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Willingness to pay for COVID-19 environmental health risk reductions in consumption: Evidence from U.S. professional sports*

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Willingness to pay for COVID-19 related environmental health risk reductions in consumption: Evidence from U.S. professional sports

Abstract: The COVID-19 pandemic caused substantial economic changes. The airborne transmission of the coronavirus increased the environmental health risks associated with many activities that entailed little risk in the pre-pandemic period, including workplace risks and risks faced by consumers. While a large literature estimates local tradeoffs between money and reduced risk of negative health outcomes in many settings, little empirical evidence addresses consumer willingness to pay for reduction in environmental health risks associated with coronavirus transmission. We estimate professional sports fans' willingness to pay (WTP) for reduced likelihood of coronavirus infection through mask and social distancing policies at games using a stated preference approach. Regression results based on a latent class logit model using survey data collected from 1,391 fans of professional sports teams in five large U.S. metropolitan areas indicate increased attendance likelihood if the venue requires masks and limits attendance to below capacity. Latent class logit models indicate significant heterogeneity in WTP across risk scenarios and sports. We characterize the types of professional sports fan as casual fans who prefer a mask requirement but are indifferent to stadium and arena capacity, rabid fans who are anti-maskers and indifferent to capacity and fans who only have a positive WTP when there is a mask requirement and low stadium/arena capacity (i.e., opportunities for the greatest amount of social distancing).

Keywords: Discrete choice experiment; Stated preferences; Willingness-to-pay; Environmental health risk

JEL Codes: I12, M31, Q51, Z20

Introduction

The 2020 COVID-19 pandemic generated widespread, substantial impacts throughout the economy. Environmental health risks increased substantially because of the pandemic. Many widely purchased consumer goods and services that entailed little pre-pandemic environmental health risk, for example eating in a restaurant, going to a concert, or attending a sporting event, suddenly posed much larger environmental health risks due to the airborne spread of the virus.

A large literature exists valuing environmental health risks (Viscusi and Dalafave 2021). Valuation of environmental health risks employs both revealed preference and stated preference methods. Stated preference methods estimate willingness to pay for small reductions in specific environmental health mortality and morbidity risks like reductions in risk of respiratory and cardiovascular disease through environmental policies (Blomquist, Dickie and O'Conor, 2011), reduction in risk of gastrointestinal illness through improved drinking water quality (Adamowicz, Dupont, Krupnick and Zhang 2011), or reduction in risk of illness from consuming raw shellfish through post-harvest processing regulations (Whitehead, Morgan, Huth, Martin, and Sjolander 2020). These studies estimate the local rate of substitution between money or wealth and a reduction in the probability of experiencing a negative health outcome.

Recent research shows a substantial impact of the COVID-19 pandemic on the valuation of environmental health risks (Hammitt 2020). However, no evidence currently exists on the willingness to pay for reductions in environmental health risks for relatively riskless consumer goods and services made risky during the COVID-19 pandemic. This paper estimates consumer willingness to pay (WTP) for reductions in health risks from attending professional sporting events, a popular consumer good available in cities around the world.

This represents an interesting setting for estimating WTP for environmental health risk reductions. Millions of consumers attended professional sporting events each year in the pre-pandemic economy, providing wide experience with a formerly low risk consumer purchase. Detailed information exists on the price/WTP for attendance pre-pandemic, providing a convenient benchmark for WTP for pandemic related health risk reduction. Focusing on consumers who expect to attend games mitigates the public good aspect of health risk reduction policies in other settings. Inexpensive masking and social distancing policies can generate substantial reductions in the likelihood of infection, reducing some of the income effects that influence WTP estimates for large reductions in environmental health risks in other settings. We analyze attendance at multiple professional sporting events with distinctly different characteristics, allowing for an analysis of heterogeneity in WTP.

We estimate WTP for environmental health risk reductions at professional sporting events, based on survey data from a sample of 1391 residents of five large US metropolitan areas who expected to attend a professional football, basketball, baseball, ice hockey, or soccer game when fans return to games. We conduct a discrete choice experiment with variation in multiple attributes under several hypothetical scenarios and asked whether they would be willing to buy a ticket for a game under stated conditions, including ticket prices and two alternative environmental health risk reduction policies. The results from latent class logit models show that the requirement of wearing a mask and reducing seating capacities increased the likelihood of attendance. Ticket price had the predicted negative relationship with attendance.

These estimates, when converted into monetary estimates, indicate substantial fan WTP for reductions in environmental health risks with patterns similar to those in the existing literature. WTP based on a 25% facility seating capacity policy and no mask requirement was about one standard deviation below the pre-pandemic WTP (average ticket price) for one latent class, substantially larger, about two standard deviations above the pre-pandemic WTP for the second class and zero for the third class. Estimated WTP for reduced environmental health risks through mask requirements were similarly large in two of the three classes. The results indicate substantial heterogeneity in WTP across latent classes and sports. NBA fans had the highest WTP, likely reflecting the fact that all NBA games occur indoors.

We contribute to the literature by developing the first empirical estimates of WTP for environmental health risk reductions for a popular consumer good impacted by the pandemic. In the spirit of the approach used by Cameron and DeShazo (2013), we focus on generic risk reduction policies -- social distancing in the form of reductions in venue seating capacity and masking requirements -- so our results likely apply to other pandemic affected consumer goods like eating and drinking in restaurants and bars, attending concerts, and going to the movies. In contrast, Oreffice and Quintana-Domeque (2020) estimate WTP for personal protective devices like masks and gloves.

The paper also contributes to the growing literature analyzing the impact of the COVID-19 pandemic on sporting events (Singleton, Bryson, Dolton, Reade, and Schreyer 2021). A large literature estimates willingness to pay for sporting events (Orlowski and Wicker 2019). Early evidence suggests attending sporting events facilitated the spread of COVID-19 (Ahammer, Halla, and Lackner 2020; Olczak, Reade, and Yeo 2020; Fischer 2021), and other evidence links sporting events to the spread of seasonal influenza (Stoecker, Sanders and Barreca 2016; Cardazzi, Humphreys, Ruseski, Soebbing, and Watanabe 2020). The evidence developed here places the environmental health risks of attending sporting events in the post-pandemic economy in context and can help inform policy makers facing difficult decisions about how to trade off demands by sports leagues, teams, and fans to reopen games and the health risks from attending games, a key issue identified by Viscusi (2020).

Survey Methods and Data

Data collection used an online Qualtrics questionnaire. The survey targeted fans of professional sports teams in the Chicago, Dallas, Los Angeles, Miami and New York City metropolitan areas, five metropolitan areas home to the largest number of professional sports teams in the US. The survey ran from August 24 to September 12, 2020. During this period Major League Baseball (MLB) played games with no fans in attendance, the National Football League (NFL) played preseason games with no fans in attendance, and the NFL played a single regular season game on 10 September at 22% capacity (16,000 fans) in a metropolitan area outside our sample, Kansas City. Survey participants likely had no experience attending games or watching games with fans in attendance on television in the pandemic era.

The survey employed target quotas in gender (50/50 male-female), age (18-34, 30.5%, 35-54 34.4%, 55+ 35.2%) and race (62.3% non-Hispanic white, 12.4% non-Hispanic black, 17.3% Hispanic and 8% Asian/other). 3682 people responded to the survey and answered some socioeconomic questions. The average respondent age was 47. Sixty percent of respondents were white and forty-three percent male. Twenty-nine percent were married with an average household size of 2.79. The average number of years of schooling was 15. Fifty-six percent were employed with an average household income of $91,000.

Survey Screening

A screening question identified respondents who attended a professional team sports game or match played in any of seven professional leagues in one of the five sample cities closest to their home prior to the start of the pandemic. The leagues included Major League Baseball (MLB), Major League Soccer (MLS), the National Basketball Association (NBA), the National Football League (NFL), the National Hockey League (NHL), the National Women's Soccer League (NWSL) and the Women's National Basketball Association (WNBA). Of the 3682 total respondents, 3042 answered the screener question.[1] Fifty-nine percent of those who answered the screener question had attended a professional sports game or match and are eligible for the remainder of the survey (n=1819). The pool of eligible respondents who had attended a professional sports game or match included those who were not married, more males, more young people, people with more education, those employed and with higher incomes. Household size and race were not factors that affected attendance.

Of this sample we excluded 428 respondents for various reasons including item nonresponse on key variables and data quality problems. Twenty-one respondents were dropped because they did not plan to attend a game in the future (7 of these did not answer the question). We dropped the respondents who stated that they would next attend a game in the two women's leagues. Only 21 respondents stated that they would next attend a game in the NWS yielding a

[1] Eight percent of the sample (n=285) were not presented the screener question because they did not live in one of the five sample cities. We assume that the 640 respondents who did not answer recognized the screener question as such and did not answer because they were not eligible.

sample too low for analysis. Two-hundred and nine respondents stated that they would attend a game in the WNBA but only 6 of these has most recently attended a game in that league. For the men's leagues, at least 66% of those who would attend a game in that league had most recently attended a game in that league. Forty-three responses were dropped because they did not answer questions about the typical price they pay for a ticket and the number of miles and minutes that it takes for them to get to the stadium or arena.

A number of respondents were dropped from the analysis because they did not pass additional quality screens, a known problem with opt-in panel data (Kennedy et al. 2020). Sixty-four respondents were dropped because they provided unreliable responses to questions about the number of miles they lived from the stadium or arena and the number of minutes it took for them to get to the stadium or arena from their home. Before these respondents were dropped the correlation between miles and minutes was $r=-0.001$. After dropping these respondents the correlation is $r=0.38$ ($p < 0.0001$). We asked respondents a question about the number of games they typically attend and several open-ended questions about the number of games that they expect to attend in the next season under different circumstances. Sixty-eight of these respondents provided a number greater than the number of home games and are dropped. Finally, we drop 12 additional respondents who did not answer the questions about mask use and their intentions about getting the Covid-19 vaccine. These decisions leave a sample of n=1381 for analysis.

Table 1 contains summary statistics for the final analysis sample (n=1381). The average average household income was $99,000 and age was 46. Forty-nine percent were male and sixty percent were white. Twenty-eight percent were married with an average household size of 2.90.

The average number of years of schooling was 16. Sixty-five percent of the sample reported being employed.

Respondents were then asked questions about the typical game or match that they attend. The typical number of games attended in a season is 4.6, the typical ticket price is $67 and the typical size of the party that attends games is 3.7. Twenty-one percent are season ticket holders. The average distance to the stadium or arena is 27 miles and the trip takes an average of 62 minutes. Thirty-six percent of respondents describe their typical seats as "very good" and 42% describe them as "good".

The discrete choice experiment focused on the decision to attend a game in the future. Forty-seven percent expected to attend a MLB game, 19% an NFL game, and 18% an NBA game. Only 7% and 8%% expect to attend an MLS or NHL game. Twenty-three percent of these respondents reside in the Chicago area, 20% are in Dallas, 23% are in Los Angeles, 15% are in Miami and 19% are in New York City.

COVID-19 Experiences

Respondents were also asked about their experience with the COVID-19 pandemic. Sixty-one percent had been following the news about COVID-19 "very closely." Sixty-seven percent were "very concerned" about the effects of the pandemic on the economy and 45% were very concerned about their own finances. Sixty-one percent were "very concerned" about the spread of COVID-19 in their home city. At the end of the survey respondents are asked about their behavior related to COVID-19. Seventy-eight percent report wearing face masks "always" during the past week. Forty-four percent are “extremely likely” to get a COVID-19 vaccine.

Discrete Choice Experiment

The survey presented respondents with several detailed scenarios describing specific game attendance conditions: “In the next several questions we are going to ask you about whether or not you would buy a ticket and plan to attend a [MLB / MLS / NBA / NFL / NHL] game in [Chicago / Dallas / Los Angeles / New York / Miami].” The survey then described a detailed situation that would exist inside the venue and instructed respondents that no vaccine for COVID-19 would be available when they attend[2], that they should consider their typical seat quality in the venue, that they will attend the game with the number of people in their usual party size, and that they should expect the home team to win.

The survey then specified detailed attendance characteristics in terms of mask policy in place, facility capacity, and ticket price paid. The mask policy described was: “The stadium may require that you wear a cloth mask over your nose and mouth. If the game is played in an outdoor stadium you must wear the mask when you are not able to social distance (in other words, stay 6 feet apart from people who are not in your seating area).” Stadium capacity was described as: “Due to social distancing policy, the number of tickets sold will be [10% / 25% / 50%] of stadium capacity. This will allow for social distancing because the available seats will be spread out.” The ticket price is described as “You have been offered a ticket, or block of tickets for the number of people you typically attend a game with, from a reseller or acquaintance. The price of

[2] The Pfizer-BioNTech, Moderna, and Johnson & Johnson COVID-19 vaccines were approved for emergency use in the U.S. in late 2020 and early 2021 but herd immunity is not expected to be reached until late Fall 2021 at the earliest.

each ticket will range from $Minimum to $Maximum."[3] Then respondents are told that "In each situation you will be asked if you would buy the ticket(s) that have been offered to you." Table 2 summarizes the scenarios presented in the discrete choice experiment.

The experimental design included five ticket price levels tailored to each league playing games in the five sampled metropolitan areas, based on the observed distribution of average ticket prices in the 2018 and 2019 seasons (Table 3). We calculated the mean and standard deviation of ticket prices in each league based only on the average ticket prices charged by teams playing in the sampled metropolitan areas. Respondents in a pretest of 378 respondents from the Qualtrics panel were presented with the mean league-specific ticket price and plus and minus one and two standard deviations rounded to the nearest final 0 or 5 digit. This pretest suggested that responses to the lowest ticket price listed were non-informative so we replaced the minus two standard deviation price with the mean price plus three standard deviation price for each league.[4]

This set-up produced an experimental design with 24 discrete choices organized into 6 blocks of 4 elements each. Each respondent received one of the six blocks of questions. Efficient design elements, including the total number of choices, attribute levels for each choice, and the specific blocking of the final design, were determined using efficient design macros in SAS

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[3] The survey asked "How closely did you read these instructions?" Eighty-six percent answered "very closely," 14% answered "somewhat closely" and less than 1% answered "not very closely".

[4] We also conducted a pretest with 159 respondents attracted through a Facebook ad to test whether the Qualtrics programming was free of major mistakes. The pretest observations were not included in the final data set.

(Kuhfeld 2003). The estimated D-efficiency of this experimental design was 98%.

The survey asked respondents "would you buy the ticket in this situation?" This question used three possible responses: "yes", "no" and "don't know." Overall, 49% responded "yes", 43% "no", and 7% "don't know." We combined the "no" and "don't know" responses for the empirical analysis. Table 4 summarizes respondents' attendance intentions for each league. [5] Slightly more than 60% of the respondents overall chose to attend a game at the minimum and mean ticket price. The percentage of "yes" responses were 44%, 41% and 32% at one, two and three standard deviations above the mean ticket price. "Yes" responses fell as the offered ticket price increased, as predicted, in each league ($p < 0.01$). Environmental health risk reduction policies mattered. 60% of respondents predicted attendance under a required mask policy ($p < 0.01$). 56%, 48% and 43% of the respondents predicted attendance at 10%, 25% and 50% venue capacity restrictions respectively. These differences are statistically significant at the p=0.01 level in MLB and the NFL, statistically significant at the p=0.10 level in the NBA and NHL and not statistically different in the MLS.

Attribute non-attendance and respondent certainty represent two important issues for the validity of stated preference questions. In terms of attribute non-attendance, respondents were asked "When you were answering the hypothetical questions about buying tickets how closely did you pay attention to the different parts of each situation?" Sixty-eight percent, 88% and 73%

[5] After the set of discrete choice questions described here, the questionnaire also included a section where respondents were asked the total number of games in a season that they expected to attend under different mask and capacity scenarios. These responses will be analyzed in future research.

of respondents answered "very closely" to the price, mask and capacity attributes.[6] Respondents were also asked how certain they were when they answered the hypothetical questions. The question was framed by a scale that ranged from zero ("not very certain") to 100 ("very certain") with the middle described as "somewhat certain." The mean certainty response is 80 with a median of 85 and a mode of 100.[7]

Empirical Analysis

We first develop a model motivating the empirical analysis. Consider the indirect utility derived from the purchase of a single unit of a risky consumer good. Suppose that $v(p, y, r)$ represents an indirect utility function decreasing in price, p, increasing in income for normal goods, y, and decreasing in an exogenous health risk, r

$$v(y - WTP, r) = v(y - p, r = 0)$$

where WTP is the willingness to pay that makes the consumer indifferent between purchasing the product and being exposed to the environmental health risk and not purchasing. If the price is a randomly assigned dollar amount, A, then the consumer problem becomes

[6] Stated and inferred attribute non-attendance issues lie outside the scope of this paper. Future research will estimate models analyzing attribute non-attendance issues along the lines of Lew and Whitehead (2020).

[7] The certainty question was framed as a scroll bar where respondents could drag the cursor to provide their certainty level on a continuous scale. The starting point for the cursor was randomly assigned at 0, 50 or 100. The conditional mean of certainty from a regression is 82. The starting point of 0 reduces the mean by 2.76 (p=0.04). There is no difference between the certainty values with starting points of 50 and 100.

$$v(y - A, r) \gtreqless v(y)$$

where $p = r = 0$ is suppressed on the right-hand side of the inequality.

The consumer will choose to purchase the product if $WTP \geq A$. Suppose that indirect utility is random with mean zero error term, $v(y, p, r) + \varepsilon$. The probability that the product will be purchased is

$$\Pr(purchase = 1) = \Pr\left(\Delta v + \varepsilon^* \gtreqless 0\right)$$

where $\Delta v = v' - v^o = v(y - A, r) - v(y)$ and $\varepsilon^* = \varepsilon' - \varepsilon^o$. If the utility function is linear in income and risk, $v = \beta_0 + \beta_1(y - A) + \beta_2 r + \varepsilon$, $\beta_0 > 0$, $\beta_1 > 0, \beta_2 < 0$, then

$$\Delta v = \beta_0 + \beta_1(y - A) + \beta_2 r + \varepsilon' - (\beta_1 y + \varepsilon^o)$$

$$\Delta v = \beta_0 - \beta_1 A + \beta_2 r + \varepsilon^*$$

As the price increases the change in utility is negative, $\frac{\partial \Delta v}{\partial A} = -\beta_1 < 0$, and the consumer is less likely to purchase the product. As the health risk increases, $\frac{\partial \Delta v}{\partial r} = \beta_2 < 0$, the consumer is less likely to purchase the product.

Willingness to pay is estimated by setting $\Delta v = 0$ (and $\varepsilon^* = 0$) and solving for A:

$$WTP = \frac{\beta_0 + \beta_2 r}{\beta_1}$$

A policy designed to decrease the health risk, $\Delta r = r' - \bar{r} < 0$, where $\bar{r}$ is baseline risk, will lead to an increase in the willingness to pay for the product.

We estimate the utility function parameters using a binary logit model. Preference heterogeneity may be important in this setting. We account for preference heterogeneity using a latent class model containing separate fixed parameter vectors estimated over $c > 1$ consumer classes (Hensher, Rose & Greene 2015):

$$\Pr(\Delta v > 0) = \sum_c \frac{\exp\,(\boldsymbol{\beta_c}' x_{it})}{1 + \exp\,(\boldsymbol{\beta_c}' x_{it})}$$

where $i = 1, \ldots, 1381$ individuals and $t = 1, \ldots, 4$ choice questions. We allow the constant term, β_0, to vary across different game attendance characteristics in each consumer class. We also interact attributes in the choice experiment with professional league indicator variables in order to investigate heterogeneity across sports. In this model the constant term represents the numerator in the WTP equation with the baseline risk (no mask policy, 25% capacity):

$$WTP|mask = 0, capacity = 25\% = \frac{\beta_0 + \beta_2 \bar{r}}{\beta_1}$$

The change in willingness to pay with an attendance policy change is

$$\Delta WTP = \frac{\beta_2 \Delta r}{\beta_1}$$

The standard errors are estimated using the Delta method (assuming symmetric confidence intervals).

Results

Table 5 contains results for a 3-latent class binary logit attendance demand model.[8] The price attribute enters the model as a level. The mask variable is binary with mask = 1 if there is a mask policy in place and mask = 0 if there is no mask policy present. The three facility capacity level variables enter into the model as two dummy variables, capacity = 10% and capacity = 50%, with capacity = 25% the omitted category. In initial models, each of the attribute variables are interacted with a binary variable equal to 1 for the professional sports league that the consumer is in the hypothetical market for. The main effects for the attribute coefficients are for MLB. The interaction effects test for differences between the MLB and the other leagues. We find no statistically significant differences across league for the mask and capacity attributes once we estimate the 3-class model and exclude those from the model. There is a 47% chance that consumers will be in class 1, a 27% that consumers will be in class 2 and a 26% chance of falling in class 3. Statistical significance is at the p=0.05 level unless otherwise noted.

Prices have the expected effects on attendance. In all but one case, MLS in class 3, the effect of ticket prices on the probability that the respondent would purchase the ticket is negative. The effect of a mask policy on attendance is positive and statistically significant for most respondents. The likelihood that a fan will attend a game increases under a mask policy in classes 1 and 3 but decreases in class 2. There is some evidence that consumers prefer lower stadium and arena capacity. Consumers in classes 2 and 3 are more likely to attend if stadium/arena capacity is 10% relative to 50%. Consumers in class 3 are more likely to attend if

[8] All models were estimated using NLOGIT (www.limdep.com). The 3-class model statistically outperformed the 2-class model according to the AIC statistic.

stadium/arena capacity is 25% relative to 50%.

Restricting the main effect price coefficients in classes 1 and 2 to be equal results in an inferior model based on a likelihood ratio test (χ^2=19.94 [1 df]). An additional restriction for class 3 is marginally significant (χ^2=3.56 [1 df], $p < 0.10$). Class 1 and 3 consumers exhibit significantly more price sensitivity than class 2 consumers. We interpret this as reflecting the idea that class 1 and 3 consumers view attending a game as an entertainment activity with many other local substitutes, while class 2 consumers exhibit more attachment to the team and the game day experience and see other local entertainment options as weak substitutes.

Class 1 consumers are less sensitive to ticket prices in the MLS, NFL, NBA and NHL relative to MLB. Class 2 consumers are less sensitive to ticket prices in the NBA and the NFL relative to MLB. Class 3 consumers are less sensitive to ticket prices in the NFL, NBA and NHL relative to MLB. Class 3 consumers have a positive ticket price coefficient for the MLS. Class 3 consumers are more likely to purchase a ticket under a policy requiring mask wearing relative to class 1 (χ^2=14.96[1 df]). Consumers in class 3 have stronger preferences for low facility capacity, as determined by social distancing policy, relative to those in class 2 (χ^2=21.36 [1 df]).

We estimate WTP and changes in WTP for various attendance policies as described above (Table 6). When exploring differences in estimated WTP across leagues, we add the league difference in the estimated price coefficient to the denominator. The top panel on Table 6 contains the baseline WTP estimates (no mask, 25% capacity). Baseline WTP in classes 1 and 2 and for all sports are positive and statistically different from zero. The baseline WTP estimates for class 3 are not statistically different from zero because the constant is not statistically different from zero. The results also exhibit substantial heterogeneity. Baseline WTP is significantly smaller in all leagues in class 1 compared to class 2. It is smaller for MLB, the MLS and the NHL in class 2, relative to the NBA and the NFL. The baseline WTP estimate is smallest for the MLB in class 1, $14, and largest for NBA game attendance in class 2, $489.

These baseline WTP estimates reflect consumer preferences under the increased environmental health risks associated with attending games generated by the pandemic. These estimates can be compared to WTP to attend games in the pre-pandemic era, as reflected by the average ticket prices for each sport in the pre-pandemic era, the 2018 and 2019 seasons, shown on Table 3. Economists typically treat professional sports teams as monopolists in the provision games played at the highest level in each sport in each metropolitan area. The price charged should reflect a monopolists' profit maximizing price based on the local demand curve, reflecting WTP.

In general, WTP for class 1 MLB, NBA, and NHL fans is greater than one standard deviation lower than pre-pandemic WTP. WTP for class 2 MLB and NBA fans is substantially higher than pre-pandemic WTP, 3 or more standard deviations higher. Again, class 1 consumers exhibit more price sensitivity, and less attachment to the game day experience than class 2 consumers, consistent with these differences in WTP.

Next consider estimated WTP for a mask policy aimed at reducing environmental health risks during the pandemic shown on the second panel on Table 6. The change in WTP for implementing a mask policy is an estimate of the value of a risk reduction, $r' < \bar{r}$. The change in WTP estimates are positive and statistically different from zero among class 1 and 3 consumers, except for MLS fans in class 3 which is not presented for reasons explained above. These professional sports fans place a positive value on mask policies. The WTP estimates in class 1 are all more than double compared to the baseline estimates on the top panel of Table 7. The WTP estimates in class 3 increase from zero without a required mask policy to more than two standard deviations above the mean ticket prices in table 3 for the MLB, NBA, NFL and NHL.

In contrast, sports fans in class 2 can be described as anti-maskers. Willingness to pay falls by 32% in each league in class 2 with a required mask policy. Willingness to pay in classes 2 and 3 are not significantly different in the MLB, NBA and NFL with a required mask policy when the constant is included to estimate total WTP.

We next explore WTP for stronger social distancing policies that take the form of lower facility capacity limits. The change in fans' WTP for a reduction in stadium capacity to 10% from 25% is an estimate of the value of a risk reduction, $r' < \bar{r}$. Only fans in class 3 have preferences for capacity limits, but these WTP differences are economically significant. In class 1, the difference in WTP is equal to the mean ticket price in the MLB, the NBA, the NFL and the NHL. The change in WTP for 10% capacity is largest in the NFL and NBA, which are not statistically different. The WTP for 10% in the NFL and the NBA are statistically greater than the WTP in the NHL which is statistically greater than in MLB. The lower WTP for reductions in venue capacity below 25% relative to masking for class 3 likely reflects fan interest in sharing the experience of watching a live game with some other fans relative to the desire to maintain some social distancing to reduce the risk of virus transmission.

Finally, we develop estimates of the willingness to accept (WTA) higher environmental health risks when attending professional sporting events, in the form of weaker social distancing policies that increase facility capacity to 50%, roughly a fan in every other seat. The WTA for an increase in stadium capacity to 50% from 25% is an estimate of the value of a risk increase,

$r' > \bar{r}$. As expected, fans in class 3 require compensation to accept an increase in environmental health risk. Most of the estimates are negative and statistically different from zero. The change in WTP is largest for NFL fans in class 2, \$83.

Mask and social distancing policies are not either/or propositions. Stadiums and arenas currently permitting fans use both mask regulations and social distancing to reduce the environmental health risks for those watching live sports. The most restrictive policy in our scenarios is a mask regulation with 10% capacity. Gross WTP estimates for a single game ticket under this scenario range from lows of \$30 and \$45 in the MLB and MLS in class 1 to highs of \$412 in the NBA in class 2 and \$380 in the NFL in class 3. The least restrictive policy is no mask regulation and 50% capacity. Willingness to pay ranges from \$11 and \$16 in the MLB and MLS in class 1 to highs of \$524 and \$380 in the NBA (class 2) and NFL (class 3). Willingness to pay in the safest scenario is almost three times as large as WTP in the riskiest scenario in class 1 in each league ($p < 0.01$). The WTP estimates in the safe and risky scenarios are not statistically different in class 2. The class 3 consumers have a high WTP in the safest scenario, not statistically different than the WTP estimates in class 2, and small negative, marginally significant WTP in the risky scenario ($p < 0.10$).

Conclusions

Fans appear to place the highest value on policies that balance social distancing with preferences to have some other fans in the venue. A social distancing policy equivalent to 25% venue capacity seems to strike that balance, although this would need to be combined with a policy requiring masks.

We exploit uncertainty about future attendance policies at professional sporting events in the late summer of 2020 to facilitate a stated preference discrete choice experiment. During the summer of 2020 state COVID-19 policies were in flux and professional sports leagues generally kept fans out of games. Major League Baseball was playing games without fans, the NBA was playing games without fans in a bubble, and the NFL was playing preseason games without fans while trying to determine whether and how to open up the regular season to fans. If the NFL did allow fans, it was unclear how many they would allow to attend. Our scenarios reflect the uncertainty about whether teams would allow fans, require masks, and limit facility capacity. This uncertainty also existed in the NBA and NHL, which planned to begin their seasons early in 2021 but had not announced attendance policies. Given uncertainty about variants and herd immunity with vaccines, these scenarios remain relevant for all professional sports leagues going forward.

Our results show that some fans who plan to attend professional sporting events in the pandemic era are willing to pay substantially higher ticket prices to attend games with policies that reduce the risk of coronavirus spread relative to WTP for tickets before the pandemic. We estimate latent class models to account for heterogeneous preferences across different probabilistic groups of consumers. Substantial heterogeneity in WTP exists across fans and sports, likely reflecting differences in factors like game timing and frequency, and other game attendance characteristics.

Sports fans clearly have a positive willingness to pay for environmental health reductions, in the form of mask requirements and social distancing policies that reduce facility capacity, in the COVID-19 pandemic era. We can characterize the types of professional sports fan that existed at the time period of the survey as casual fans who prefer a mask requirement (class 1), rabid fans (i.e., high WTP) who are anti-maskers and rabid fans only when there is a mask requirement and low capacity. There is a 46% probability that a respondent will be in class 1. This class is characterized by price sensitive, casual fans (i.e., low WTP) that prefer safety in the form of a mask requirement but are indifferent towards capacity restrictions. There is a 27% probability that a respondent will be in class 2. In class 2 are the rabid fans are anti-maskers who are also indifferent to capacity. There is a 26% probability that a fan will be in class 3. These fans are not willing to pay anything unless there is a mask requirement and then are willing to pay more if there is a capacity restriction to 10%.

In general, the WTP estimates for reducing environmental health risks in this novel setting resemble existing estimates in the literature. Consumer WTP in this new risk environment resembles WTP estimates for reductions in previously analyzed negative health outcomes like respiratory disease and gastrointestinal illness (Viscusi and Dalafave, 2021). Estimated WTA a risk increase from looser social distancing policies appears smaller than WTP for risk reductions, suggesting that behavioral issues like uncertainty avoidance present in other settings also affect consumer preferences in this setting.

In future research we plan to explore models that address respondent heterogeneity. The latent class model allows preference heterogeneity for a fixed set of consumer groups. The random parameter model assumes a continuous distribution of heterogeneity across the sample. Preliminary random parameter model estimates suggest the presence of considerable heterogeneity in responses to each of the attributes. Also, we have explored “full preservation” models in the context of attribute non-attendance in this paper (Lew and Whitehead 2020). In other words, we assume that respondents do not engage in attribute non-attendance behavior. Attribute non-attendance exists if respondents ignore some attributes when making their choices which can significantly affect willingness to pay estimates. We have some evidence that respondents engage in attribute non-attendance with the attribute non-attendance statements. We plan to use these statements to estimate stated attribute non-attendance models and compare these to inferred attribute non-attendance latent class models.

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Table 1. Summary statistics (n=1381)

		Mean	SD
Income	Household income ($1000s)	98.90	56.56
Age	Age of respondent, in years	45.72	15.58
Gender	Male = 1, 0 otherwise	49%	
Race	White = 1, 0 otherwise	60%	
Marital status	Married = 1, 0 otherwise	28%	
House	Household size	2.90	1.31
School	Years of schooling	15.56	2.53
Employment status	Employed = 1, 0 otherwise	65%	
Games	Games attended in a typical season	4.58	5.60
Miles	Distance from stadium/arena	26.72	24.71
Minutes	Time to get to the stadium/arena	61.58	44.98
Party	Party size that attends games	3.63	1.54
Price	Typical ticket price	67.43	51.96
Season	Season ticket holder	21%	
Very good seats	"Very good" seats	36%	
Good seats	"Good" seats	42%	
MLB	Major League Baseball fan	47%	
MLS	Major League Soccer fan	7.1%	
NBA	National Basketball Association fan	18%	
NFL	National Football League fan	19%	
NHL	National Hockey League fan	7.6%	
Chicago	Chicago resident	23%	
Dallas	Dallas resident	20%	
Los Angeles	Los Angeles resident	23%	
Miami	M resident	15%	
New York	New York city resident	19%	

Table 2. Discrete choice experiment attributes

Attribute	Description	Levels
Mask Requirement	The stadium may require that you wear a cloth mask over your nose and mouth. If the game is played in an outdoor stadium you must wear the mask when you are not able to social distance (in other words, stay 6 feet apart from people who are not in your seating area).	Required Not required
Stadium/arena capacity	Due to social distancing policy, the number of tickets sold will be either 10%, 25% or 50% of stadium capacity. This will allow for social distancing because the available seats will be spread out.	10% 25% 50%
Ticket price	You have been offered a ticket, or block of tickets for the number of people you typically attend a game with, from a reseller or acquaintance. The price of each ticket will range from $[minimum] to $[maximum].	Mean - $(1 \times \sigma)$ Mean Mean $+ (1 \times \sigma)$ Mean $+ (2 \times \sigma)$ Mean $+ (3 \times \sigma)$

Table 3. Ticket prices used in the choice experiment

	MLB	MLS	NBA	NFL	NHL
Mean $-(1 \times \sigma)$	20	20	60	90	45
Mean	35	35	105	115	75
Mean $+(1 \times \sigma)$	50	50	150	140	100
Mean $+(2 \times \sigma)$	60	60	195	165	130
Mean $+(3 \times \sigma)$	75	75	235	195	160

Table 4. Attendance response by attribute level

	Percent Yes (number of choice occasions)				
Ticket Price	MLB	MLS	NBA	NFL	NHL
Mean - $(1 \times \sigma)$	61.8 (555)	76.0 (79)	59.5 (215)	56.8 (227)	62.1 (87)
Mean	62.5 (536)	73.0 (89)	50.9 (210)	61.4 (223)	50.6 (87)
Mean + $(1 \times \sigma)$	42.9 (546)	66.7 (81)	35.7 (210)	39.0 (223)	38.6 (88)
Mean + $(2 \times \sigma)$	42.56 (435)	52.9 (68)	32.9 (170)	33.7 (175)	28.6 (70)
Mean + $(3 \times \sigma)$	32.85 (548)	50.6 (79)	26.1 (207)	25.5 (224)	18.5 (92)
χ^2 (4 df)	147.35***	18.10***	64.81***	83.81***	43.39***
	Percent Yes (number of choice occasions)				
Mask Requirement	MLB	MLS	NBA	NFL	NHL
Required	59.3 (1310)	72.7 (198)	50.6 (506)	54.1 (536)	47.2 (212)
Not required	37.9 (1310)	56.1 (198)	32.4 (506)	34.4 (536)	32.6 (212)
χ^2 (1 df)	119.79***	11.99***	34.45***	46.71***	9.46***
	Percent Yes (number of choice occasions)				
Stadium/Arena Capacity	MLB	MLS	NBA	NFL	NHL
10%	57.7 (876)	68.4 (132)	46.5 (338)	51.1 (360)	48.9 (141)
25%	47.9 (862)	61.4 (139)	40.1 (337)	44.2 (353)	36.7 (139)
50%	40.4 (882)	64.6 (125)	37.4 (337)	36.8 (359)	34.0 (144)
χ^2 (2 df)	52.83***	1.47	5.86*	15.03***	7.47*

***, **, * indicates statistical significance at p = 0.01, 0.05, 0.10

Table 5. Latent class logit model (dependent variable = 1 if respondent will attend)

	Class 1			Class 2			Class 3		
	Coeff.	SE	t-stat	Coeff.	SE	t-stat	Coeff.	SE	t-stat
Constant	0.9246	0.2520	3.67	3.0769	0.4935	6.23	0.4900	0.5473	0.90
Ticket Price	-0.0651	0.0067	-9.79	-0.0189	0.0065	-2.93	-0.0448	0.0089	-5.03
× MLS	0.0220	0.0058	3.81	-0.0100	0.0092	-1.09	0.1457	0.0432	3.37
× NBA	0.0365	0.0051	7.09	0.0126	0.0048	2.60	0.0254	0.0065	3.90
× NFL	0.0428	0.0053	8.04	0.0094	0.0046	2.06	0.0271	0.0062	4.35
× NHL	0.0264	0.0060	4.38	-0.0001	0.0046	-0.02	0.0193	0.0064	3.02
Mask Requirement	1.0780	0.1802	5.98	-1.0063	0.3184	-3.16	4.0191	0.5759	6.98
10% Capacity	-0.0508	0.1860	-0.27	0.5195	0.2447	2.12	2.2285	0.4379	5.09
50% Capacity	-0.2355	0.1755	-1.34	0.2193	0.2206	0.99	1.4686	0.3871	-3.79
Class probability	46.7%			27.4%			25.9%		
Ending Log-L	-3094.96								
Beginning Log-L	-3499.81								
χ^2	809.72								
MR^2	0.116								
AIC	6247.9								
Sample	1381								
Periods	4								

Table 6. Willingness to pay estimates

	Gross WTP | no mask requirement, 25% capacity								
	Class 1			Class 2			Class 3		
	WTP	SE	t-stat	WTP	SE	t-stat	WTP	SE	t-stat
MLB	14.20	3.13	4.53	162.95	42.06	3.87			
MLS	21.42	4.95	4.33	106.38	32.87	3.24			
NBA	32.27	7.43	4.34	489.08	148.57	3.29			
NFL	41.40	9.58	4.32	324.19	81.15	3.99			
NHL	23.87	5.98	3.99	162.29	24.28	6.68			
	Change in WTP with a mask requirement								
	Class 1			Class 2			Class 3		
	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat	WTP	SE	t-stat
MLB	16.56	3.05	5.43	-53.29	24.03	-2.22	89.74	16.76	5.36
MLS	24.98	5.28	4.73	-34.79	14.67	-2.37			
NBA	37.62	7.16	5.25	-159.96	76.55	-2.09	206.98	35.29	5.86
NFL	48.27	8.73	5.53	-106.03	47.20	-2.25	226.85	44.54	5.09
NHL	27.82	5.69	4.89	-53.08	17.94	-2.96	157.72	31.57	5.00

Table 6. Continued

	Change in WTP with 10% Capacity relative to 25%								
	Class 1			Class 2			Class 3		
	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat	WTP	SE	t-stat
MLB							49.76	10.79	4.61
MLS									
NBA							114.77	25.25	4.55
NFL							125.78	28.21	4.46
NHL							87.46	21.53	4.06
	Change in WTP with 50% Capacity relative to 25%								
	Class 1			Class 2			Class 3		
	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat	WTP	SE	t-stat
MLB							-32.79	8.20	-4.00
MLS									
NBA							-75.63	18.67	-4.05
NFL							-82.89	22.11	-3.75
NHL							-57.63	15.21	-3.79

Note: shown are those WTP estimates that are statistically significant at the 95% confidence level in a two-tailed test. The MLS WTP estimates in class 3 are wrong-signed due to a positive price coefficient.

Table 7. Gross willingness to pay estimates under the safest and riskiest scenarios

	Safest | Mask requirement, 10% Capacity					*Riskiest | No mask requirement, 50% capacity*				
Class 1	WTP	SE	t-stat	95% CI		WTP	SE	t-stat	95% CI	
MLB	29.98	2.72	11.01	24.64	35.32	10.59	2.84	3.72	5.01	16.16
MLS	45.23	5.79	7.81	33.88	56.57	15.97	4.48	3.57	7.20	24.74
NBA	68.12	7.04	9.68	54.33	81.90	24.05	6.80	3.54	10.72	37.38
NFL	87.39	8.32	10.51	71.09	103.69	30.86	8.82	3.50	13.57	48.15
NHL	50.38	6.90	7.31	36.86	63.89	17.79	5.36	3.32	7.28	28.30
Class 2	WTP	SE	t-stat	95% CI		WTP	SE	t-stat	95% CI	
MLB	137.16	35.02	3.92	68.52	205.81	174.56	45.34	3.85	85.70	263.42
MLS	89.55	30.44	2.94	29.89	149.21	113.97	34.70	3.28	45.95	181.98
NBA	411.70	123.81	3.33	169.03	654.36	523.94	158.79	3.30	212.72	835.17
NFL	272.89	63.70	4.28	148.04	397.75	347.29	86.70	4.01	177.37	517.21
NHL	136.61	21.24	6.43	94.98	178.24	173.86	26.47	6.57	121.98	225.73
Class 3	WTP	SE	t-stat	95% CI		WTP	SE	t-stat	95% CI	
MLB	150.44	17.36	8.66	116.41	184.48	-21.85	13.35	-1.64	-48.01	4.31
MLS	-66.76	31.21	-2.14	-127.93	-5.58	9.70	4.75	2.04	0.38	19.02
NBA	346.98	42.23	8.22	264.21	429.75	-50.40	29.38	-1.72	-107.98	7.19
NFL	380.29	52.10	7.30	278.16	482.41	-55.23	33.65	-1.64	-121.19	10.72
NHL	264.41	42.20	6.27	181.69	347.12	-38.40	22.80	-1.68	-83.08	6.27