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Consumer preferences for chlorine-washed chicken, attitudes to Brexit and implications for future trade agreements

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ABSTRACT

This research employs two discrete choice experiments to examine UK consumer preferences regarding chlorine-washed chicken. Our analysis differentiates value estimates by respondents' beliefs about the impact of Brexit on food. The results reveal that those holding positive attitudes towards food post-Brexit tend not to value chlorine-washed chicken as negatively as those who have negative attitudes about food post-Brexit. Yet, of equal or greater significance, those respondents who hold positive beliefs about the impact of Brexit on food still value EU food safety standards, quality assurance schemes and country of origin information. This indicates that attitudes to food post -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, in particular food labels enabling informed food choice.

1. Introduction

As a consequence of the Brexit vote in 2016, the United Kingdom (UK) decided to leave the European Union (EU). The UK now needs to reconsider how it relates to the world with respect to trade with much attention given to how the UK will position itself with regard to food. 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 maybe 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. Similarly, Curtice et al. (2020) note that when a large sample of UK respondents was asked "Should the UK allow chlorinated chicken" only 24 percent responded positively whereas 76 percent responded negatively. Savanta ComRes (2020) report similar results in research carried out for the Royal Society for the Prevention of Cruelty to Animals (RSPCA).

Currently, a chlorine wash is used in certain countries (e.g., US) to rinse whole chickens to remove 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, concerns have been raised about the practice in relation to how it compensates for poor animal welfare practices during production. The supply-side 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. Spence (2017) reports that the additional costs associated with complying with EU production practices are 5.1 percent whereas US production costs are some 20 percent lower than average EU costs. Thus, certainly from a US perspective, the ban on imports is because of use of a chlorine wash is potentially being employed to circumvent issues regarding cost competitiveness.

Regardless of the reasons for banning the importation of chlorine-washed chicken into the UK, the level of negative feeling being expressed in the UK regarding the potential importation of chlorine-washed chicken has led to several UK supermarkets to vow 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 very little economic research examining consumer preferences and this would seem to be an oversight given

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the high profile nature of the subject and its potential importance in how future FTAs might be implemented.

Understanding consumer preferences is important as it might inform how the UK implements future FTAs, especially as the UK has decided to no longer align with EU rules governing trade or other aspects of food safety meaning that it can diverge from EU rules. How to align trade arrangements and consumer's preferences has been a subject of discussion for some time in food policy circles (e.g., Hobbs and Kerr, 2006; Sawyer et al., 2008; Sheldon, 2019; Wilkinson, 2020). As Wilkinson (2020) observes, simply implementing a ban on specific agricultural and food items, as demanded by many in the farming sector, 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 (which include both sanitary and phytosanitary measures and Technical Barriers to Trade) 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 non-tariff measures via sanitary and phytosanitary measures. However, for chlorine-washed chicken, it is highly unlikely that any non-tariff measures can be justified by sanitary and phytosanitary measures. If the UK did attempt to implement this type of policy, then 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) also observes 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 is generally not supported.

Therefore, if UK consumer preferences are to be met by any FTA, UK farmers need to go beyond calls to ban specific imports. Given the constraints imposed by WTO obligations, a labelling policy offers a potential solution. However, as Hobbs and Kerr (2006) explain, mandatory labelling on food products is restricted by the WTO 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 via the WTO. A solution to this dilemma could be the introduction of voluntary labelling schemes that domestic producers adopt to signal a specific product attribute.[2] For any FTA this requires that the criteria used to adopt a particular labelling scheme are well understood and are not implicitly or explicitly used to restrict trade. Furthermore, the requirements needed to satisfy the labelling scheme must be clear, transparent, and openly available.

There already exist examples of labelling schemes in the UK that can enable consumers to make informed choices. For example, the UK has implemented country of origin (CoO) food labelling for many meat products including chicken (Balcombe et al., 2016). There are also quality assurance labels such as the Red Tractor quality assurance standard and the RSPCA Assured quality standard.[3] The Red Tractor label informs consumers about aspects of quality assurance regarding agricultural production and food whereas the RSPCA Assured quality label focuses specifically on animal welfare. Both assurance standards are widely recognised by UK consumers. For example, YouGov (2021) conducted a large survey of the UK public and note that when asked about food scheme logos 74 percent recognised the Red Tractor logo and 47 percent the RSPCA logo. They also observe, *"that in a post-Brexit world, there may be increased importance placed on the presence of assurances scheme logos on food products to reassure consumers that what they are buying can be trusted"*. (p. 13) Much the same point has been made by the Trade and Agriculture Commission (2021), *"Labelling has a role, and in particular country of origin labelling and third-party assurance schemes provide convenient ways to signal that the product has reached a certain standard"*. (p. 7).

In this paper, we examine preferences for chlorine-washed chicken using a discrete choice experiment (DCE). Our DCE employs both CoO labels and quality assurance labels as attributes allowing us to examine the value placed on them by respondents (i.e., willingness-to-pay (WTP)). Our analysis also considers the extent to which positive or negative attitudes to food post Brexit impact our results. We undertake this analysis by conditioning our econometric specifications on our respondent's views regarding food following the Brexit vote. Another important feature of our DCE is that we employed two formally equivalent 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. 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 a non-standard way to frame a DCE, the availability of vouchers is now relatively common in many retail contexts. Many supermarkets offer loyalty cardholders money off vouchers for specific products, there are also smartphone apps, such as Shopmium, as well as websites such as Coupons.com, that offer vouchers plus cashback on specific product purchases. In addition, within the DCE literature, it is sometimes suggested that respondents struggle to make decisions. As a result, it is commonplace to include a "reference point" within the choice task to help respondents make decisions. Common reference points include an opt-out (e.g., a no-choice option, a dual response design) and/or the inclusion of a status quo option. It is regarded as good practice in most cases to include an opt-out (no choice) for several 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) and Campbell and Erdem (2019).[4]

Given the focus of our study, we make several useful contributions to the literature. First, our DCE examines the potential value consumers place on CoO and quality assurance labels that could be used to differentiate food products as a means to signal quality differences that matter to consumers. Importantly, our estimates are differentiated by respondents' attitudes to food following Brexit. In the context of the DCE examined in this study, the potential importation of chlorine-washed chicken into the UK, if consumer preferences are to be satisfied in a manner that is consistent with the WTO then the value attached to this type of label needs to be known.

Second, this research contributes to the literature on novel food production and consumer attitudes and values. Although many DCEs have examined issues such as hormones 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; Moore et al., 2017; Micciche et al., 2018; Thames and Sukumaran, 2020). To date, 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, Balcombe et al. (2021) examined consumer preferences for four food items including chlorine-washed chicken, hormones in beef and pork and corn grown using a banned pesticide. The chlorine-washed chicken results we report for DCE1 employ the same data as Balcombe et al. (2021). However, Balcombe et al. (2021) focused specifically on consumer preferences for each of the food items examined and the resulting WTP estimates generated. The emphasis placed on the WTP estimates for all of the products followed from discussions

[2] The relative strengths and weaknesses of labelling schemes have been examined extensively in the literature (e.g., Roe and Teisl, 2014).

[3] For details see: https://redtractor.org.uk/ and https://science.rspca.org.uk/sciencegroup/farmanimals/standards

[4] There 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.

around the welfare implications associated with maintaining the bans currently in place for these food items. Although, we generate some of the same results previously reported in Balcombe et al. (2021), our analysis significantly extends the results reported in several ways. First, we condition our model results on respondents' attitudes to food post-Brexit for both DCEs examined. Second, we focus on the CoO and quality assurance attributes given the potential role that this type of information could play in helping to facilitate future FTAs. Third, we report the results for DCE2. Finally, we also examine the extent of attribute non-attendance (ANA) in our data and the potential impact on the validity of the results generated.

Third, our approach of providing individuals with a voucher in DCE2, adds to the literature that examines the impact of alternative framing of DCE. 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) whereas Alemu and Olsen (2018) employ a repeated statement explaining the purpose of the opt-out. Like List (2003), these studies indicate that "experienced" respondents are not affected by the use of a frame that creates a default reference point.[5] We hope that since we employ a food product that is familiar to all respondents, chicken breast,[6] alternative framing of the reference point should not impact our results greatly. However, Thaler (1980) gives numerous examples of decisions where the observed choices do not coincide with normative theory due to the way that they are framed. If we do observe differences between DCE1 and DCE2, then one explanation is what Thaler (1980) termed the "endowment effect". The endowment effect has itself been rationalised as a reference point effect (see Kogler et al., 2013). 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. We are therefore interested to see whether our DCE design substantively changes the observed preferences, with a particular focus on 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 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.

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

2. DCE survey design

2.1. DCE attributes identification, description and levels

The DCEs we have designed are hypothetical tasks that require survey respondents to consider buying chicken that might have been subject to a chlorine wash which is not a production method currently allowed in the UK. 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 made because it is a familiar product to consumers in the UK.

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 set of attributes and associated levels was arrived at as follows. First, we reviewed the relevant literature on novel food production and identifying a set of potentially important attributes (e.g., Clark et al., 2017; Edenbrandt et al., 2018; Erdem, 2015, 2018; Fischer et al., 2016; Frewer, 2017; Grebitus et al., 2018; Konstantinos et al., 2018, Lusk and McCluskey, 2018; Merritt et al., 2018; Messer et al., 2017; Miller et al., 2016, Tonsor et al., 2005). The review examined product and attribute coverage and the methodology used to implement food DCEs. The review of the antecedent literature yielded a reasonably large set of attributes that have been examined in relation to novel food production, including: Price (or Cost); Traceability; Country of Origin; Food Safety; Trust in Information; Production Practices; Brand; Health Claims; Nutrition Claims; Nutrition Fact Panels; Sustainability Claims; Packaging; Endorsements; Natural Product Claims; and, Environment Claims. Second, given the potential number of attributes, we sought the opinion of policymakers which allowed us to develop an initial version of the survey instrument. We then shared several versions of the survey with a group of consumers who provided feedback on the attributes, the levels used, and other aspects of the survey instrument. After several iterations of the survey instrument, we 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, in that model results in terms of attributes and associated values all appeared plausible.

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 Standards	None, RSPCA, QAI, Red Tractor
Chlorine-Washed	Yes/No

Note: RSPCA — Royal Society for the Prevention of Cruelty to Animals; QAI — Quality Assurance International.

The attributes and the levels employed are summarised in Table 1:

All of the attributes shown in Table 1, were defined and introduced to survey respondents prior to undertaking the choice tasks. For the Price attribute the range reflected those found in major food retail outlets for this cut of meat. In terms of the two DCE, the only difference in how the Price attribute was framed can be understood from how Price was described. 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*".

For DCE1, we asked respondents to make a selection first before allowing 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. In the analysis, we do not use the "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 DCE2, the Price attribute was described as:

> "*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*

[5] DellaVigna (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.

[6] It is well documented that UK consumers prefer chicken breast to all other types of chicken meat (Cowen and Morrin, 2018).

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. In this way, the no-choice (opt-out) option simply obtains the cash value of the voucher.

With regard to CoO the levels selected explicitly did not name a country or countries outside the EU (Non-EU) to avoid conflating this attribute with the chlorine-washed attribute. For Organic Production, this was defined as a farming system that does not use various forms of chemicals in the production process, whereas non-organic was defined as conventional production. For Food Standards, we explicitly stated that all the food for sale in the UK meets the required legal standards, although there are differences in standards between countries of the world. Turning to the Quality Assurance Standards we explained that this attribute indicates if the food was produced to recognised industry quality standards for food safety, hygiene, animal welfare, and the environment, and reflects best industry practice. The Red Tractor is a widely used logo in the UK and it is found on food products that meet a given set of standards that are applied across the supply chain. It has been in use since 2000 and given the extent of its use, it is unsurprising that 74 percent of shoppers know the logo (YouGov, 2021). The RSPCA assured logo is specifically dedicated to animal welfare with there being a specific standard for the production of chickens. The RSPCA indication is also widely recognised by UK consumers. We also employed the Quality Assurance International (QAI) assurance label as an example of an international quality standard. For all of these attributes, we did not give specific details or explain strengths and weaknesses as we wished to see how respondent knowledge was revealed in terms of the choices made.

The final attribute we employed is that describing if the chicken has been subject to a chlorine wash. 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 either have: chlorine-washed or Not chlorine-washed"*

We framed this attribute this way given how food production in the EU/UK is implemented. For example, Spence (2017) notes that poultry is produced using production and processing methods called the "farm to fork" approach. The description of the chlorine-washed approach was based on information obtained from the US National Chicken Council.[7]

2.2. DCE experimental design and survey implementation

For the given 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 cashback for DCE2. To keep the choice task manageable in terms of time to complete and 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 (MNL) utility specification assessed using D-error with uninformative priors (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 Fig. 1 and 2 respectively.

As can be seen by inspecting Figs. 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 the 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 Fig. 2, there is an example where the voucher is worth less than the other two options and in this case, if the respondent wants to select option B or C then they must also make an additional payment.

In addition, to the choice task our survey instrument also collected data on stated ANA as well as the rank order of importance of the attributes to respondents. This information was collected by employing de-briefing questions that all respondents answered after the choice tasks had been completed. This data has been collected so that we can assess the level of engagement with the survey instrument. We also asked respondents to answer a question regarding their attitudes about food following Brexit after they had completed the choice tasks. 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?"*

We asked this question as we wanted to understand if attitudes about food following Brexit might impact our results. The variation in attitudes to food post-Brexit captured by this question is 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 "Brexit-Positive", those with a negative view as " Brexit-Negative" and we combine and label the neutral and do not know respondents as "Neutral".

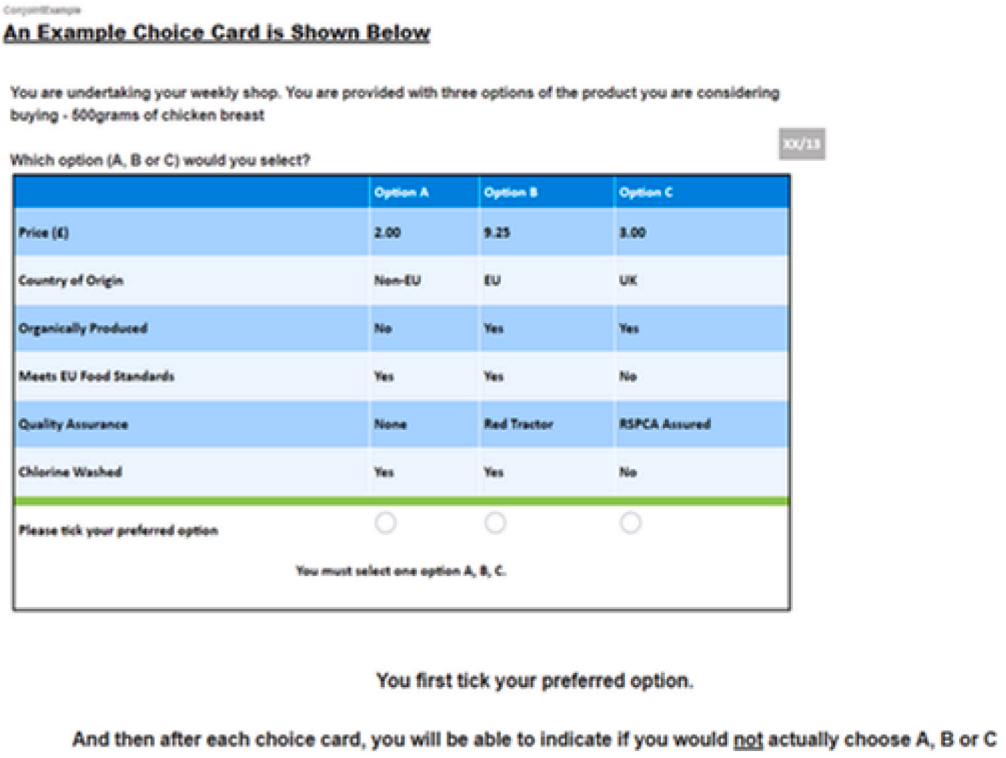
As explained below, we have used responses to this question to examine for differences in preferences, especially with regard to chlorine-washed chicken as well as the other attributes employed in the DCE. The reason for placing this question after the choice tasks had been completed was because we did not want to bias any responses we obtained for the DCE. By asking about Brexit-related issues before the DCE tasks, we would have likely primed answers to the DCE and we wished to implement the DCE without explicitly discussing Brexit.

Finally, once we have finished designing the survey instrument we moved to full implementation online. This involved collecting 338 responses for DCE2 and 449 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 A.1 in Appendix A. As can be seen from the sample data shown in Table A.1, the composition of both samples is very similar statistically, with no obvious reasons to assume that sample mix would bias results.

3. Model estimation, specification and selection

To analyse our DCE data, we employed a Hierarchical Bayesian Logit (HBL) (Balcombe et al., 2016). A HBL is a flexible approach that allows for a continuous distribution of preferences across the population. When implemented in "willingness-to-pay" space the model also affords the introduction of prior information regarding reasonable bounds upon the distributions of respondent's WTP. Popular alternatives to this model include classical approaches such as the Mixed Logit and the Latent Class models. However, the HBL can deliver similar results to the classical Mixed Logit but offers the opportunity

[7] For specific details see: https://www.nationalchickencouncil.org/chlorine-use-in-chicken-processing/.



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

XX/13

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

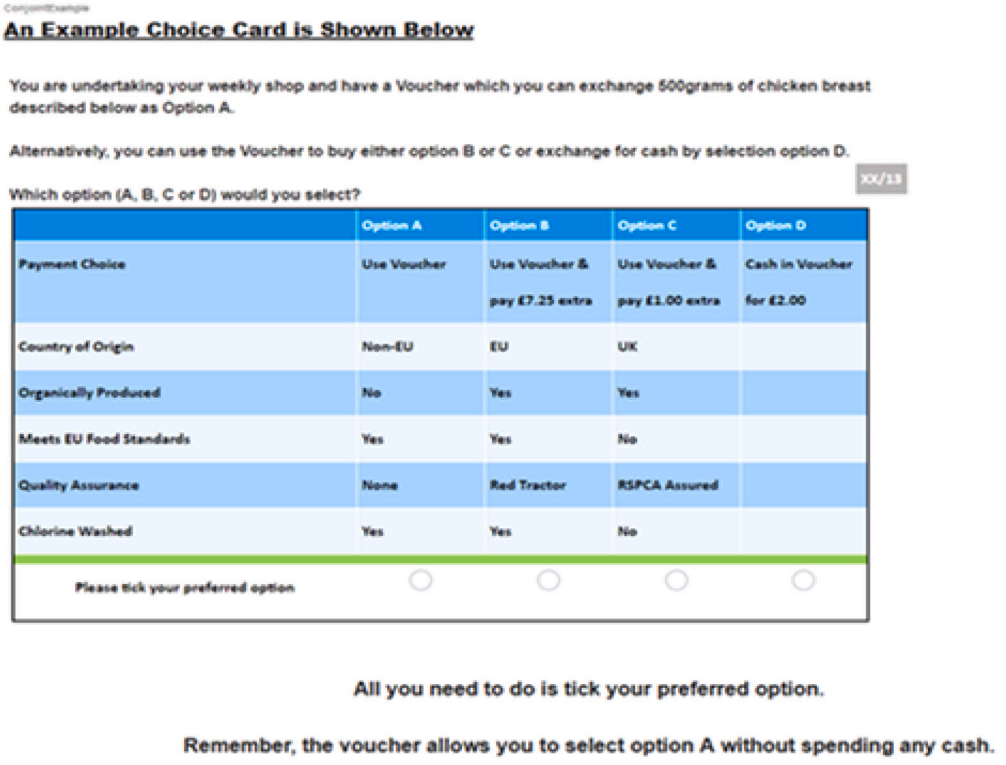
	Option A	Option B	Option C
Price (£)	2.00	9.25	3.00
Country of Origin	Non-EU	EU	UK
Organically Produced	No	Yes	Yes
Meets EU Food Standards	Yes	Yes	No
Quality Assurance	None	Red Tractor	RSPCA Assured
Chlorine Washed	Yes	Yes	No
Please tick your preferred option	○	○	○

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

Fig. 1. DCE1 choice card.



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.

XX/13

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.

Fig. 2. DCE2 choice card.

to use relatively "weak" information such as extreme bounds for the distribution of normally distributed parameters that can greatly improve estimates under some circumstances. Our choice of model also reflects our belief that respondent heterogeneity is best modelled as a continuous distribution rather than treating respondents as being drawn from a set of groups which is implied if employing a Finite Mixture/Latent Class model.

Our model specification is formally defined as follows. Let x_{ijs} denote a $k \times 1$ vector of attributes from the DCE presented to individual $j (j = 1, \ldots, J)$ in the ith option $(i = 1, \ldots, I)$ of the sth choice set

$(s = 1, \ldots, S)$. 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 ith choice in the sth choice set. Consequently, the utility function is of the form:

$$U_{ijs} = V_j\left(x_{ijs}\right) + e_{ijs} \tag{1}$$

where $V_j\left(x_{ijs}\right)$ 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 jth person from the sth choice set is:

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

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 is somewhat vague.

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

$$V_j\left(x_{ijs}\right) = \exp\left(\beta_{1,j}\right) \times \begin{bmatrix} -price_{ijs} + \beta_{2j} Chlorwash_{ijs} + \beta_{3j} EUFS_{ijs} + \beta_{4j} Organic_{ijs} \\ +\beta_{5j} CoOEU_{ijs} + \beta_{6j} CoOUK_{ijs} + \beta_{7j} QS\,\mathrm{Re}dTrac_{ijs} \\ +\beta_{8j} QSRSPCA_{ijs} + \beta_{9j} QSQAI_{ijs} + \beta_{10j} OptOut_{ijs} + \beta_{11j} Endow \end{bmatrix} \tag{3}$$

where $\beta_{2j}, \ldots, \beta_{11j}$ represent WTP parameters for the jth 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 CoOEU 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 towards food post-Brexit. That is:

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

where $z_{i,j}$ is 1 if individual j replied "Yes" to the ith Brexit attitudinal question (positive, negative, neutral in Section 2.2) 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 the 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.

Table 2
Attitudes to food post-brexit.

Attitudes post Brexit	Frequency	Percent	Percent DCE1	Percent DCE2
Brexit-Negative	259	32.9	32	34
Neutral	332	42.2	43	41
Brexit-Positive	196	24.9	25	25
Total	787	100	100	100

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

4.1. Food and Brexit

We begin by reporting our results for the question regarding attitudes to food after Brexit. The results are reported in Table 2.

As we can see in Table 2, for the DCE1 sample, the results are that 25 percent of respondents are positive about food after Brexit, 32 percent are negative and 43 percent are neutral. The results from DCE2 are very similar. Thus, there are very similar responses from respondents from both DCE in terms of attitudes to food after the Brexit vote. Overall, the responses indicate that more respondents think that Brexit will have a negative rather than a positive effect on food.

Next, we present results to assess how our groups of respondents are allocated between the three categories (Brexit-Negative, Brexit-Positive, and Neutral). To do this we have estimated a MNL model specification and the results are shown in Table 3.

For the model specification shown in Table 3, Brexit-Negative is the base dummy level for the dependent variable. In terms of independent variables Age, Income and Education are treated as continuous, and all have quadratic terms included to allow some non-linearity. In terms of the results generated, we see that the experimental treatment dummy (DCE1 v DCE2) is statistically insignificant as are many of the covariates. However, the strongest statistical difference is for Females who have a less positive view of Brexit outcomes concerning food than do Males. In addition, households with Children appear to be more positive as do larger households. We can also see Income is significant at the 10 percent level, with higher incomes initially making people less likely to be Neutral than Negative but the quadratic term indicates that this relationship is reversed for those on higher incomes. Finally, the exclusion test for each of the variables confirms these results. As to whether this small difference in attitudes to food post-Brexit and socio-economic characteristics has any strong impact on the model results we report, this is considered below.

4.2. Attribute non-attendance and rankings

As part of both DCE surveys, we included ANA questions and attribute ranking questions. We included these questions as means to assess the quality of the data we have collected. The results of these questions are summarised in Fig. 3.

On the left of Fig. 3 are the average ANA and rankings with respect to the attributes. The rankings are one for the most important attribute and six for the least important. On the right are the pooled results for both DCE broken down by the answer to the Brexit food question. The bars represent 95% confidence intervals.

Overall the ANA answers are broadly in line with what we would expect relative to other surveys we have conducted. We observe that the stated rankings and ANA measures are relatively stable over the two DCEs (left-hand side figures), with the exception of the Organic

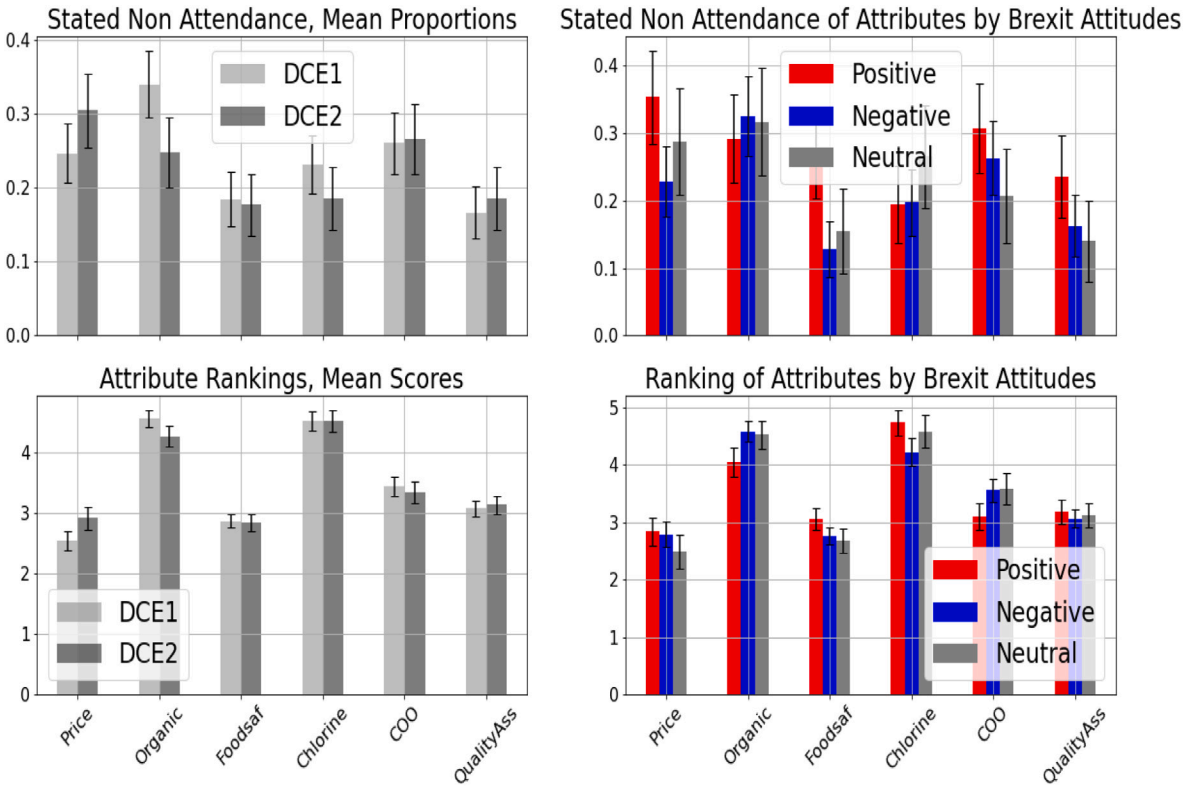


Fig. 3. Stated ANA by DCE and Brexit attitudes.

Table 3
MNL results for attitudes to food post-Brexit.

Brexit attitudes	Neutral vs Negative		Positive vs Negative	
Variables	Coefficients	SE	Coefficients	SE
Female	−0.134	0.179	−0.976***	0.214
Children	0.034	0.213	0.593**	0.255
Eat Meat	0.379	0.466	0.086	0.569
Age	0.585**	0.251	0.142	0.297
Age2	−0.087**	0.035	−0.015	0.041
Education	0.146	0.256	−0.311	0.287
Education2	−0.044	0.042	0.050	0.045
Income	−0.494***	0.179	−0.226	0.211
Income2	0.042**	0.017	0.014	0.019
DCE2	−0.188	0.179	0.216	0.206
Household Size	0.166	0.085	0.226**	0.096
Model summary				
% Correctly Predicted	45.2			
Log Likelihood	−737.19			
Likelihood Ratio (df=22)	96.62***			
Joint exclusion restrictions	$\chi 2$ **Test statistic**			
Gender	23.38***			
Children	6.54**			
Eat Meat	0.71			
Age+Age^2	6.29			
Education+Education^2	8.62			
Income+Income^2	9.25*			
DCE2	1.47			
Household Size	6.21**			

Note: SE: Standard Error.
***Significance level 1%.
**Significance level 5%.
*Significance level 10%.

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 Washed 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 ANA measure of the attributes by Brexit attitudes are also relatively stable across the groups, especially so for the rankings. Interestingly, the Brexit-Positive group seems to have a higher stated ANA than the Brexit-Negative 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.

As to why the Brexit Positive group are more likely state ANA for Price and Food Safety is difficult to explain. Ultimately, to explain these responses requires an understanding of what respondents wish to communicate when answering ANA questions. We contend that for many respondents stating ANA does not mean they ignored an attribute when making their choices. It is possible that they reinterpret these questions in a way that does not reflect their behaviour in the context of the DCE. Therefore, in this specific case, the higher ANA for Food Safety reported by Brexit Positive respondents could be an expression of the view that they do not believe that Food Safety is likely to be jeopardised because of Brexit. Likewise, higher Price ANA may be an expression of the fact that they do not believe prices will be higher because of Brexit. This interpretation cannot be substantiated and as such requires further research beyond the scope of the current study.

4.3. Mean WTP results

We next examine the mean WTP results for the two DCEs (corresponding to the distribution of the parameters $\alpha_{i,k}$ in Eq. (4)). The results are reported in Table 4, and we label individual's in response to their beliefs about the impact of Brexit on food.

The first thing to note about the results in Table 4 is that for both DCEs, the mean value estimates are considerably larger than the standard deviations for most attributes. In Bayesian terms, this

Table 4
DCE1 and DCE 2 - Distribution of mean attribute values, 500 g of chicken.

DCE1	Neutral	StdN	Brexit Negative	StdR	Brexit Positive	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
DCE 2	**Neutral**	**StdN**	**Brexit Negative**	**StdR**	**Brexit Positive**	**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 Brexit Negative; StdL — standard deviation Brexit Positive; Sigma — estimate of the standard deviation of the error terms u_{kj} in Eq. (4).

implies that there is a relatively large probability mass on 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 for both DCEs in Table 4 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 DCE are within two standard deviations (based upon pooled estimates). The three exceptions are the scale coefficient for the Brexit Negative group and the opt-out effect for Neutral and Brexit Negative 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 Brexit Negative and Brexit Positive groups in both DCE. Another difference is that the DCE2 results in Table 4 have 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 concerning 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). In both DCE1 and DCE2, we observe that Brexit Positives placed greater value on UK CoO than Brexit Negatives or Neutrals, and Neutrals in turn place greater value than Brexit Negatives on UK CoO. Another interesting result for CoO is that the positive valuation of EU CoO dropped across all groups for DCE2. Given the analysis being undertaken we are unable to explain why this specific result occurred. Further research would be required to examine if this result is a function of the specific DCE and/or the sample of respondents.

Second, turning to the attribute of particular interest for this study, we see that for both DCE1 and DCE2 Neutral and Brexit Negative 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 Brexit Positives. By contrast, Brexit Positives showed a very small tendency to dislike the chlorine-washed attribute in DCE1 (£−0.09) and a tendency to like the chlorine-washed attribute in DCE2 (£0.40). However, at the mean, both Brexit Positive estimates had standard deviations larger than the mean, therefore, we do not have strong evidence that Brexit Positives are on average anything but neutral towards chlorine-washed chicken. Thus, looking at the average values, Neutrals, and Brexit Negatives in particular, attached a large negative value to avoiding chlorine-washed chicken, whilst Brexit Positives 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 Brexit Positives and/or positive values by Brexit Negatives. 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 Brexit Positives. 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 4, that Brexit Negatives 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 Brexit Positives 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 the 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. We might speculate that the endowment effect is stronger among Brexit Positive respondents because it acts as a proxy for their preferences on Brexit: they prefer to keep what they have rather than exchanging it for something else. However, to address this result requires additional research that is beyond the scope of this paper.

Table 5
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

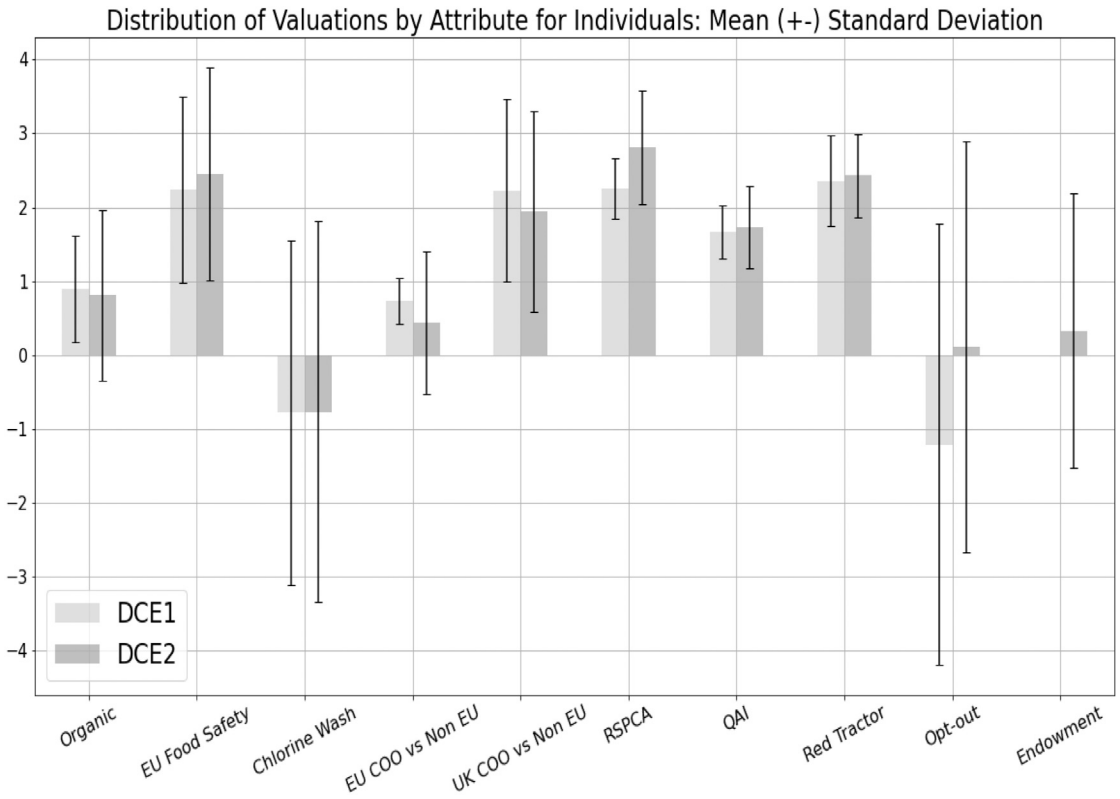


Fig. 4. Distribution of valuations by attributes by respondents.

Finally, our Sigma estimates in Table 4 are sizable in both DCE1 and DCE2, reflecting a high degree of heterogeneity in the individual values estimated by the model that is not explained by attitudes towards food post-Brexit. Thus, while there seem to be strong mean differences between groups based on their attitudes to food post-Brexit, it would be a mistake to believe that these attitudes are necessarily a powerful predictor of values.

We next present the distributions for the latent values in Table 5 and Fig. 4 for both DCEs.

The mean estimates in Table 5 tend to reflect what has already been commented on, though they merge all respondents. Again, while there are differences, the value estimates across the two DCE models appear 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 5 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 seems to value the chlorine-washed chicken positively.

Finally, as already noted, there seemed to be differences in the attitudes of people concerning food post-Brexit and the valuation of certain attributes. To further analyse this effect, we break down the percentages by post-Brexit attitudes to food in Table 6 and Fig. 5.

Based on the results shown in Table 6 and Fig. 5, we see that the chlorine-washed attribute is disliked (liked) by 70 (30) percent and 82 (18) percent of Brexit Negatives 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 Brexit Positives liking the attribute; 53 and 54 percent respectively.

Table 6
Frequency of positive valuations by attribute and Brexit attitudes.

	DCE1			DCE2		
	Neutral % > 0	Negative % > 0	Positive % > 0	Neutral % > 0	Negative % > 0	Positive % > 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

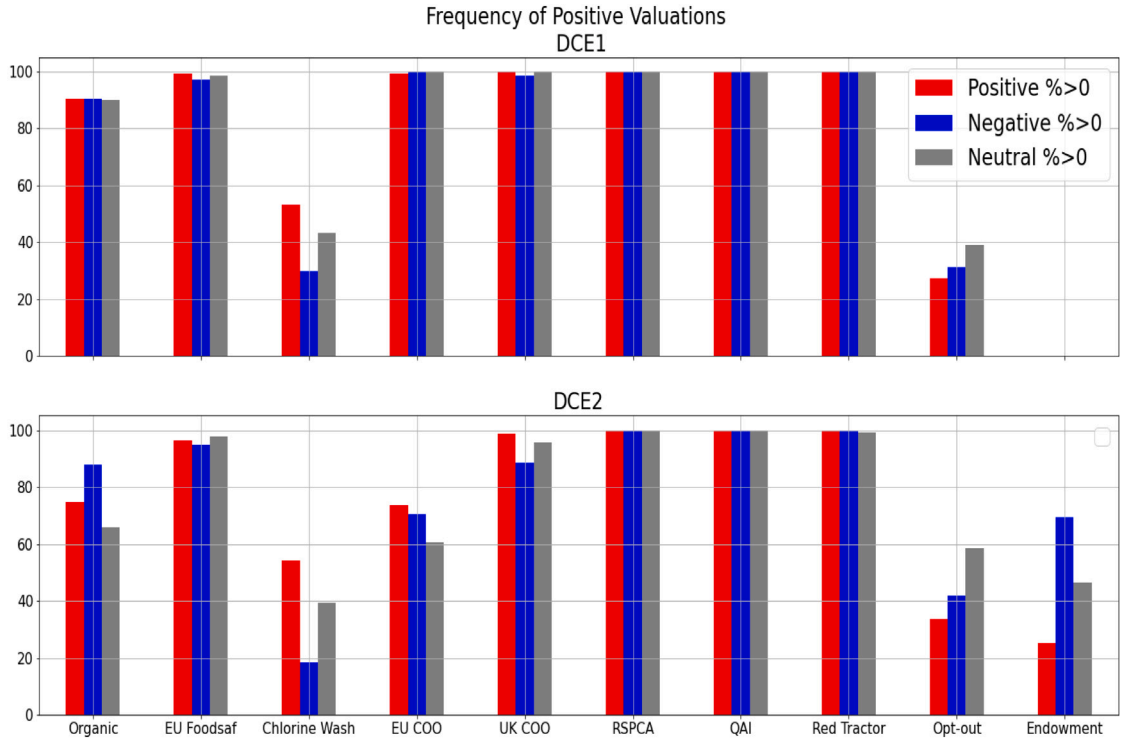


Fig. 5. Frequency of positive valuations by attribute by DCE.

The percentages in Table 6 and Fig. 5 also yield evidence that regardless of attitudes to food post-Brexit, EU Food Safety standards are valued positively (> 95% for all groups). Thus, attitudes about food post-Brexit do not align with how potential FTA may result in the importation of food produced at lower safety standards. Additionally, the percentages on the endowment effect again demonstrate a split with 70 percent of Brexit Negatives seemingly having a positive endowment effect, but 75 percent of Brexit Positives having a negative endowment effect, with a slight minority of Neutrals having a positive endowment effect.

Finally, we experimented with including covariates in the HBL specification. However, we did not run a model where all potential socio-economic variables were used as covariates for the WTPs since this would result in overparameterising the model. We did explore conditioning the HBL by income only and the resulting WTPs were practically invariant to the inclusion of this variable. Given these findings, we then examined the impact of socio-economic variables on WTPs using a two-stage approach where we regressed our attribute WTP estimates from the HBL on the socio-economic data plus a regression that also included a dummy for the DCE type. The statistically significant coefficients are reported in Table A.2 in the appendix Table A2. Notably, the covariate with the most significant effect was the DCE. However, as we have already seen, while the results in Table A.2 were significant they did not yield any substantively meaningfully differences in our WTP estimates.

5. Policy implications

There are number of policy implications that stem from the results we report that have both short and long term implications. The most pressing issue is 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 given Brexit. As Ranta (2019) noted food was not a significant issue during the EU membership referendum. However, how to organise UK agriculture and food policy has become ever more contentious since Brexit. There are ongoing discussions with the EU concerning Northern Ireland and the trade agreement that was reached. There are also 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 such as chlorine-washed chicken.

With regard to chlorine-washed chicken, a clear majority of respondents in our survey viewed this practice negatively regardless of which DCE we consider. 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. There was also some degree of delineation of values between people who had positive or negative views towards food post-Brexit. For those that were Brexit Positive, we found that they were equally split between liking and disliking chlorine-washed chicken. For those who were Brexit Negative, it was more likely that they disliked chlorine-washed chicken. These findings reflect survey findings reported by Curtice et al. (2020) who found a difference in attitudes to chlorine-washed chicken when taking account of how respondents voted regarding Brexit. They report that of those respondents who voted to remain in the EU some 82 percent had a negative view of chlorine-washed chicken. In contrast, for respondents who voted against Brexit, some 72 percent had a negative view of chlorine-washed chicken.

Of equal importance from the policy standpoint was our result that attitudes towards food post-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 a way that satisfies EU food standards.

Taken as a whole our results indicate, regardless of attitudes to food post-Brexit, 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. Therefore, the potential role that specific types of food labelling might play, given the constraints imposed by the WTO, becomes more significant. In terms of employing food labels to signal product differentiation, our results reveal that the Red Tractor and RSPCA quality assurance labels are valued almost as highly as EU food safety standards. We also find that CoO labels, especially for UK produce, are highly valued corroborating results reported by Balcombe et al. (2016). Therefore, we can in principle consider our results as providing strong support for the use of labelling as a means to enable product differentiation if following an FTA between the UK and another country new food products become available to UK consumers.

The potential for voluntary labels to help satisfy consumer preferences regarding chlorine-washed chicken has also been examined by Sheldon (2019) who frames such 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 or RSPCA quality assurance schemes for example, 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. Furthermore, the Red Tractor quality assurance scheme has recently been updated[8] and it would seem a relatively straightforward matter to extend this scheme and the RSPCA scheme to include chicken that has not been chlorine-washed. But, there are clearly challenges to extending CoO labelling and quality assurance schemes to the large array of processed products that contain chicken. However, 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.

Of course, the willingness of other countries to agree to the use of a quality assurance scheme such as Red Tractor requires these schemes to be considered unbiased. Unfortunately, as reported by Casalicchio (2021), the Red Tractor has become embroiled in exchanges in relation to trade policy and agricultural practices in other countries most notably Australia and New Zealand. This raises an immediate concern about the acceptance of this scheme as part of a FTA with either country. In addition, the Red Tractor scheme has also been subject to criticism in the UK as a result of the requirements surrounding levels of pesticide applications (NFFN, PAN UK and RSPB, 2022). Criticism such as this can easily tarnish the reputation that Red Tractor has with the UK public. Finally, it also needs to be understood that although many consumers recognise various quality assurance labels the extent to which this information guides choice is much lower. Food Standards Agency (FSA) (2022) report that the actual use of food label information such as CoO, Red Tractor and RSPCA by consumers in making food choices is frequently less than 40 percent. Thus, although our research indicates that respondents place significant value on this type of information, revealed preferences indicate that we need to be cautious about placing too much emphasis on the role that food labels could play in supporting domestic food production.

In terms of longer term implications stemming from our research, a fundamentally important point that needs to be understood is that there is a distinction between free trade and FTAs. As Rodrik (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 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.

It is also the case that there have been calls for the UK to be active in helping to reframe rules around trade and food especially concerning various production practices and animal welfare. For example, Wilkinson (2020) has advocated 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. Much the same position has been set out by the UK Trade and Agriculture Commission (2021). However, this is approach to changing the type of trade rules that can be included in an FTA that are WTO compliant is almost certainly a medium to long term strategy. There are also problems with how the WTO dispute settlement process is currently functioning. As Beghin and O'Donnell (2022) explain these issues have emerged as a result of the growth in Regional Trade Agreements (RTA) and as such trade deals and dispute resolution is evolving.

Finally, another issue that may well change the form and type of FTAs that the UK may need to sign, is the emphasis on health related food policy to eat less but better meat and dairy produce (Trewern et al., 2022). The food transition that is underway may well influence the form and type of FTA that the UK needs to sign. If this transition is to continue then consumers need information to make informed food choices, so yet again the importance of CoO and quality assurance schemes becomes relevant. Thus, the drivers for information around food are likely going to be driven by domestic as well as trade concerns.

In summary, the policy implications that result from our analysis are informed by our main result, that on average there is a clear dislike of chlorine-washed chicken. However, how the UK then attempts to reconcile consumer preferences regarding food with how it develops future FTAs is as yet unclear even with the publication of the Trade and Agriculture Commission (2021) report. We have indicated that CoO and quality assurance labelling schemes offer one solution. Whether or not future FTAs negotiated by the UK attempt to balance consumer preferences, agricultural and food industry demands and those of potential trading partners by resorting to the use of food labels amongst other policy instruments, is likely to be a subject of ongoing debate.

[8] https://redtractor.org.uk/about-red-tractor/our-impact-and-history/

Table A.1
Descriptive statistics.

Variable	Units	% DCE2 (n = 338)	% DCE1 (n = 449)	P value
Gender	Female	56	50	0.094
	Male	44	50	0.094
Age	18–25	12	11	0.664
	26–35	18	18	1.000
	36–45	18	17	0.715
	46–55	17	17	1.000
	56–65	18	17	0.715
	Over 65	18	20	0.478
Household Size	1	16	18	0.458
	2	39	38	0.775
	3 or more	44	42	0.575
Children	Yes	61	63	0.567
	No	39	37	0.567
Household Income	Up to £15,599	24	24	1.000
	£15,600 to £25,999	24	23	0.744
	£26,000 to £36,399	21	19	0.488
	£36,400 to £51,999	13	13	1.000
	£52,000 and above	9	11	0.351
	Prefer not to say	9	9	1.000
Highest Level	School education to 16	22	21	0.736
of Educational Attainment	A-level or equivalent	22	19	0.304
	Further Education	19	16	0.275
	Undergraduate Degree	20	26	0.046
	Postgraduate Degree	12	13	0.674
	Higher	4	4	1.000
Employment	Employed	62	61	0.775
	Unemployed	8	6	0.280
	Other	30	33	0.369

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. 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.

From a methodological perspective, 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. Instead, we observed there was a high degree of heterogeneity across respondents with regard to the endowed option. For example, we found evidence of a reference point effect associated with keeping the endowment option, and somewhat surprisingly we found that this effect was dependent on attitudes towards food post-Brexit. Respondents expressing positive views about food after Brexit were more likely to switch away from the endowed option, while those that expressed negative views about food post-Brexit showed more tendency to stick with the endowed option. As we have discussed, there is no obvious reason why this result should emerge and as such we have no conclusive explanation. Another result that is also difficult to explain relates to how values for EU CoO differ between DCE1 and DCE2. These results may well be idiosyncratic but they warrant further investigation as these results clearly illustrate a limitation of this research.

Turning to other areas of future research, one area that warrants more attention relates to how the question of novel food products is framed. In our DCE, we have framed the choice in a binary way and clearly, the tone used to differentiate the choice matters. There is most certainly scope to re-examine this type of choice issue with, for example, variations in information provision. For a subject that is as "heated" as chlorine-washed chicken employing several information treatments to enable the research to disentangle the real reason for the attitudes to the product would seem a meaningful next step.

There is also good reason to employ revealed preferences methods to examine the extent to which the food labels that are highly valued are really used by consumers when buying food. This is particularly important given the limited use of these food labels reported by the Food Standards Agency (FSA) (2022). There already exists limited research on CoO in the UK for beef by Hussein and Fraser (2018) but there is obviously a need for more research on other food products and other food labels such as the quality assurance labels considered here.

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Table A.2
Regression results for individual WTPS against socio-economic data.

	Male	EatMeat	Children	Income	Edu	Age	HHSize	DCE1
Chlorine Wash		−0.53						
EU Food Safety	−0.38							−0.23
Organic	0.38		0.46			−0.3	0.24	
EU CoO						−0.10		0.29
UK CoO								0.33
Red Tractor	−0.13							−0.58
RSPCA	−0.07						−0.04	−0.08
QAI	−0.15					0.04		−0.10
Opt-out						0.22		−1.40

In this table, we only include coefficients that are significant at the 5% level.

of Food Safety" at the XVI European Association of Agricultural Economics Congress 2021 and the Eastern Arc Experimental Social Sciences Workshop who provided comments on an earlier version of the paper.

Appendix A. Additional tables

See Tables A.1 and A.2.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.foodpol.2022.102327.

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