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Preferences for Sustainability and Supply Chain Worker Conditions: Evidence during COVID-19

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Abstract

In the context of COVID-19, we empirically investigate whether consumers are willing to pay for greater sustainability and safer working conditions in food supply chains. We elicit consumer valuation via two online consumer choice survey experiments and revealed preferences using a mixed Logit discrete choice model. We find that consumers have a significant positive marginal utility towards sustainability, estimating an average implied willingness-to-pay of 5 cents per pound. Alternatively, we estimate that consumers require an average compensation of 58 cents per pound to choose products produced under safer working conditions. However, respondents personally impacted by COVID-19 will pay a significant premium. Our findings have policy implications in that they suggest a market-based potential to nudge certain consumer segments who desire to decrease their environmental footprint or purchase products with safer working conditions, namely, by revealing information in the form of labeling. **Keywords:** Choice experiments, Discrete choice model, Willingness to pay, Labeling, Sustainability, Food production safe working conditions, COVID-19.
JEL Classification: M30, Q18, Q25, Q21, C12, C24.

1 Introduction

Understanding consumer preferences and how they may change is of particular importance to understanding how consumer choices affect the environment and supply chain participants. The rise of Eco and Sweatshop-free labeling has created a market for sustainable and worker safety options. However, such labels have historically not been widely available to guide consumers who want to follow a diet consistent with such values. This paper empirically assesses whether consumers respond to information on the sustainability and labor conditions of the food they choose.

One of the many side effects of the COVID-19 pandemic has been an increase in discussions about the environment and working conditions. When the shelter-in-place orders shut down economies, traffic levels plummeted affecting air quality (Liu et al. (2020)). At the same time, calls for increased protections for essential workers went viral across the globe. Consumers were inundated with news reports of mass COVID-19 outbreaks within our food supply chains, markedly at US meatpacking, which triggered meat shortages and widespread debates on the conditions facing workers.

Our research questions are twofold: first, to examine whether consumer preferences changed towards considering environmentally friendly alternatives; and second, towards choosing products from companies that protect their workers. The empirical strategy to investigate preferences towards sustainability is to design an experimental information treatment on the sustainability trade-off among available options in the first survey instrument. We test whether consumer choice differs when a greener alternative is possible and consumers are aware of the sustainability trade-off. Additionally, we test whether the pandemic has increased environmental consciousness. The empirical approach to testing for awareness towards essential worker risks during the pandemic is to implement a survey modeled to gauge consumer consciousness regarding worker and community safety in treated (individuals who, either themselves or a loved one, have tested positive for COVID-19) and control groups. We assess whether individuals in the treatment group have a higher willingness to pay for safer

working conditions within the meatpacking sector. In our model, consumers are informed via a "COVID-19-Safe" package labeling.

We estimate a model of consumer choice where a product is defined as a bundle of attributes: price, production meat type, and sustainability or safety information at the point of choice. Varying the attribute space presented to consumers in the experimental choice design, and collecting data on consumer characteristics, gives us the data variation to estimate a discrete choice model specification assuming consumers choose the option that maximizes their utility. The estimated model parameters consist of marginal utilities for price and for characteristics that allow us to obtain estimates of the implied willingness to pay (WTP) for product characteristics. Additionally, we empirically test whether consumer characteristics affect their WTP.

The contribution of our paper is twofold: (1) to estimate stated preferences and corresponding WTP for sustainability and worker safety in the production of meat, and (2) to investigate whether consumers respond to information about environmental consequences of food they consume and safety of workers in the production of the food they purchase. Our findings will equip resource managers with important information on the efficacy of potential labels pertaining to sustainability and working conditions in production, as well as a barometer reading on consumer stated preferences.

Related literature investigates consumer knowledge about sustainability (Tait et al. (2011)). With respect to market mechanisms to nudge consumers, numerous studies have shown that information about product sustainability through "eco-labels" impacts consumer choices (Hallstein and Villas-Boas (2013)). Therefore, given consumers' stated lack of knowledge on the sustainability of their diets and the effectiveness of eco-labels in other settings, this paper contributes to the literature by estimating how much consumers would value sustainability in the midst of a pandemic and economic shutdowns.

This paper contributes to the literature surrounding dangerous working conditions among marginalized groups and consumer awareness in the context of a rapidly spreading global

pandemic and especially in the meat producing supply chain (Saitone et al. (2021)). We focus our empirical strategy on this supply chain due to issues arising in the pandemic to measure consumers' preferences to ensure safer working conditions. Also related, an established body of literature investigates consumer preferences for working conditions such as child labor and sweatshops (see e.g,Harrison and Scorse (2004)). We assess whether preferences are affected by a natural experiment of increased awareness into essential workers working conditions during this pandemic. Additionally we are able to test whether the economic crises brought on and worsened by COVID-19 (unemployment and exposure to COVID-19) influences the WTP.

We follow and expand on the existing revealed and stated preference literature, which uses a variety of reduced form (Roheim et al. (2011)) and structural approaches to infer the value consumers place on product attributes that are not observable by a consumer's physical senses at the point of purchase. Structurally, demand system approaches are estimated to place a willingness to pay for product attributes (Alfnes et al. (2006); Teisl et al. (2002)). Our work is the first to use these methods to place a value on sustainability and safe working conditions in meat production.

2 Empirical Setting, Survey Design, and Data

This study uses discrete choice surveys to evaluate consumer preferences for sustainability and safer working conditions in meat production.[1] Discrete choice experiments are among the most common methods for gathering stated preference, and are rooted in Random Utility Models. The first step is to define a product as being made up of a set of attributes. Then respondents are asked to choose a single option among alternatives, simulating the context that consumers are normally presented with in the marketplace. We present details on the sustainability survey first, that we now call Survey 1, and then on the worker safety survey, henceforth called Survey 2.

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[1]See the Online Appendix for links for the two survey instruments.

2.1 Sustainability Survey 1

We asked survey respondents to reveal their preferences for two options, one sustainable and one not sustainable in five different pair-wise choice scenarios, varying the products and prices displayed in each choice. These products were featured in the survey because they vary in the sustainability of their production process.The next set of questions in the survey aimed at quantifying each respondent's attitudes towards the environment and assessing pandemic concerns. We also ask an additional question aimed at assessing whether consumers would be amenable to meat products' pricing including a carbon tax. Finally, we implement a randomized experimental treatment, where a random subset of the respondents are given information on sustainability of food options, before they are asked to make food choices in the survey, and the control group is not given such information prior to making their choice. The Treatment consists of showing respondents a page containing the amount of Greenhouse Gas emissions in the production of several agricultural food products. Both the treated and the control group performed the choice experiment for five different products. The respondent is given two options to choose from, where she sees the price of each of the two alternatives but also that the meat alternative produces 10 times more Greenhouse gases than the plant-based meat alternative.

2.1.1 Data Summary Statistics Survey 1

The survey instrument was sent to a total of 420 respondents by Qualtrics via email. Summary statistics of our data set are presented in Table 1 where, in the top part, the demographic makeup of survey respondents in the treatment and control groups is compared to the total California population. We chose to send the survey to potential respondents in California as we hypothesized that the population in California is very diverse in terms of socioeconomic characteristics.

We see that the gender break down is about half-and-half, both in the survey and in California's general population. The sample data are skewed towards both older and younger

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populations at the expense of the middle age ranges. Whites are vastly over-represented at the expense of all other categories. Income levels in the sample overall are fairly representative of the California population, as is race and gender. Finally, education attainment levels of "Less than some college" is under-represented in the survey sample as is "Graduate degree or more." When comparing the treatment and control groups to each other, we have balance across all the demographic variables for all rows in Panel A.[2]

In the bottom of Table 1 we report summary statistics for the constructed Environment, Pandemic and COVID-19 Scores for each respondent. We use the survey data to construct an Environmental Score (ES) of each respondent based on the degree of agreement/disagreement (on a scale of 1 to 5, 1 being strong disagreement and 5 strong agreement) with a series of nine statements regarding environmental issues, as well as seven statements pertaining to the pandemic to create a Pandemic Score (PS). Finally we use answers to four COVID-19 questions to form a COVID-19 Score (CS) for each respondent. If a respondent strongly agrees with all nine statements he gets an ES of 45, and otherwise strong disagreement with all statements gets him a score of 9. Similarly, the Pandemic Score (PS) ranges from 7 to 35, and the COVID Score (CS) ranges from 4 to 20.[3] Comparing the average scores by treatment and by control group separately, we find a balance, as the sample averages for each of the three score types are not statistically different between the treated and control respondents, consistent with the random assignment having succeeded along these score classifications.

Finally, besides the demographics and the three scores, we also classify a respondent with an indicator "Chose Taxed Meat" equal to one if he chooses meat products when they are taxed with a hypothetical carbon tax, instead of a plant-based meat alternative. Summary statistics of the proportion of respondents that chose the taxed meat options instead of the plant based one are reported in the last row of Table 1. The proportions are very similar between the treated (60 %) and the control group (63.33%) and we cannot reject the null of

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[2]We cannot reject that the average is similar between control and treated groups for any of the demographic variables.

[3]See Figure A1 in the Online Appendix for summary statistics for the average agreement with a representative set of statements.

equality between the control and treatment groups.

2.1.2 Average Choices in Sustainability Survey 1

In Table 2, we present the share of respondents choosing the greener option along demographic segments as well as broken down for the treatment and control group in the bottom of the table. The share of green choice is very similar across genders with the greener option being chosen 51% of the time for men and 40% of the time for women respondents. An interesting pattern emerges as we go down the table from younger to older respondents, namely that for lower age, the proportion of times the green option is chosen is higher (50% for the youngest segment) than for the older segments, with the exception that ages between "35 − 44" have the highest share of the greener option chosen, 59%. Higher income ranges show a higher share of respondents choosing the greener alternative than lower income ranges. We see that the highest education respondents also, on average, have the highest proportion of choosing the greener alternative. Finally, in terms of the information treatment, the treated group has a significantly higher average proportion of choosing the greener alternative (53%) than the control group respondents (47%).

2.2 Worker Conditions Survey 2

The second survey, implemented in the Winter of 2021, focused on stated preferences for worker safety and COVID-19 exposure. We ask respondents for their demographic profile, whether they are essential workers, were unemployed due to the pandemic, and whether they could shelter in place during the mandates. These variables are used as characteristics of each respondent. We then ask them to choose among four different options: one conventional with no changes in safety, a second with slightly increased worker safety attached to a slightly higher price, a third option with an incrementally higher price and greater safety than option two, and a final option not to choose any of the above. Each respondent is asked to repeat the process in three different choice scenarios varying the product; first for bacon,

then chicken, and finally ground beef. Finally, we also ask respondents whether they or anyone they love were infected with COVID-19. The group of respondents who said yes to the infection questions corresponds to the treatment group, and a control group consists of those not infected with COVID-19. Both the treated and the control group performed the choice experiment for the three meat products.

2.2.1 Data Summary Statistics Survey 2

The survey instrument was sent to a total of 890 respondents. The survey was implemented via email by Alchemer. The respondents were sampled from states affected by COVID-19 outbreaks at meatpacking plants in 2020: Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Montana, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin.

Summary statistics of our data set are presented in Table 3. This table is organized in two main parts. In the top we present the demographic makeup of survey respondents. In the bottom, we present the share and the number of respondents stating to have been unemployed due to the pandemic, the average share and the number of respondents classifying themselves as essential workers, the share of respondents stating they were able to shelter in place during the mandates, and, finally, the share and the number of respondents infected (or a loved one) by COVID-19 (the treatment group).[4]

In Table 3 we see that the sample consists mostly of respondents with income less than 90 thousand dollars (which is consistent with U.S. census data for the area), where the share of respondents earning less than 25 thousand dollars annual income is 23.4%. Only 7.8% of our respondents fall into the two highest income groups. In terms of reported education, there is considerable variation in the respondents' stated education achievements, consistent with each educational category specified by U.S. Census data for the Midwest within a 90% confidence interval. The sample has a white respondents' share of 82.6% which, according to the U.S. Census Bureau, is consistent, on average, with the white population make up of

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[4]See the Online Appendix for a comparison of Sample and State level Demographics, and Summary Statistics of Choices by unemployment and sheltered status.

the states we sampled from; as is our sample Median age and Average Household Size. In terms of Age, respondents are representative of the Midwest as a whole, with the median age within the sample being 38 years old and the median age in the U.S. Census data for the Midwest being 38.8 years old.

The sample is skewed towards women (with 65.3% share), with a total of 581 women, 296 men, and the remaining respondents stating non-binary or preferred not to say. WTP calculations were weighted to account for this difference. The activities of respondents are quite diverse and 8.9% of the respondents classify themselves as unemployed as their current status. Moving to the bottom of Table 3 we see that a higher share of respondents state a professional activity as their main activity but classify themselves as unemployed due to the pandemic, a share of 20.4%. In the sample, 42.6% of the respondents classify themselves as essential workers. On average 56.6% of respondents state they were able to shelter during the mandates. Finally, a total of 625 respondents state that they (or a loved one) were infected with COVID-19 resulting in a 70.2 percent of 890 respondents being in the "Treated" group when we pursue the next analysis of stated choices among safe and unsafe working conditions in meat production. In addition, we have 265 control group respondents for a total of 890 responses used.

2.2.2 Average Choices in Safe Worker Conditions Survey 2

In Table 4, we present the share of respondents choosing each of the presented options broken down for the control group (left columns) and treated group (middle columns). The rightmost columns report alternative choice frequencies and proportions for all respondents. The 4 alternatives differ in price and in a Safety attribute presented at the time of choice. The "Safe" Options (meat produced under safer COVID-19 working conditions) are options 2 and 3. Option 1 is the conventional non-safe option (no change in safety), and option 4 is choosing none of the other three.

Among all three choice situations, in the three row block segments, we see that, on

average, respondents choose the conventional alternative (alternative 1) most frequently, between 37.1% and 39.5% among all respondents (most right columns). The second highest share of choices falls in alternative 2, the safe working conditions option with a lower price than alternative 3, that is also safe. Alternative 0 in Table 4 corresponds to choosing none of the other three alternatives and we see that, on average, all respondents have the lowest frequency of choosing that alternative, with a share between 5.4% and 11.1% (again for all respondents in the most right columns).

For those not affected by COVID-19, and thus belonging in the Control Group, we see on the right the number and proportion of respondents in each of the three choice situations in the blocked row sets. In the middle columns the same is reported for the Treated group. Comparing the proportion of choices between Treated and Control groups we see that, generally, the safe alternative 2 is chosen more often in the Treated than in the control group, and the opposite is generally the case for the conventional option 1. Interestingly, the proportion of respondents who opt for none of the three alternatives is much smaller in the treated group (between 3.4% and 8.6%) than in the control group (between 10.2% and 17.0%).

3 Empirical Strategy to Estimate WTP for Sustainability and Worker Safety Attributes

The survey data—with respondent-specific choice information and demographics — enables us to estimate a specification of heterogeneous preferences in an econometric discrete choice model. We use the observed variation in choices among alternatives, their attributes, and characteristics of respondents, including the treatment status, to infer the preferences towards sustainability and safe worker conditions of products. We define information content as an additional or differentiated product attribute. Recognizing that products can be defined as a bundle of perceived attributes provides the framework to compute consumers'

preferences and, ultimately, willingness to pay for product attributes in a discrete choice model. Starting from a random utility framework McFadden and Train 2000) the utility from consuming a particular product can be described as

$$U_{ji} = X_j\beta_i + \epsilon_{ji}. \tag{1}$$

The matrix X_j indicates the attributes of product j, the vector β_i indicates the marginal utility that individual i places on these attributes, and ϵ_{ji} indicates the error term. If we assume that ϵ_{ij} is independently and identically distributed extreme value (type I) and that the marginal utility coefficients vary according to the respondent's observed demographics D_i we have a mixed Logit model, where different decision-makers may have different preferences.

Assuming that consumers choose one unit of product j among all the possible alternatives N available at a certain time that maximizes their indirect utility, then the probability that good j is chosen is the probability that good j maximizes consumer i's utility. The following closed form solution can be derived for the probability that a respondent's product choice corresponds to product j as

$$Prob_{ji} = \frac{e^{X_j\beta_i + \alpha\mathrm{Price}_j}}{\sum_{k=0}^{N} e^{X_k\beta_i + \alpha\mathrm{Price}_k}}, \tag{2}$$

where $\alpha = \alpha_0$ is the marginal utility with respect to price, that is constant for all respondents, and β_i contains the marginal utilities relative to the remaining attributes X for respondent i. The mean utility of the option "I would not purchase any of these" is normalized to zero.

Finally, given that each respondent makes T choice decisions (for the T different product categories separately), then we obtain the probability of individual i making a sequence of choices among the N alternatives and the outside option $(j = 0, ...N)$. Given a total of I respondents, the parameters $(\alpha, \beta_0, \beta_1)$ are estimated by maximizing the log-likelihood function of these sequences of choices for all respondents.

The ultimate goal is to estimate average and heterogeneous willingness to pay (WTP)

for the product attributes of interest. These are obtained as the ratio of β_i and the absolute value of the marginal utility with respect to price α. This estimate gives us, in dollars (as price is measured in dollars per pound), what is the willingness to pay for increasing the characteristic X_i by one unit. We can therefore recover not just the average WTP but also the way the WTP in the sample of respondents varies according to respondent's demographics, being treated in the sustainability survey, and being infected by COVID-19 or being unemployed in the worker safety survey.

4   Results

4.1   Mixed Logit Sustainability Choice Estimates

We present the estimates of the mixed Logit choice model specifications in Table 5. The coefficients are estimated by maximizing the likelihood of the sample, and we perform model comparisons using the Akaike information criterion (AIC) and discuss the best specification used moving forward. The dependent variable in both the columns is an indicator variable that is equal to one if an individual chooses the greener alternative and equal to zero otherwise. All specifications include product choice occasion fixed effects.

In column (1), the right hand side variables are the price, product dummies, Treatment status of respondents, and respondents Environment, Pandemic, and COVID-19 scores. The coefficient on price is negative and significant (-0.54), meaning that a high price decreases the marginal utility of purchasing the greener alternative. The $Treatment$ status of respondents has an average marginal utility of 0.22 which is positive and significant. On average, treated respondents have a higher marginal utility choosing the greener alternative than respondents in the control group. The COVID-19 score has no significant marginal utility, controlling for the other covariates, while both a higher pandemic and environmental scores have a positive average marginal utility.

In column (2) we further add respondents' demographics and their interactions with

treatment status. What we see is that, on average, a person's treatment status does not affect marginal utility in a different way along any of the respondents' demographics or the three score measures, given that none of the interactions in the bottom of the table are statistically significant. There are therefore no significant heterogeneous effects of treatment on the probability of choosing the greener alternative. The environmental status has a positive and significant marginal utility (point estimate of 0.04), the price a marginal utility (point estimate of -0.59) as before, and also consumers who have chosen the carbon tax meat options have a lower marginal utility of choosing the greener alternative, controlling for other factors in the regression. For the remainder of the analysis of estimating the implied willingness to pay for the greener alternative, we use the specification in column (2) given its lower Akaike information criterion.

4.2   Safe Working Conditions Multinomial Mixed Logit Estimates

In Table 6 we present the estimates of the mixed logit choice model specification. The dependent variable in all columns is an indicator variable that is equal to one if an individual chose that alternative, among four possible ones, and equal to zero otherwise. All specifications include individual fixed effects as well as product fixed effects.

In column (1), the right hand side variables are the price, a product dummy, and an indicator $Safe$ equal to one if the alternative is listed as having safer COVID-19 conditions for workers in its production. From the estimates in column (1) we see that the coefficient on price is negative and significant (-0.424), meaning that a high price decreases the marginal utility. The $Safe$ attribute has an average marginal utility of -0.222 which is negative and significant. This means that, on average, respondents have a marginal dis-utility from choosing (i.e., do not like to choose) the alternatives featuring a worker Safe disclaimer. In column (2) we further add whether a respondent is in the Treated Group (if the respondent or a loved one had COVID-19), and interact the Treatment Status with the Safe product attribute. What we see is that, on average, people in the non-COVID group have a dis-

utility from choosing the safe attribute (point estimate of -0.454), whereas if they are in the Treated group they have a positive marginal utility for safety relative to the control group with a significant point estimate for the Treated and Safe Interaction being 0.329.

The specification in column (3) allows us to estimate the average marginal utility for all variables in column (2) as well as departures from those averages with respect to the observable characteristics of the respondents. In column (4) we add interactions between Treatment Status and reported essential worker, unemployment status, as well as interactions with having sheltered during the mandates. In column (5) we further do triple interactions of Treated, Safe, and Demographics.

When comparing models, the specification in column (5) is ultimately preferred given its lower AIC estimate of 6219. There is heterogeneity in specification (5) that the averages in (2) mask. In particular, due to treatment status, white respondents value the safe attribute significantly if not affected by COVID (the coefficient on the interaction "White X Safe" is significant and 0.345), but the white respondents affected by COVID (in the treated group) do not value the safe attribute and have a lower marginal utility than the control group given the point estimate of "Treated X White X Safe" being -0.744. For the treated group, higher education is associated with a higher marginal utility for the safe attribute than in the control group, given the point estimate of "Treated X Education X Safe" of 0.527.

5   Willingness to Pay (WTP)

Dividing the marginal utilities of product attributes on average and interacting with respondents characteristics and treatment status by the absolute value of the marginal utility of price yields a data set of estimated willingness to pay (TWP) for all respondents. We relate WTP to observable characteristics in a series of graphical correlations next and estimate a multivariate linear regression model where the dependent variable is the respondent j WTP_j and the explanatory variables are the characteristics of the respondent j.

5.1 WTP for Sustainability in the Form of the Greener Alternative for the Treated Group Relative to the Control Group

Dividing the Treatment average marginal utility parameter 0.22 in Table 5 column (1) by the absolute value of the price (measured in US Dollars) marginal utility parameter 0.54 yields an average willingness to pay for the Greener alternative of the treated group relative to the control of 0.22/0.54 = 0.40. This means that the treated group is willing to, on average, pay 40 cents more than the control group for the greener alternative (5 cents more when re-weighting individual WTP to be more representative of California's demography). There is, however, considerable heterogeneity in the estimates that range from a negative WTP of −2.3 dollars to over 2 dollars.[5]

Figures 1 and 2 show the marginal correlations between the differential WTP between Treated and Control Groups against a series of respondents' characteristics. The first Figure 1 focuses on demographics and the second Figure 2 shows correlations among environmental score, pandemic score, COVID-19 score, and whether respondents choose carbon tax options over plant based alternatives.

The top left panel of Figure 1 shows a positive relationship between the differential Treatment WTP and respondents' income (as shown in the fitted line added to the scatter top left panel). The top right panel shows that the average differential treatment willingness to pay for College educated is significantly higher than for those with less than a college education. In the bottom left panel we find that there appears to be no significant correlation between the differential treatment WTP and age categories of respondents. Finally, the bottom right panel shows that the white respondents on average have a significantly lower differential treatment WTP than the non white respondents. The top right panel of Figure 2 shows that the higher the Pandemic Score (PS) the higher the estimated WTP for the greener alternative. In the bottom left panel we also show that the COVID-19 Score (CS) is positively correlated with the estimated WTP for the greener alternative. Finally, in the

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[5]See the histogram in the online appendix Figure A2.

bottom right panel we see that the WTP is significantly higher for respondents choosing the carbon taxed options.

Beyond the depicted marginal correlation in both Figures above, the variation in the differential WTP between Treated and control groups for the Greener Alternative is investigated in a multivariate linear regression model. The results are in Table 7. Being in a higher income category is significantly correlated with a higher WTP, ceteris paribus, given the point estimated 0.179 for "Respondent's Income Category." Being in a higher age category is also positively correlated with a higher WTP, with a coefficient of 0.023. White respondents have a significantly lower WTP than nonwhite respondents (point estimate -0.816). A respondent who has either a higher environmental score or has chosen the carbon taxed meat options over plant-based meat also has higher estimated WTP than those with lower ES and not having chosen the carbon taxed option, in the hypothetical survey scenario.

5.2   Willingness to Pay for Safe Working Conditions

The estimated worker safe WTP range is between a compensation of 3.46 dollars per pound to a willingness to pay a premium of 1.93 dollars per pound.[6] The average is a compensation (discount) of 70 cents per pound to choose the safe attributes and the re-weighted average is 58 cents (when re-weighting individual WTP to be more representative of Census demographics). Figures 3 and 4 show correlations between estimated WTP_i for the safe attribute and demographic characteristics of the respondents in the sample.

The top left panel of Figure 3 shows a positive relationship between the WTP and respondents' income. The top right panel shows a positively sloped relationship between the fitted values of WTP and education. In the bottom left panel we see that the fitted relationship between WTP and age is negative given the fitted line. Finally, the bottom right panel shows that the white respondents on average place a smaller value (more negative WTP) on the safe attribute than non white respondents and the difference is significant.

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[6]See the entire distribution in Figure A3 in the online Appendix.

Figure 4 breaks up the average estimated WTP for the Treated subgroup (got or a loved one got COVID) and the Control in the top left panel. We see that the COVID treated group would need a compensation of 50 cents to choose the safe attribute, which is significantly smaller than the control group who would need an average compensation over one dollar. The top right panel shows that the unemployed group also values the safe attribute more than the employed group. Similarly, in the bottom left panel, we show that the essential worker status places a higher value on the safe attribute than the non essential group, albeit both needing to be compensated to choose said attribute, as the average WTP are negative for both groups. Finally, in the bottom right panel, we break up the average WTP among respondents who could shelter-in-place during the pandemic and those that could not. We estimate that the sheltered group would need an average compensation for the safe attribute of close to 10 cents, whereas the non sheltered group would need to be offered the safe attribute at an average discount of almost a dollar and 50 cents.

Results from the multivariate linear regression model are in Table 8. On average, respondents in the treated group value the safe attribute by 40.6 cents per pound more than the control group respondents, controlling for all other covariates in the model (income, education, age, etc), a finding consistent with other survey evidence during the pandemic where 25% of consumers believe that a company's treatment of its employees has increased in importance as a buying criterion since the crisis started.[7] Income and Education have a positive and significant marginal effect on the WTP given the positive and significant coefficients on the income and education categories. Respondents who could shelter during the mandates are, on average, willing to pay 1.02 dollars more per pound for a safe attribute, than the non sheltered respondents, holding all else equal.

On average women would be willing to pay a higher premium of 7 cents per pound more than the other gender declared categories combined. White respondents also reveal a need

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[7]https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/survey-us-consumer-sentiment-during-the-coronavirus-crisis#. Similarly, an Edelman report estimates that 81% of those surveyed expect brands to "do what is right." See https://www.edelman.com/sites/g/files/aatuss191/files/2020-06/2020%20Edelman%20Trust%20Barometer%20Specl%20Rept%20Brand%20Trust%20in%202020.pdf

to being offered an average 31.4 cents per pound discount relative to non white respondents to choose the safe attribute. Finally, one more year of age decreases WTP by 1.3 cents per pound for the safe attribute. This finding is contrary to what we had found for the greener alternative for the treated relative to the control group. For the safe worker attribute, though, a respondent that is ten years younger than another would place a value of 13 cents per pound more on the safe attribute. This result is also consistent with evidence from other studies that find younger generations are motivated by such values when making purchase decisions than older ones.[8]

6   Conclusion

This paper investigates stated survey evidence on U.S. consumer's willingness to pay for more environmentally friendly food options and food produced under safer working conditions. It also uses two experimental treatments at the time of the survey implementation to estimate how willingness to pay is affected by information on how food choices impact our environment, and if COVID-19 affected consumer stated preferences. More specifically, we empirically determine if consumers would pay more for food to protect the environment and essential workers in food supply chains.

We find that, on average, there is an implied positive willingness to pay for sustainability. Moreover, when informing consumers about sustainability in the survey treatment design, this increases respondents' estimated WTP for the sustainable options significantly by about 5 cents per pound of product. Moreover we estimate heterogeneity in WTP according to demographics. In terms of worker safety, on average, respondents would have to be compensated by 58 cents per pound to choose an option featuring a safe attribute relative to the alternatives presented. Younger respondents would be willing to settle for the lowest compensation or even pay a positive premium to choose the safe attribute, while older respondents fall within the ones that dislike safe options the most. Finally, the WTP for safety

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[8]https://www.psfk.com/2017/12/psfk-launches-the-forecast-z-report.html

increases significantly among respondents who had (or a loved one had) COVID-19 as well as with income, education, and the ability to shelter in place during the mandates.

The consumer valuation estimates provide insights into the policy debate regarding how to label and present food products (Lee and Hatcher (2001)) in the U.S. and in a future of climate crises and awareness of essential workers' labor conditions. While a comprehensive cost-benefit analysis also requires data on the cost (possibly involving technological changes) in production, our findings have policy implications in that they suggest there to be at least a demand-side, market-based potential to nudge certain segments of consumers, but not all, who want to follow a more sustainable diet as well as choose products produced by workers in safer settings.

Given that there can be disparities between consumers' stated preferences and their actual purchases (Hensher and Bradley (1993)), future work should extend the experimental approach into a retail-level consumer field study—using actual choices rather than survey choices and based on a larger and more representative sample. Furthermore, future work should repeat the survey during non-pandemic years, given that the WTP estimates may be different if the analysis is performed in years where worker safety and environmental concerns are less salient.

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A   Tables and Figures

Figure 1: Willingness to Pay Estimates for the Greener Alternative and Respondents' Characteristics: Part 1/2
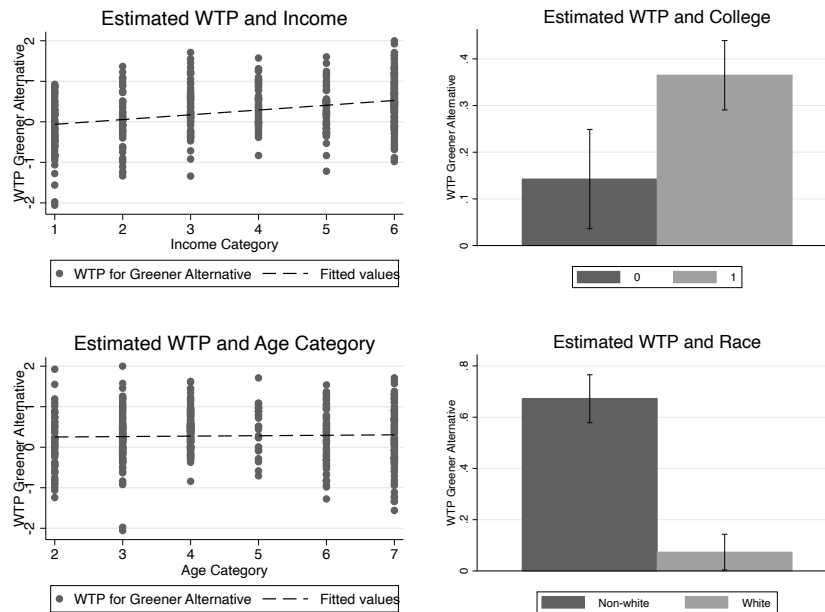
Note: This Figure depicts the Relationship between the differential WTP between the Treated and Control Groups for the Greener alternative and Respondents' income (top left), college (top right), age (bottom left) and race (bottom right) . Based on the Mixed Logit estimates in Table 5 column (2).

Figure 2: Willingness to Pay Estimates for the Greener Alternative and Respondents' Characteristics: Part 2/2
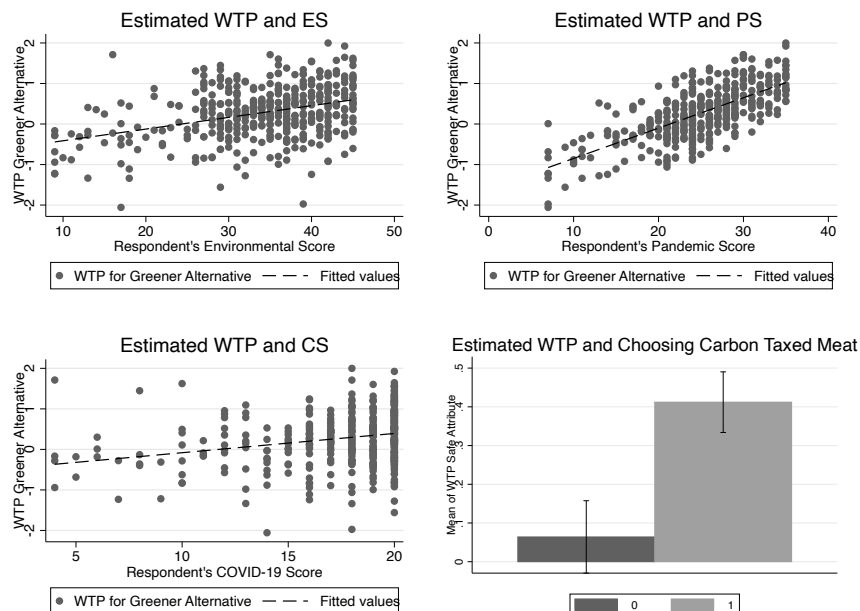
Note: This Figure depicts the Relationship between the differential WTP between the Treated and Control Groups for the Greener alternative and Respondents' Environmental Score (ES) (top left), Pandemic Score (PS) (top right), COVID Score (CS) (bottom left) and An Indicator for Having Chosen the Carbon Taxed Meat alternative instead of the Plant Based (bottom right) . Based on the Mixed Logit estimates in Table 5 column (2).

Figure 3: Willingness to Pay Estimates for Safe Attribute and Respondents' Characteristics: Part 1/2
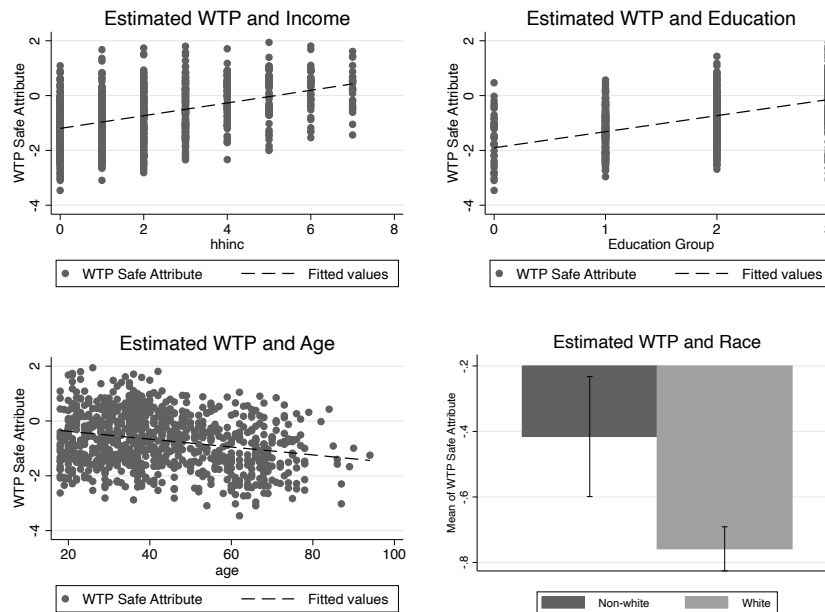
Note: This Figure depicts the Relationship between WTP and Respondents' income (top left), education (top right), age (bottom left) and race (bottom right) . Based on the Multinomial Mixed Logit estimates in Table 6 column (5).

Figure 4: Willingness to Pay Estimates for Safe Attribute and Respondents' Characteristics: Part 2/2
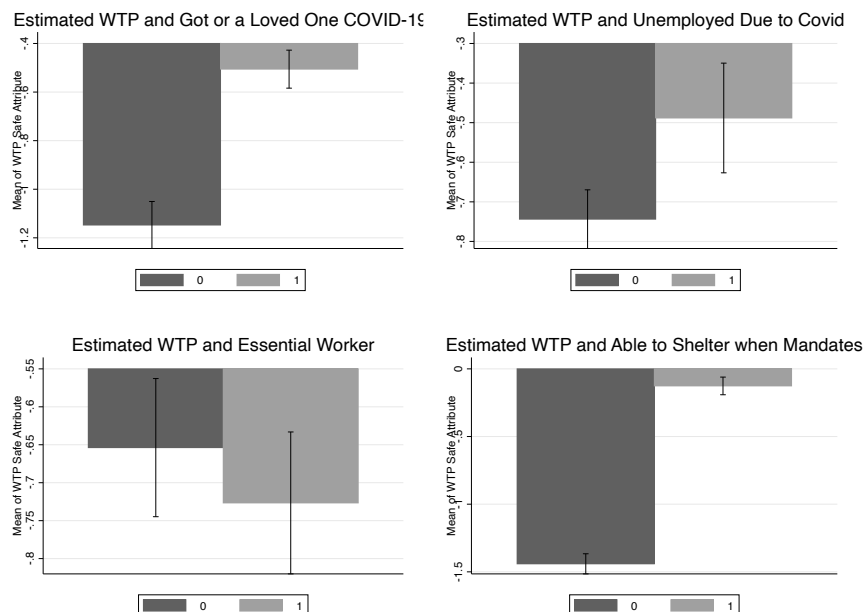
Note: This Figure depicts the Relationship between WTP and Respondents' having had (or a loved one) COVID-19 (top left), Unemployment due to the pandemic (top right), Essential Worker Status (bottom left) and Ability to Shelter during Mandates (bottom right). Based on the Multinomial Mixed Logit estimates in Table 6 column (5).

Characteristics of Respondents and CA residents

	Treated Group		Control Group		California*
	N	%	N	%	%
Female	102	48.6	108	50	50.7
Male	108	51.4	102	50	49.3
Age 18-24	22	10.5	29	13.8	6.7
Age 25-34	49	23.3	40	19	15.3
Age 35-44	54	25.7	59	26.1	13.4
Age 45-54	16	7.6	11	5.2	12.8
Age 55-64	23	11	35	16.7	12.1
65 and older	46	21.9	36	17.1	14.8
White	144	68.6	132	62.9	36.3
African American	25	11.9	26	12.4	5.5
Latino	23	11	28	13.3	39.4
Asian	13	6.2	18	8.6	14.6
Other	5	2.4	5	2.4	3.9
Income $45K or less	65	36.3	54	30.7	28.7
$50,000-$99,999	49	27.8	59	33.5	29.70
$100,000 or more	65	36.3	63	35.8	41.6
Less than some college	88	41.8	75	35.8	32.52
Associate degree, Bachelor degree	69	32.9	80	38.1	30.58
Graduate degree or more	53	25.2	55	26.2	36.89
	Average Score	Std	Average Score	Std	
Environmental Score (ES)	33.96	8.16	33.97	8.40	
Pandemic Score (PS)	25.20	6.17	24.96	6.35	
COVID-19 Score (CS)	17.78	3.12	17.40	3.60	
	%	Std	%	std	
Chose Carbon-Taxed Meat	60.00	49.01	63.33	48.21	

Table 1: Summary Statistics Survey 1 - Sustainability Survey

Note: Source Survey 1, Qualtrics implemented in the Winter of 2021. Sample size is 420 respondents.

* Source for the California Data: CA Census Fact Finder Database.

Variable	Greener Option Chosen (%)
Female	49
Male	51
18-24	50
25- 34	54
35- 44	59
45- 54	48
55- 64	40
65 and older	42
$24,999 and less	47
$25,000 - $44,999	43
$45,000 - $64,999	47
$65,000 - $89,999	59
$90,000 - $144,999	51
$115,000 and more	52
No high school diploma/GED	44
High school diploma/GED	50
Some college no degree or Associate's Degree	45
Bachelor's degree	49
Graduate's degree	58
Control	47
Treatment	53

Table 2: Frequency of Greener Option Chosen - Sustainability Survey 1
Note: Source Survey 1, Qualtrics implemented in the Winter of 2021. Sample size is 420 respondents.
* Source for the California Data: CA Census Fact Finder Database.

Variable		n	%	$\sum$%
Household income	$24,999 or less	208	23.4	37.9
	$25,000 to $44,999	205	23.0	60.9
	$45,000 to $64,999	145	16.3	77.2
	$65,000 to $89,999	135	15.2	92.3
	$90,000 to $109,999	68	7.6	100.0
	$110,000 to $139,999	59	6.6	6.6
	$140,000 to $169,999	44	4.9	11.6
	$170,000+	26	2.9	14.5
Education	No High School Diploma/GED	37	4.2	75.2
	High School Diploma/GED	212	23.8	57.3
	Trade-school/Certificate/Professional License	20	2.2	100.0
	Some College	201	22.6	97.8
	Associates Degree	105	11.8	11.8
	Bachelor's Degree	193	21.7	33.5
	Masters Degree or PhD	122	13.7	71.0
Race_Ethnicity	White	735	82.6	100.0
	Asian	29	3.3	3.8
	Black or African American	75	8.4	12.8
	Hispanic or Latino/a	34	3.8	16.6
	Middle Eastern or North African	4	0.5	17.1
	American Indian or Alaska Native	5	0.6	0.6
	Native Hawaiian or Pacific Islander	2	0.2	17.3
	Bi-Racial or Multi-Racial	5	0.6	4.4
	Other	1	0.1	17.4
Gender ID	Female	581	65.3	65.3
	Male	296	33.3	98.5
	Trans or Non Binary	9	1.0	100.0
	Prefer not to say	4	0.5	99.0
Job/Main Activity	Administrative work	86	9.7	9.7
	Business Owner	52	5.8	15.8
	Professional or Technician	147	16.5	53.0
	Service and/or sales worker	68	7.6	76.5
	General Labor	77	8.7	24.5
	Skilled agricultural, forestry and fishery worker	9	1.0	77.5
	Armed Forces	3	0.3	10.0
	Retired	141	15.8	68.9
	Stay-at-home Parent	79	8.9	86.4
	Student	42	4.7	91.1
	Unemployed	79	8.9	100.0
	None of these	107	12.0	36.5
	Unemployed due to COVID-19	182	20.4	
	Self Classify as Essential Worker	379	42.6	
	Were Able to Shelter in Place during Mandates	504	56.6	
	Were (or a loved one) infected with COVID-19	625	70.2	
N	Number of Observations	890		

Table 3: Sample Demographics - Worker Safety Survey

Note: Source Survey responses of Email Survey implemented by Alchemer during the Winter of 2021. The respondents were sampled from states affected by or near meat plant COVID-19 outbreaks in 2020: Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Montana, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin. See the Appendix for a comparison of Sample and State level Demographics.

Products	Alternatives	Control Group			Treated Group			All Respondents		
		n_0	$\%_0$	$\sum \%_0$	n_1	$\%_1$	$\sum \%_1$	n_{all}	$\%_{all}$	$\sum \%_{all}$
Bacon Choice	0	45	17.0	17.0	54	8.6	8.6	99	11.1	11.1
	1	111	41.9	58.9	241	38.6	47.2	352	39.5	50.7
	2	85	32.1	91.0	219	35.0	82.2	304	34.2	84.8
	3	24	9.1	100.0	111	17.8	100.0	135	15.2	100.0
	Sum	265	100.0		625	100.0		890	100.0	
Chicken Choice	0	27	10.2	10.2	21	3.4	3.4	48	5.4	5.4
	1	109	41.1	51.3	221	35.4	38.7	330	37.1	42.5
	2	90	34.0	85.3	235	37.6	76.3	325	36.5	79.0
	3	39	14.7	100.0	148	23.7	100.0	187	21.0	100.0
	Sum	265	100.0		625	100.0		890	100.0	
Ground Beef Choice	0	30	11.3	11.3	37	5.9	5.9	67	7.5	7.5
	1	106	40.0	51.3	233	37.3	43.2	339	38.1	45.6
	2	90	34.0	85.3	222	35.5	78.7	312	35.1	80.7
	3	39	14.7	100.0	133	21.3	100.0	172	19.3	100.0
	Sum	265	100.0		625	100.0		890	100.0	

Table 4: Alternative Chosen for each Animal meat by COVID-19 Affected (Treated) Group

Note: Source Survey responses of Email Survey implemented by Alchemer during the Winter of 2021. Sample of 837. Treatment Group: Individuals personally infected with COVID-19 or with close Loved One infected with COVID-19. Alternative Choice: Safer Choice=2,3 Not Safer Choice=0,1.

	Likelihood of Choosing the Greener Choice	
	(1)	(2)
Price	-0.54***	-0.59***
	(0.06)	(0.07)
Env Score	0.04***	0.04**
	(0.01)	(0.02)
Pandemic Score	0.05***	0.03
	(0.02)	(0.02)
Covid Score	-0.02	-0.02
	(0.03)	(0.04)
Treatment	0.22*	-1.00
	(0.13)	(0.99)
White		-0.05
		(0.23)
Income		-0.03
		(0.06)
Age		-0.05
		(0.06)
Chose Carbon Taxed Meat		-1.40***
		(0.20)
Treatment X Env Score		-0.01
		(0.03)
Treatment X Pandemic Score		0.05
		(0.03)
Treatment X Covid Score		-0.01
		(0.06)
Treatment X White		-0.49
		(0.31)
Treatment X Age		0.02
		(0.09)
Treatment X Income		0.08
		(0.08)
Treatment X Chose Carbon Taxed Meats		0.23
		(0.28)
Constant	-2.00***	0.06
	(0.45)	(0.72)
Observations	2,100	2,100
Log Likelihood	-729	-675
Akaike Inf. Crit.	1,479	1,393

Table 5: Mixed Logit Choice Model Regression Results
Note: Robust standard errors in parentheses. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. The table displays the estimates of mixed Logit specifications with interactions of respondents' Treatment and Demographics. The dependent variable is equal to one if the greener product is chosen and equal to zero otherwise. The estimated parameters represent Marginal Utilities. Robust standard errors in parentheses. Source Authors' calculations.

	(1)	(2)	(3)	(4)	(5)
Constant	3.485***	3.096***	3.792***	4.094***	4.123***
	(0.310)	(0.322)	(0.439)	(0.503)	(0.506)
Price	-0.424***	-0.431***	-0.448***	-0.502***	-0.506***
	(0.060)	(0.061)	(0.061)	(0.066)	(0.066)
Safe	-0.222***	-0.454***	-0.558***	-0.909***	-0.570*
	(0.046)	(0.079)	(0.181)	(0.212)	(0.333)
Treated		0.704***	0.730***	0.721***	0.613***
		(0.154)	(0.159)	(0.173)	(0.175)
Treated X Safe		0.329***	0.243***	0.179*	-0.231
		(0.090)	(0.093)	(0.097)	(0.413)
Income			0.088*	0.039	0.040
			(0.048)	(0.051)	(0.051)
Income X Safe			0.065***	0.049*	0.045
			(0.024)	(0.025)	(0.049)
Age			-0.001	0.005	0.005
			(0.005)	(0.005)	(0.005)
Age X Safe			-0.008***	-0.006**	-0.008
			(0.003)	(0.003)	(0.005)
Education			-0.397***	-0.440***	-0.405***
			(0.097)	(0.108)	(0.109)
Education X Safe			0.266***	0.226***	-0.142
			(0.052)	(0.055)	(0.098)
White			0.691***	0.404*	0.362
			(0.193)	(0.219)	(0.221)
White X Safe			-0.213*	-0.159	0.345*
			(0.116)	(0.122)	(0.207)
Female			-0.658***	-0.696***	-0.671***
			(0.180)	(0.195)	(0.196)
Female X Safe			0.001	0.039	-0.179
			(0.088)	(0.091)	(0.166)
Sheltered				-0.113	-0.110
				(0.176)	(0.177)
Sheltered X Safe				0.769***	0.985***
				(0.091)	(0.168)
Essential Worker				0.732***	0.721***
				(0.192)	(0.193)
Essential X Safe				-0.111	0.165
				(0.094)	(0.171)
Treated X White X Safe					-0.744***
					(0.249)
Treated X Education X Safe					0.527***
					(0.116)
Num of Obs.	10764	10764	10716	10284	10284
Log Likelihood	-3410.357	-3385.239	-3308.687	-3098.008	-3080.672
AIC	6827	6780	6647	6238	6219

Table 6: Multinomial and Mixed Multinomial Logit Choice Model Regression Results
Note: Robust standard errors in parentheses. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. The table displays the estimates of a multinomial Logit (column 1) regression, and of a multinomial mixed Logit regression (columns 2, 3, 4, and 5) where we interact the safe attribute with interactions of respondents' Treatment and Demographics. The dependent variable is equal to one if an alternative among four is chosen and equal to zero otherwise. Column (5) displays only the significant interactions with "Treated" status, due to space (not included are interactions with income, age, female, shelter, essential, and unemployed due to COVID-19. Source Authors' calculations.

	(1) Mixed Logit WTP for Greener alternative for the Treated Relative to the Control Group
Respondent's Income Category	0.179***
	(0.012)
Respondent's Age Category	0.023**
	(0.012)
Respondent is White	-0.816***
	(0.044)
Respondent's Environmental Score	0.029***
	(0.002)
Chose Carbon Taxed Meat	0.358***
	(0.038)
Constant	-1.180***
	(0.115)
Num of Obs.	420
R squared	0.644

Table 7: Regression of Respondents' Mixed Logit WTP Estimates for the Greener Alternative on Respondents' Characteristics

Note: Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. The dependent variable is each respondents' estimated implied Willingness to Pay (WTP) for the Greener alternative from the mixed Logit estimates Table 5 column (2). The estimated parameters represent the correlation between the WTP and each variable controlling for the other variables in the multivariate linear regression. Source Authors' calculations.

	Mixed Multinomial Logit WTP for Safe Attribute
Respondent Got or a Loved One COVID-19	0.406***
	(0.049)
Respondent's Income Category (coded as 1 to 8)	0.098***
	(0.009)
Respondents' Education Category (coded as 1 to 4)	0.439***
	(0.030)
Respondent's Age	-0.013***
	(0.001)
Respondent is a Female	0.070*
	(0.037)
Respondent is White	-0.314***
	(0.063)
Respondent is an Essential Worker	-0.222***
	(0.041)
Respondent could Shelter during Mandates	1.016***
	(0.038)
Respondent became Unemployed due to the Pandemic	0.018
	(0.038)
Constant	-1.813***
	(0.099)
Num of Obs.	857
R squared	0.761

Table 8: Regression of Respondents' Mixed Multinomial Logit WTP Estimates on Demographics

Note: Robust standard errors in parentheses. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$. The dependent variable is each respondents' estimated implied Willingness to Pay (WTP) for the Safe Workers' Attribute from the multinomial mixed Logit estimates Table 6 column (5). The estimated parameters represent the correlation between the WTP and each variable controlling for the other variables in the multivariate linear regression. Source Authors' calculations.