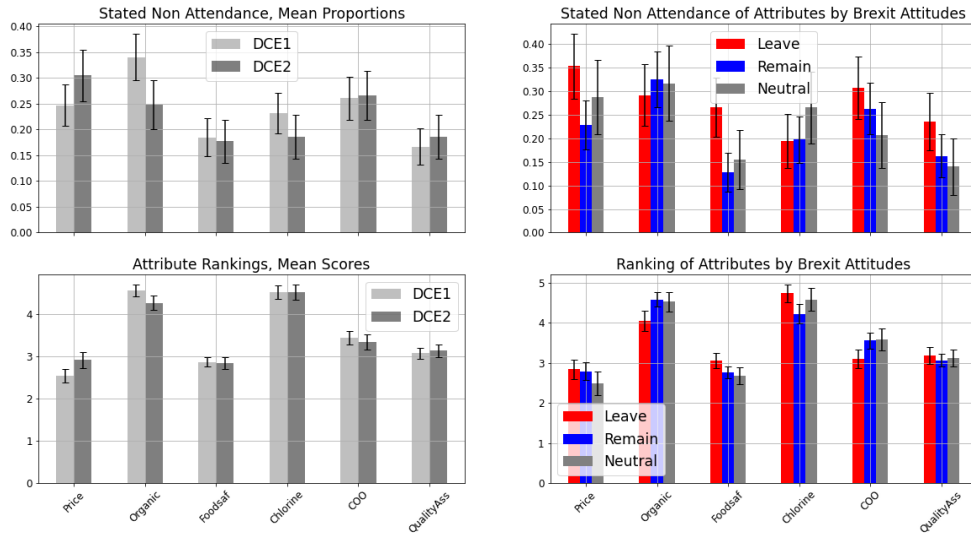
4. Results

All the results we report for both DCE are condition by respondent’s attitudes to food post Brexit. The models were also estimated without conditioning on the Brexit questions but in terms of the averages for the sample these results correspond very closely to what we present. We begin by reporting DCE specific results for the conditional WTP latents for the sample population. We then consider the main effects results that allow us to examine difference in the unconditional (individual-specific) WTP estimates based upon respondent specific attitudes to Brexit.

4.1. Attribute Attendance and Rankings

As part of both DCE surveys, we included attribute attendance questions and attribute ranking questions. The results of these questions are summarised in Figure 3. On the left of Figure 3 are the average non-attendance and rankings with respect to the attributes. The rankings are one for the most important attribute and six for least important. On the right are the pooled results for both DCE broken down by the answer to the Brexit question. The bars represent 95% confidence intervals.

Figure 3: Stated Non-Attendance by DCE and Brexit Attitudes



Overall the attendance answers are broadly in line with what we would expect relative to other surveys we have conducted. We observe that the stated rankings and non-attendance measures are relatively stable over the two DCEs (left-hand side figures), with the exception of the Organic attribute which is on average ranked as less important and not attended as highly in both DCE, but less attended and ranked higher in DCE1. Interestingly, the Chlorine Wash attribute is ranked poorly in terms of importance in both DCE, yet tends to be one of the better attended attributes.

Both the rankings and non-attendance measure of the attributes by Brexit attitudes are also relatively stable across the groups, especially so for the rankings. Interestingly, the Leave group seems to have a higher stated non-attendance than the Remain group for the Price and Food Safety attributes, but interestingly this does not seem to translate into a substantive difference in the rankings of these attributes. Thus, although only descriptive these results suggest some differences between respondents once we take account of attitudes to Brexit.

4.2. Mean WTP Results

We next examine the mean WTP estimates for the two DCEs (corresponding to the distribution of the parameters $\alpha_{i,k}$ in equation 4). The results are reported in Tables 2 and 3 and we label an individual that responded positively to the question in Section 2.3 as "Leave", and a person who responded negatively to this question as "Remain".

Table 2: DCE1 - Distribution of Mean Attribute Values, 500G of Chicken

	Neutral	StdN	Remain	StdR	Leave	StdL	Sigma
Logged Scale	-0.65	0.07	-0.55	0.08	-1.02	0.09	0.79
Chlorine Wash	-0.64	0.24	-1.44	0.27	-0.09	0.34	1.34
EU Food Safety	2.19	0.19	2.36	0.22	2.06	0.28	1.89
Organic	0.84	0.18	1.05	0.20	0.76	0.26	2.84
EU COO vs Non EU	0.76	0.17	0.77	0.19	0.61	0.27	0.82
UK COO vs Non EU	2.22	0.20	1.82	0.23	2.71	0.28	1.78
Red Tractor	2.35	0.22	2.40	0.25	2.28	0.31	0.96
RSPCA	2.23	0.21	2.44	0.23	2.02	0.32	0.69
QAI	1.63	0.20	2.01	0.22	1.24	0.30	1.30
Opt-out	-0.83	0.30	-1.44	0.35	-1.40	0.40	3.55

Note: StdN - standard deviation Neutral; StdR - standard deviation Remain; StdL - standard deviation Leave; Sigma - estimate of the standard deviation of the error terms u_{kj} in equation (4).

Table 3: DCE2 - Distribution of Mean Attribute Values. 500G of Chicken

	Neutral	StdN	Remain	StdR	Leave	StdL	Sigma
Logged Scale	-0.85	0.10	-0.88	0.11	-1.29	0.13	0.95
Chlorine Wash	-0.61	0.31	-1.74	0.35	0.40	0.43	1.92
EU Food Safety	2.52	0.27	2.59	0.30	1.99	0.39	2.20
Organic	0.49	0.26	1.20	0.29	0.74	0.38	3.16
EU COO vs Non EU	0.29	0.29	0.52	0.32	0.54	0.41	1.87
UK COO vs Non EU	2.02	0.27	1.49	0.30	2.36	0.38	2.09
Red Tractor	2.35	0.29	2.60	0.31	2.28	0.42	1.53
RSPCA	2.62	0.30	3.19	0.32	2.51	0.42	1.15
QAI	1.54	0.29	2.22	0.32	1.33	0.42	1.34
Opt-out	0.65	0.37	-0.10	0.41	-0.45	0.49	3.50
Endowment	0.36	0.30	0.923	0.32	-0.58	0.41	2.58

Note: StdN - standard deviation Neutral; StdR - standard deviation Remain; StdL - standard deviation Leave; Sigma - estimate of the standard deviation of the error terms u_{kj} in equation (4).

The first thing to note about the results in Tables 2 and 3 is that for both DCEs, the mean value estimates are considerably larger than the standard deviations for most attributes. In Bayesian terms this implies that there is a relatively large probability mass one side of zero. This broadly corresponds to a classical interpretation that the means are "significantly different from zero" and therefore, we can be reasonably certain that on average respondents value (either positively or negatively) the attributes employed in both DCE.

Secondly, from a practical perspective, value estimates in Tables 2 and 3 are similar for most of the attributes. There is no tendency for one DCE to systematically yield higher or lower values across the attributes. Moreover, although we do not present the results here, the differences in the attributes common to both experiments are within two standard deviations (based upon pooled estimates). The three exceptions are the scale coefficient for the Remain group and the opt-out effect for Neutral and Remain groups. Thus, the most striking difference across the DCEs is in terms of the opt-out, which has a negative value for the DCE1 and a positive value for DCE2 for the Neutral group, whereas it is negative for both Remain and

Leave groups in both DCE. Another difference is that Table 3 has, of course, an additional variable (Endowment), which we will discuss shortly.

Next, when we consider the attribute specific results we find some interesting results. First, in terms of the overall magnitude of the various quality assurance schemes attributes (e.g., Red Tractor, RSPCA and QAI) they are all very highly valued. We find very similar results with respect to the Organic Production and CoO attributes. There is also a high value placed on UK production compared to Non EU production by all groups (estimates ranging from £1.49 to £2.71). We in both DCE1 and DCE2 we observe that Leavers placed greater value on UK CoO than Remainers or Neutrals, and Neutrals in turn place greater value than Remainers on UK CoO.

Second, turning to the attribute of particular interest for this study, we see that for both DCE1 and DCE2 Neutral and Remain respondents had a negative valuation for the Chlorine Washed attribute, of around £0.61 to £0.64 for Neutrals, and £1.44 to £1.73 for Remainers. By contrast Leavers showed a very small tendency to dislike the Chlorine Washed attribute in DCE1 (£-0.09) and a tendency to actually like the Chlorine Washed attribute in DCE2 (£0.40). However, at the mean, both Leaver estimates had standard deviations larger than the mean, therefore, we do not have strong evidence that Leavers are on average anything but neutral towards Chlorine Washed chicken. Thus, looking at the average values, Neutrals and Remainers in particular, attached a large negative value to avoiding Chlorine Washed chicken, whilst Leavers show no clear sign that they share these preferences.

Third, a particularly interesting result emerges when we examine the EU Food Safety attribute. As noted earlier, the fact that this attribute was framed as EU Food Safety standards, not UK standards, might have potentially triggered an adverse reaction by Leavers and/or positive values by Remainers. This turned out not to be the case. This attribute was consistently and highly valued across both DCE (£1.99 to £2.59) although in DCE2 the lower value of £1.99 was for the Leavers. Notably, the values here did not seem to be particularly dependent on the Brexit question, and unambiguously signalled that all consumers value the EU Food Safety attribute.

Next, we consider the issue of whether or not DCE2 created an endowment effect. The answer to this seems to be somewhat more confusing than we had anticipated. There is some evidence of an endowment effect, and it appears to be dependent on attitudes towards Brexit. Specifically, we see in Table 3 that Remainers had a strong tendency to stick with their endowed voucher (which changed from task to task). However, the Neutrals had a lesser tendency to do so and the Leavers certainly less so, with the evidence pointing in the opposite direction i.e., that they tended to shift away from their endowed option. Therefore, while it does appear that the endowment approach created another reference point, our results suggest that this is highly dependent on attitudes of respondents. In this case it pertains towards Brexit, yet this may be acting as a proxy for other attitudes or behavioural traits when it comes to food choice.

Finally, our Sigma estimates in Tables 2 and 3 are sizable in both DCE1 and DCE2, reflecting a high degree of heterogeneity in the individual values estimated by the model that are not explained by attitudes towards Brexit. Thus, while there seems to be strong mean differences between groups based on their attitudes to Brexit, it would be a mistake to believe that attitudes

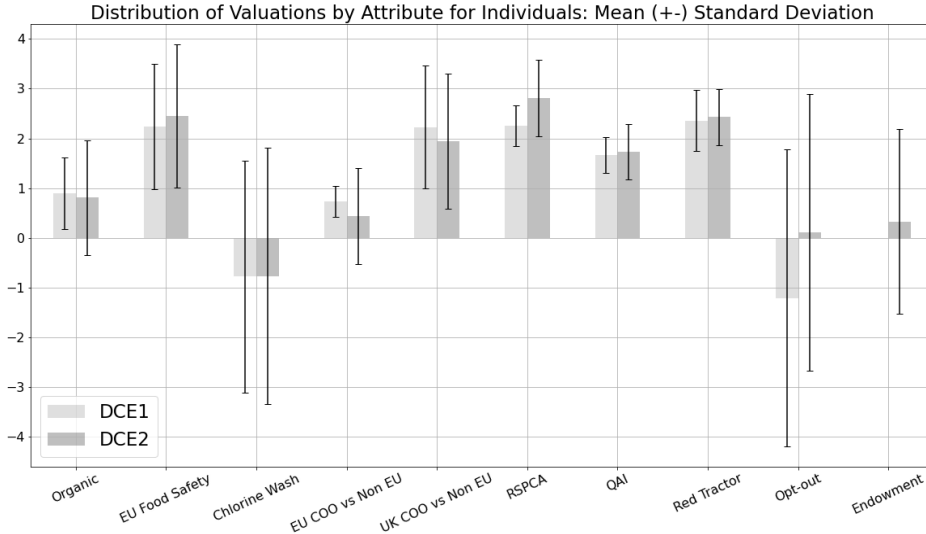
to Brexit are necessarily a powerful predictor of values.

We next present the distributions for the latent values in Table 4 and Figure 4 for both DCE.

Table 4: Latent Distributions for DCE1 and DCE2

	DCE1					DCE2				
	Mean	Stdv	25%	75%	%>0	Mean	Stdv	25%	75%	%>0
Log Scale	-0.72	0.64	-1.14	-0.22		-0.97	0.77	-1.54	-0.37	
Organic	0.90	0.72	0.38	1.39	90	0.81	1.15	0.01	1.61	75
EU Food Safety	2.24	1.26	1.34	2.96	98	2.45	1.44	1.44	3.37	96
Chlorine Wash	-0.78	2.33	-2.28	0.74	41	-0.77	2.58	-2.66	0.97	36
EU COO	0.73	0.31	0.52	0.94	100	0.44	0.97	-0.17	1.05	67
UK COO	2.23	1.23	1.37	2.95	100	1.95	1.36	1.05	2.70	94
RSPCA	2.25	0.41	1.96	2.48	100	2.81	0.77	2.28	3.24	100
QAI	1.66	0.36	1.39	1.90	100	1.73	0.56	1.29	2.13	100
Red Tractor	2.36	0.62	1.96	2.70	100	2.43	0.56	2.04	2.72	100
Opt-out	-1.21	2.99	-3.63	1.18	34	0.11	2.78	-2.43	2.55	47
Endowment						0.33	1.86	-0.95	1.36	49

Figure 4: Distribution of Valuations by Attributes by Respondents



The mean estimates in Table 4 tend to reflect what has already been commented on, though they merge all Brexit Groups. Again, while there are differences, the value estimates across the two DCE models seem similar. The values produced do not show any systematic tendency to be higher in one DCE than the other. Nor is there an obvious shift in the dispersal of the distributions across individuals as reflected in the standard deviations. The last column of Table 4 gives the percentage of respondents that have a positive value for the attributes in question. Again this highlights the quality marks (i.e., RSPCA ,QAI and Red Tractor) have positive values for all participants across both DCE, although these values differ. The CoO variables are also valued with the UK CoO attribute being positively valued by 100 percent of

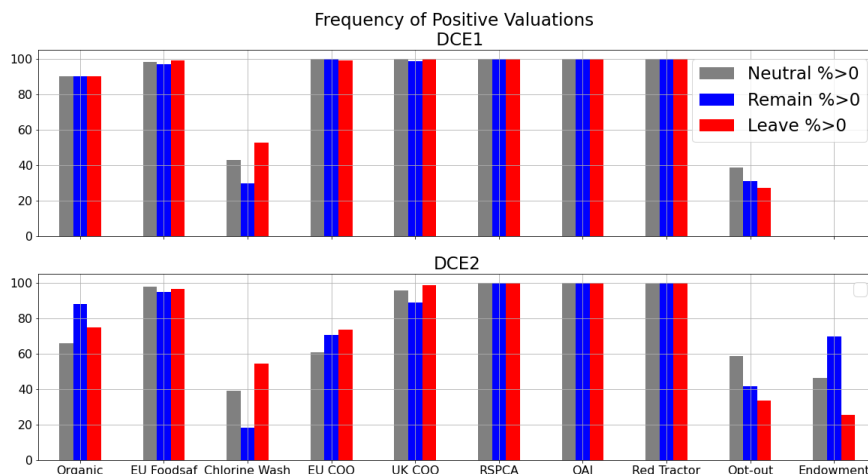
respondents in DCE1 and 95 percent in DCE2. Over 95 percent of respondents are estimated to value the EU Food Safety positively for both DCE. However, when it comes to the Chlorine Washed attribute, we see that a substantive minority seem to value the Chlorine Washed chicken positively.

Finally, as already noted, there seemed to be differences in the attitudes of people with regard to Brexit and the valuation of certain attributes. To further analyse this effect, we break down the percentages by Brexit attitude in Table 5 and Figure 5.

Table 5. Frequency of Positive Valuations by Attribute

	DCE1			DCE2		
	Neutral %>0	Remain %>0	Leave %>0	Neutral %>0	Remain %>0	Leave %>0
Organic	90.0	90.0	90.0	66.0	88.0	75.0
EU Food Safety	98.0	97.0	99.0	98.0	95.0	96.0
Chlorine Wash	43.0	30.0	53.0	39.0	18.0	54.0
EU COO	100.0	100.0	99.0	61.0	70.0	73.0
UK COO	100.0	99.0	100.0	96.0	89.0	99.0
RSPCA	100.0	100.0	100.0	100.0	100.0	100.0
QAI	100.0	100.0	100.0	100.0	100.0	100.0
Red Tractor	100.0	100.0	100.0	99.0	100.0	100.0
Opt-out	39.0	31.0	27.0	59.0	42.0	34.0
Endowment				46.0	70.0	25.0

Figure 5: Frequency of Positive Valuations by Attribute by DCE



Based on the results shown in Table 5 and Figure 5, first, we see that the Chlorine Washed attribute is disliked (liked) by 70 (30) percent and 82 (18) percent of Remainders across the two DCE. The Neutrals have a slight majority disliking the Chlorine Washed attribute (57 and 61 percent) and there is an similar split in the other direction with a small majority of Leavers liking the attribute; 53 and 54 percent respectively.

Second, the percentages shown in Table 5 and Figure 5 once again reflect the evidence that regardless of attitudes to Brexit, EU Food Safety standards are valued positively (>95% for

all groups). Thus, attitudes to Brexit do not align with how potential FTA may result in the importation of food produced at lower safety standards.

And finally, the percentages on the endowment effect again demonstrate a split with 70 percent of Remainers seemingly having a positive endowment effect, but 75 percent of Leavers having a negative endowment effect, with a slight minority of Neutrals having a positive endowment effect.

5. Policy Implications

There are number of interesting policy implications that stem from the results we report. In particular, how should the UK consider designing its agricultural and food production legislation given the need to implement new trading arrangements with the rest of the world. Interestingly, Ranta (2019) noted that food was not a significant issue during the EU membership referendum. However, agriculture and food have become ever more contentious as ongoing discussions with the EU continue with regard to Northern Ireland and the trade agreement that was reached, as well as potential future trade deals, especially with the US, that have raised the possibility of the UK allowing imports of agricultural produce and food produced using methods of production currently not allowed.

With regard to chlorine washed chicken, a clear majority of respondents in our survey viewed this practice negatively. However, there was also a substantive minority that viewed it positively or attached very little value to it. This is not surprising in that some people may associate this practice with safe food. On the other hand, there was a delineation of values between people supporting Brexit or not, with those supporting Brexit being equally split between liking and disliking chlorine washed chicken, but those not supporting Brexit being much more likely to dislike chlorine washed chicken. Of equal importance from the policy standpoint was that attitudes toward Brexit had very little or no impact on people's willingness to pay for EU food safety standards. Respondents were overwhelmingly positive towards EU food safety standards, and our estimates suggested that respondents might be willing to pay approximately £2.00 extra on average for 500 grams of chicken breast produced in way that satisfies EU food standards.

A potentially important policy implication that could be drawn from these results, regardless of attitudes to Brexit, is that any future trade deal should attempt to take account of consumer preferences. Consequently, any trade deals that jeopardise existing food standards may lead to a substantial welfare loss. Clearly, had the UK decided to maintain equivalence of the food standards that existed prior to Brexit with the EU then consumer preferences regarding food would have been satisfied. However, the UK has decided to no longer align with EU rules governing trade or other aspects of food safety meaning that it might diverge from EU rules in the future. This then gives rise to an important question: what might be feasible within any trade deal with regard to agriculture and food such that UK consumer preferences are satisfied?

A fundamentally important point that needs to be understood is that there is a distinction between free trade and FTAs. As Roderik (2018) explains trade agreements are no longer only about market access and the removal of tariffs. Thus, what a FTA introduces is less about free trade per se but more about bilateral or multilateral trading arrangements. The scope and complexity of new trade agreements are extensive, they can take long periods of time

to negotiate and typically place more focus on meaningful economic integration. Therefore, the speed at which the UK is proposing to move forward in terms of introducing FTAs is somewhat surprising given the complexities involved especially if consumer preferences such as those revealed in this study are to be taken into account.

The specific issue of how to align trade arrangements so as to satisfy consumers preferences has been a subject of discussion for some time. Research by Hobbs and Kerr (2006), Swayer et al. (2008), Sheldon (2019) and Wilkinson (2020) are a few relevant examples. As Wilkinson (2020) observes, simply implementing a ban on specific agricultural and food items, even if supported by consumers is unlikely to occur given World Trade Organisation (WTO) rules. Furthermore, as Grübler and Reiter (2021) explain, non-tariff measures (NTMs) (which include both sanitary and phytosanitary (SPS) measures and Technical Barriers to Trade (TBT)) have replaced tariffs as the key issue under consideration during trade negotiations with agriculture and food being the goods most likely to be subject to NTMs via SPS measures. However, certainly in the case of chlorine washed chicken it is highly unlikely that a NTM can be justified by SPS measures. In fact, there is good reason to think that if the UK did attempt to implement this type of policy that the US, for example, would be highly likely to win a challenge to the policy if brought before the WTO (Congressional Research Service, 2017). Wilkinson (2020) provides a neat summary of this issue noting that food safety concerns relating to the use of a chlorine wash are at best inconclusive and a trade restriction based on how a good is produced are generally not supported.

Given the above discussion, we are therefore in agreement with Wilkinson (2020). If UK consumer preferences are to be met in any FTA, UK farmers need to go beyond simple calls to ban specific imports. In addition, Wilkinson (2020) is correct to advocate for the UK government to proactively engage with the WTO so that the concerns and issues being expressed by consumers can be coherently integrated into the WTO rules. However, this is approach to changing the potential type of trade rules that can be included in an FTA that are WTO compliant is almost certainly a medium to long term strategy.

In the short term, however, given all the constraints imposed by WTO obligations, it appears that a labelling policy offers the most appropriate solution. However, as Hobbs and Kerr (2006) explain, the introduction of mandatory labelling on food products is restricted by the WTO. This situation holds even if two countries agree on the use of labels that could be seen to enable consumer choice because any third country can challenge this type of agreement through the WTO. A relatively simple solution to this dilemma would be the introduction of voluntary labelling schemes that domestic producers could adopt so as to signal that a specific product has been produced in a particular manner. The relative strengths and weaknesses of labelling schemes have been examined extensively in the literature (e.g., Roe et al., 2014). In terms of a FTA this would require that the criteria used to adopt a particular labelling scheme are well understood and are not used implicitly or explicitly to restrict trade. Furthermore, the requirements needed to satisfy the labelling scheme need to be clear, transparent and openly available.⁴ Importantly, there are already examples of such labelling schemes and a specific example in the UK is the Red Tractor standard. The Red Tractor label informs consumers

⁴For details see: <https://redtractor.org.uk/>

about aspects of quality assurance regarding agricultural production and food. Importantly, from the results we report here, we find that UK consumers already place a high value on the Red Tractor quality mark. In our results the Red Tractor label is valued almost as highly as EU food safety standards and the RSPCA animal welfare label. Furthermore, the Red Tractor quality assurance scheme has recently been improved and it would seem a relatively straightforward matter to extend the scheme to include chicken that has not been chlorine washed. However, there are challenges to extending this scheme to the large array of processed products that contain chicken, but if producers can realise a benefit from this type of production differentiation, then there is no reason why the use of the label could not be extended.

The potential for voluntary labels to help satisfy consumer preferences in regard to chlorine washed chicken has previously been discussed by Sheldon (2019). Sheldon (2019) frames the analysis of the use of voluntary labels as a means to signal to consumers about a credence attribute of the specific good. If the labelling scheme was implemented via the Red Tractor scheme then this might in part reduce some of the concerns raised by Sheldon (2019) regarding who sets the standard and how this affects consumer welfare.

6. Conclusions

In this paper, we examined UK consumer preferences for various attributes of chicken including whether or not the product is Chlorine Washed. Additionally, we have investigated whether such preferences were shaped by attitudes towards Brexit. Two DCEs were employed. One used the common "*which would you purchase*" format. The other was formally equivalent in terms of the attributes and levels except that it endowed consumers with a voucher for a chicken product which they could then redeem, exchange, or use in part to buy some other preferred product. We argued that the potential benefit of the voucher approach was that it provided respondents with an additional reference point that could potentially improve decision making by respondents. In doing so, we recognised that this reference point may create an endowment effect as has been found in the behavioural economics literature. We anticipated that an endowment effect, should it exist, would be broadly uniform across the population. However, while we found evidence of a reference point effect associated with keeping the endowment option, somewhat surprisingly we found that this effect was dependent on attitudes towards Brexit. Respondents expressing positive views towards Brexit were more likely to switch away from the endowed option, while those that expressed negative view towards Brexit showed more tendency to stick with the endowed option. More generally, there was a high degree of heterogeneity across respondents with regard the endowed option. Overall our two DCEs delivered similar results in terms of the direction and the magnitudes of the estimated values, increasing our confidence in the results.

Turning to the policy implications that stem from our analysis there appears to be on average a clear dislike of chlorine washed chicken. However, how the UK then attempts to reconcile these preferences with how it develops future FTAs is unclear. In this paper, we identify that private labelling schemes offer one solution and there is already one such scheme operating in the UK that could meet this need. Whether or not future FTAs negotiated by the UK attempt to balance consumer preferences and agricultural and food industry demands with those of

trading partners is likely to be a subject of ongoing debate.

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Appendix A: Additional Tables

Table 1A: Descriptive Statistics

Variable	Units	% DCE2 (n=338)	% DCE1 (n=385)
Gender	Female	56	50
	Male	44	50
Age	18-25	12	11
	26-35	18	18
	36-45	18	17
	46-55	17	17
	56-65	18	17
	Over 65	18	20
	Household Size	1	16
2		39	38
3 or more		44	42
Children	Yes	61	63
	No	39	37
Household Income	Up to £15,599	24	24
	£15,600 to £25,999	24	23
	£26,000 to £36,399	21	19
	£36,400 to £51,999	13	13
	£52,000 and above	9	11
	Prefer not to say	9	9
Highest Level of Educational Attainment	School education to 16	22	21
	A-level or equivalent	22	19
	Further Education	19	16
	Undergraduate Degree	20	26
	Postgraduate Degree	12	13
	Higher	4	4
Employment	Employed	62	61
	Unemployed	8	6
	Other	30	33