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Willingness to Pay for Bat-Friendly Tequila

An economics undergraduate thesis completed for fulfillment of the Honors Degree
requirement

by

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THE HONORS PROGRAM

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Abstract
The tequila industry has grown 158% since 2002 and has witnessed an average growth of 6.1% per year. As of 2016, the tequila and mescal industry constituted 1.25% of the GDP of Mexico. While this growth can be seen as a good thing, modern farming practices have put tequila producers at risk due to a lack of natural pollination. Since this pollination is provided by bats, the Bat-Friendly Tequila Project launched a special release of 300,000 bottles of bat-friendly tequila in 2017; however, consumer preference data was not collected or publicized to share the popularity of this release among consumers. This study sought to discover a willingness to pay for bat-friendly tequila (BFT) by issuing a stated-preference survey to 215 people within the United States to measure if information had any impact on their willingness to participate in the BFT market. A discrete choice model was used to compare BFT against a consumer's preferred brand with price and quality held constant. It was discovered that access to information, a person's environmental concern, and the amount spent on a bottle of tequila were significant in influencing an individual's willingness to pay for BFT using OLS estimates.

1 Introduction

1.1 The Bat-Agave Relationship

In recent years, tequila demand has been rising as clear spirits have become more desirable (Mintel, 2018). Figure 1 is a graph that depicts the increase in sales (by volume of 9-liter cases) and revenue (in millions of dollars) from 2003-2019, demonstrating the 158% increase in volume since 2002 (Distilled Spirits Council of the United States, 2020):

Figure 1: Tequila volume in the U.S. (2003-2019)
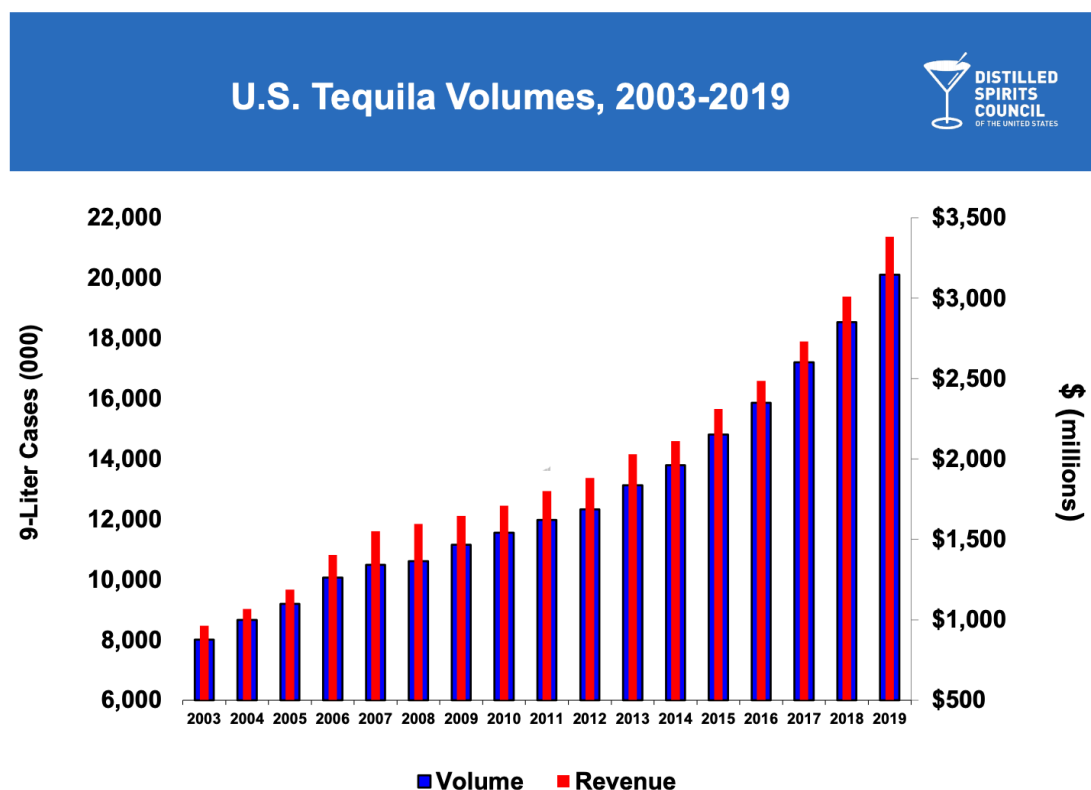
Since agave is the primary ingredient used to make tequila, this increased demand has resulted in changes to agave farming, specifically the growing duration of the plant. While this has helped the tequila industry to meet demand, it has had repercussive effects

on the population of *Leptonycteris nivalis*, more commonly known as the lesser long-nosed bat (Tequila Interchange Project, 2016; Trejo-Salazar et al., 2016; Ulaby, 2017). This species of bat relies on the flower of the agave plant as an important food source, but they also act as pollinators for the farmers, much like the honeybee to the flower (Committee on the Status of Pollinators in North America et al., 2007). Due to the increased demand, agave producers have been harming the populations by harvesting the flowers before they bloom in order to capture the plants at their highest sugar concentration (Trejo-Salazar et al., 2016; Williams, 2017). This technique has disrupted the bat-agave relationship within the ecosystem and has been mutually detrimental. The bat population declined and the agave farmers lost the genetic diversity that the bats provided through pollination. The current method of agave production relies on cloning, a process by which only a few plants are used to plant more agave. This process decreases the genetic diversity of the crop, making it more vulnerable to plagues of disease or fungi while also decreasing seed yield (Borbón-Palomares et al., 2018; Colunga-garcíamarín & Zizumbo-villarreal, 2007; Trejo-Salazar et al., 2016; Vargas-Ponce et al., 2009). Considering that in 2016, the tequila and mescal industry made up 1.25% of the country's gross domestic product (GDP), any threat to the crops could have serious implications for the industry and the economy (Michail, 2019).

1.2 UNAM & Tequila Interchange Project

A researcher by the name of Dr. Rodrigo Medellín of National Autonomous University of México (UNAM) teamed up with a non-profit organization called the Tequila Interchange Project to address the issues resulting from harvesting the agave flower too early. He and others collaborated on a paper titled "Save Our Bats, Save Our

Tequila" which hypothesized that if tequila producers saved 5% of their crop to bloom, it could help feed around 2 million bats per night (Trejo-Salazar et al., 2016). This would help restore bat populations and ensure that agave farmers had a means of diversifying their crop. In order to incentivize this practice, he and his team at UNAM established a certification process that awarded a bat-friendly label to compliant producers. Five tequila companies complied and, combined, released a combined 300,000 bottles of certified bat-friendly tequila globally in 2017 with most of the bottles going to the United States (Williams, 2017).

By 2018, the lesser long-nosed bat was removed from the endangered species list (Bat Conservation International, 2018). The goal of the project was achieved; however, a few problems remain unanswered. The consumer popularity and demand was not measured or recorded in any sort of publication and the tequila industry is still placing themselves at risk by using these cloning practices. This thesis aims to investigate whether there is a market demand for bat-friendly tequila by measuring willingness to pay (WTP) for such a product by conducting a survey to gauge consumer demand. The findings could guide tequila producers' decision to comply with the policy to create a reserve of genetically diverse seeds.

2 Literature

2.1 Case Study: Willingness to Pay (WTP) for Shade-Grown Coffee & Implications for Bat-Friendly Tequila (BFT)

Shade-grown coffee, a certification similar to bat-friendly tequila (BFT), promotes preservation of habitat for birds and other species while allowing for a sustainable way to grow coffee. Consumer willingness to pay (WTP) for this coffee via

revealed preference data experiments suggest that, even when competing with fair-trade and organic coffee as found in Loureiro & Lotade (2005), people still value and will pay a premium for an environmentally sustainable coffee (Klimas & Webb, 2018). Shade-grown coffee is very similar to BFT because both focus on environmental sustainability and biodiversity. If people are willing to pay a more for shade-grown coffee because of its environmental benefits, the same could be true for BFT.

While this case does offer insight into the valuation of environmentally beneficial certifications that a beverage can receive, it is studying a certification that is being surveyed in the same questionnaire with labels such as "organic" or "free-trade" which are more well-known by the public (Arnot et al., 2006). This is a key difference between shade-grown coffee and BFT because the tequila is dealing with a certification/label that most of the consumer base is unaware of (66% of consumers did not have any prior knowledge of bat-friendly tequila in a pilot survey). For this reason, this thesis will be using survey and analysis approaches found more commonly in the fields of psychology and marketing which are described in the methods section.

2.2 Eco-Marketing & Eco-Consumption

There is a difference between WTP for vice and virtue products, especially for organic and prosocial products (Gassler et al., 2019; van Doorn & Verhoef, 2011). Gassler et al. provide an example of prosocial attributes, suggesting that companies emphasize "their products' environmental benefits when communicating with consumers by using environmental and biodiversity claims associated with organic labelling, such as their support of soil carbon storage and pollinators," (2019). This marketing technique that places more emphasis on prosocial attributes, when implemented in a revealed

preference experiment, found an increased WTP for vice products. Both coffee and tequila can be considered vice products using a definition of providing short-term utility and benefits but long-term side effects and costs, making them even more appropriate as comparisons (Verma et al., 2016). Van Doorn and Verhoef (2011) found similar results in that people in the Dutch organic food market had a higher WTP for organic/prosocial vice products whereas they had a low WTP for organic/prosocial virtue products that were already perceived as healthy using revealed preference data.

From the consumer side, while demographic information can predict WTP for eco-friendly products, for example consumers who are more educated are more likely to participate in green purchasing behavior (Barbarossa & De Pelsmacker, 2016), a far better predictor has been the environmental attitude of the respondent (Barbarossa & De Pelsmacker, 2016; Klimas & Webb, 2018; Loureiro & Lotade, 2005). Those who say they value the environment tend to act on this and as Klimas & Webb (2018) discovered, there was no significant difference between the number of individuals who stated they would pay a premium than those who actually did in the revealed experiment. While Klimas & Webb (2018) use in-depth measures of environmental behavior called NEP, this study will ask participants to rate their environmental concern using a Likert scale from 1 "not concerned" to 5 "very concerned", which is similar to what Loureiro & Lotade (2005) used for their WTP study.

Eco-friendly products can be perceived as weaker than their non-environmentally friendly counterparts when strength is a main attribute of the product (Luchs et al., 2010). According to White et al. (2019), multiple influences can alter participation in eco-friendly behavior. To establish this, they offer case studies of different eco-labeling or

eco-marketing campaigns. One that they discuss related to tequila is a campaign carried out by Jack Daniel's Whiskey. The campaign promoted eco-friendly behavior by asking that the consumer reduce waste and use less plastic, but since the company is already viewed as being a masculine or strong brand (Holt, 2006), their focus on sustainability did not fall victim to the devaluing Luchs et al. (2010) suggest (White et al., 2019). Tequila may be affected by this dynamic within the demographics of the respondents to the survey, making it something that should be recognized as a potential bias, but an area for further research. To investigate this as a potential bias, respondents were asked if they would continue buying their preferred brand of tequila if it suddenly became bat-friendly. While this may give insight into receptiveness to bat-friendly practices, it also can be used as an indicator of brand loyalty. If a consumer does not want to switch to the bat-friendly brand but would continue buying their preferred brand if it became bat-friendly, this could mean that a consumer rates their brand preference above the environmental ethics of that brand. If this is true, each brand can conduct their own focus groups to test the appeal of this with their market base.

3 Methods

3.1 Experimental Design

The sample population only included U.S. residents who are 21 years or older, who drink tequila, and who pass an attention check[*]. Demographic information was asked of participants, specifically age, gender, race, income, and education, in order to see which segments of the population would be willing to pay more for a bat-friendly

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[*] An attention check was used to ensure active, mental engagement with the study. Refer to appendix B to view the survey participants took.

product. Purchasing behavior was also collected such as frequency of tequila consumption and the average amount spent on a 750 ml, standard-size bottle of tequila. Respondents were also asked to rate their environmental concern ranging from "not concerned" to "very concerned" based on a Likert scale (McLeod, 2019). Since this is also a survey about a seemingly unknown product, participants were asked if they had any prior knowledge of bat-friendly tequila and if they did, they were allowed to specify from where. The final question is whether they view bats as pests, which has become a relevant, potential bias given the current Coronavirus outbreak.

The main experiment in this study is to quantify consumer responsiveness to different information. The respondents were randomly assigned into two groups with one receiving a video on micro-plastics in the ocean (control) and the other receiving a video specifically about bat-friendly tequila with a description of the policy below the video (treatment). Both videos had a similar format and length which makes them appropriate for comparison. There was not a group in the design that received no video because the equality of the intervention needed to be maintained between groups. The micro-plastics video also had nothing to do with bat-friendly tequila and provides the participant no additional or pertinent information. This serves the same purpose as a no-video control group while also preventing people from leaving the survey to seek more information. After exposure to this information (which had a timed duration before they could proceed), they were asked to briefly summarize the information they just consumed to prove they were receptive to it. Consequentialism and "cheap talk" *ex ante* approaches were used with the intention to correct consumers toward more realistic statements of their WTP (2013WAEA Keynote Address, 2014). After an attention check, respondents

were reminded of their budget constraint and were also told that the results were to be used as a policy recommendation. This was done to mitigate overstatement of WTP, which is a common problem for stated preference experiments. Once they read this statement, respondents were asked to disclose the average amount they spent on a 750 ml bottle of tequila and were given access to a pricing sheet that had some of the most popular brands and their prices ("Tequila Prices Guide 2020 – 20 Most Popular Tequila Brands in US," 2020).

3.2 Methodology

The test that the bat-friendly tequila (BFT) was put through involved brand-plus attribute discrete choice (Raghavarao et el., 2010). Since only a handful of tequila brands complied with the bat-friendly practices in 2017, this means consumers most likely had to face a choice between two or more brands when they looked at the bottles on the shelf and choose whether they preferred the BFT or their preferred brand. To mimic this, the survey participants were asked to do the same, pitting a bat-friendly "other" brand against their preferred or "go-to" brand. This discrete approach is used in marketing to determine the qualities that people look for in a product (Gilbride & Allenby, 2004). Discrete choice allows for the product to be compared in a competitive environment within the mind of the respondent where factors like brand-loyalty become relevant (Raghavarao et al., 2010). Participants were told that both were listed for the same price and were the same quality to offer a point of control. The survey design process was overseen by an expert in survey design and sociology research at the university: Dr. Markus Kemmelmeier. The entire survey can be found in appendix B.

4 Results

4.1 Description of Variables

Using Stata to run a multiple regression analysis, a model will be created using Ordinary Least Squares (OLS) estimates to determine how each of the variables influence willingness to pay for BFT as well as willingness to buy it (Stata 16). While it should be noted that other studies have used different forms of analysis such as Weibull survival regression (Loureiro & Lotade, 2005), OLS will be used in this study to determine the explanatory effect of the variables combined on WTP using R^2 between the control and treatment groups. Since there is a treated group versus an untreated group to determine the impact of information on WTP, this experiment resembles a psychological or marketing study more closely than it does a traditional WTP study. These studies tend to use ANOVA or a similar analysis to determine the difference between groups; however, this survey employs a two-sample t-test in order to determine the effectiveness of the treatment. The impact of the treatment is measured using multiple regression. The R^2 of the model with the treatment was compared to one without to determine sample size. While determining the impact of information is one of the main goals of this study given the lack of knowledge (66% had no prior knowledge in a pilot study) of bat-friendly tequila, multiple regression analysis using OLS is better suited for establishing a model of WTP that includes impacts of other factors. This allows tequila producers to look at a wider variety of demographic and price point influences on WTP. A treatment dummy variable was created to separate treated versus untreated WTP responses.

The variables are defined in Table 1 and are adapted from the survey:

Table 1: Variable Descriptions

Variable	Value(s)
years	numeric
frequency of tequila consumption	1=1-3 times per year 2=1-3 times per month 3=1-3 times per week 4=4-6 times per week 5=Every day
treatment dummy	1=bat video 0=control video
gender identity	male=0 female=1 other=2
white respondents	1=white, 0=other
per household	US Dollars
education	1=no ed 2=12th grade or less, no diploma 3=HS diploma or GED 4=Some college, no degree 5=Associates 6=Bachelor's 7=Master's 8=Doctorate/PhD
personal rating of environmental concern	scale of 1-5 w/ 1 being "not concerned' & 5 being "very concerned
amount spent on 750 ml bottle	1=$10-$19.99 2=$20-$29.99 3=$30-$39.99 4=$40-$49.99 5=$50-$59.99 6=$60 or more
prior knowledge of BFT	1=yes, 0=no
view bats as pests	1=yes, 0=no

To measure WTP and WTB, the following metrics were utilized:

Table 2: Dependent Variable Description

Variable	Values
Willingness to Pay for BFT	0=$0 1=$1 2=$2 3=$3 4=$4 5=$5 6=Other amount (fill in the blank required)
Willingness to Buy BFT	1=yes 0=no

All 215 respondents elected an amount between $0 and $5 for WTP with nobody filling in a specified "other amount". For the purpose of the statistical analysis, anybody who indicated that they were not willing to buy BFT or who were not willing to pay extra for it were determined to have a WTP of $0 (refer to appendix B to see question order). The 95 respondents who indicated that they would pay extra for BFT selected an amount between $1 and $5.

Table 2 compares the covariates between the treatment and control groups using a t-test of equal variance by treatment. The p-values indicate whether the sample means were unequal between the groups. One will notice that there was no significant difference between the groups with the exception of age and prior knowledge. The control group is older and had more people with prior knowledge of BFT at an alpha of .05. Considering that the treatment and control groups were randomly generated, this is by chance, but one will notice later that these variables were not significant in describing WTB or WTP in the regression analysis.

Table 3: Comparison of covariates between groups

	Control Group	Treated Group	Difference	P-value
age*	37.19	34.08	3.11	0.0438
tfreq	1.80	2.16	-0.36	0.2245
gender	0.45	0.36	0.09	0.2295
race	0.69	0.66	0.03	0.5948
inc	2.12	2.26	-0.14	0.1488
educ	5.58	5.75	-0.17	0.2769
env	3.88	3.77	0.11	0.4161
price	2.03	2.10	-0.07	0.6021
pk*	0.11	0.04	0.07	0.0367
pests	0.30	0.28	0.02	0.7319

*A t-test of unequal variance between groups was used for these variables

4.2 Treatment Effectiveness

A Cohen's f^2 test was used to determine the effect size of the treatment on the

WTP (Selya et al., 2012):

$$Cohen's\ f^2 = \frac{R^2_{AT} - R^2_A}{1 - R^2_{AT}}$$

Where *AT* is the regression including the treatment variable and *A* is the regression

without the treatment. In a pilot study (n=39), f^2 of the treatment was .1859, so using a

95% power threshold and an alpha of .05 (*df*=11), it was determined that a sample of 146

people would be required. In this study, I was able to obtain a sample of 215 respondents.

The following hypothesis was proposed to determine if the treatment was

impactful on a participant's WTP using a two-sample t-test assuming equal variance.*

This is a crucial component of the study because only about 16 out of the 215 participants

(appx. 7%) had prior knowledge of the issue in the survey.

The hypothesis was constructed as follows:

$$H_0: (control\ mean\ WTP - treated\ mean\ WTP) \geq 0$$

$$H_A: (control\ mean\ WTP - treated\ mean\ WTP) < 0$$

It was determined that the null hypothesis could be rejected at an alpha of .05:

Table 4: Two-sample t-test

t group	observation	mean	std.err.	std. dev
Control (0)	107	1.00935	0.15684	1.62234
Treated (1)	108	1.64815	0.17714	1.84094
total	215	-0.63880	0.23674	
Results:				
diff = mean(0) - mean(1)	t = -2.6984	df=213		
$H_A < 0$	$H_A \neq 0$	$H_A > 0$		
p=.0038	p=.0075	p=.9962		

*The variances were proven to be equal at an alpha of .05 in a separate test of the standard deviations

This signals that the means of WTP between treatment groups was significantly different, with the treated group willing to pay more. This indicates that the treatment was likely effective and people may respond well to more information if this were to be carried out in a marketing campaign. This is also reflected in the significance of the treatment variable in the regression analyses presented in the next section.

4.3 Regression Analysis & Models

The following unrestricted models were created to calculate the impact of variables on WTB & WTP:

$$WTB = \beta_0 + \beta_1 age + \beta_2 tfreq + \beta_3 t + \beta_4 gender + \beta_5 race + \beta_6 inc + \beta_7 educ$$
$$+ \beta_8 env + \beta_9 price + \beta_{10} pk + \beta_{11} pests + u$$

$$WTP = \beta_0 + \beta_1 age + \beta_2 tfreq + \beta_3 t + \beta_4 gender + \beta_5 race + \beta_6 inc + \beta_7 educ$$
$$+ \beta_8 env + \beta_9 price + \beta_{10} pk + \beta_{11} pests + u$$

Where β_0 is the constant and u is the error term. These models describe WTP in U.S.

dollars and WTB as a percentage change in likelihood of a person's WTB. Below are the

descriptive statistics of all the variables used to build the WTB & WTP equations:

Table 5: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
age	215	35.62791	11.28025	21	79
tfreq	215	2.18140	0.95194	1	5
t	215	0.50233	0.50116	0	1
gender	214	0.40654	0.51106	0	2
race	215	0.67442	0.46969	0	1
inc	213	2.19249	0.68373	1	3
educ	215	5.66512	1.14771	3	8
env	215	3.82326	0.98892	1	5
price	215	2.06512	1.03465	1	6
pk	215	0.07442	0.26306	0	1
pests	215	0.28837	0.45406	0	1

One will notice that the sample involved a demographic of more men than any other

gender identity. The age is slightly lower than the median age of 38.2 in the U.S. which

can be expected from online surveys (Rogers, 2019). A Breusch-Pagan test was

conducted to test for heteroscedasticity in the regression and it resulted in an F of 1.6478

which is less than the critical value of 1.833 (num. df=11, denom. df=215) needed to

reject the null of homoscedasticity (Breusch & Pagan, 1979).

Tables 6-9 are the results of the regression analyses. Every single regression was

effective at predicting WTB and WTP with the R^2, df and F statistic reported below each

table.

Table 6: WTB regression

wtb	Coefficient β	Std. Err.	p-value
age	-0.00313	0.00245	0.203
tfreq	0.02714	0.02946	0.358
t	0.25928	0.05422	0.000
gender	0.02978	0.05393	0.582
race	0.00184	0.05976	0.975
inc	0.01100	0.04155	0.791
educ	0.02721	0.02531	0.284
env	0.06764	0.02804	0.017
price	-0.00084	0.02665	0.975
pk	0.14543	0.10614	0.172
pests	-0.22789	0.06117	0.000
_cons	0.29544	0.20704	0.155

R^2 of .2226 (df=11, Prob. F= 0.000)

In Table 6, treatment, environmental concern, and pest rating were able to predict WTB. This led to the following reduced formula to describe the WTB using just those three variables:

Table 7: WTB reduced regression

wtb	Coefficient β	Std. Err.	p-value
t	0.26585	0.05219	0.000
env	0.07205	0.02710	0.008
pests	-0.22124	0.05894	0.000
_cons	0.42223	0.11634	0.000

R^2 of .1987 (df=3, Prob. F=0.000)

Those who were treated with the BFT video were 26.9% more likely to buy the product than their untreated counterparts. For every point higher a person rates themselves on environmental concern, they are 7.3% more likely to buy BFT, and if a person signals that they view bats as being pests, they are 22.1% less likely to buy the product. This results in the following, reduced model:

$$WTB = .42223 + .26858t + .0725env - .22124pests + u$$

This model would be able to accurately predict a person's WTB given the discrete choice circumstances provided in the survey.

Table 8: WTP regression

wtp	Coefficient β	Std. Err.	p-value
age	0.00220	0.01054	0.835
tfreq	0.17999	0.12675	0.157
t	0.69481	0.23325	0.003
gender	0.30387	0.23203	0.192
race	-0.07014	0.25708	0.785
inc	0.15873	0.17874	0.376
educ	-0.06744	0.10889	0.536
env	0.56752	0.12061	0.000
price	0.30322	0.11466	0.009
pk	0.21291	0.45665	0.642
pests	-0.16358	0.26318	0.535
_cons	-2.28263	0.89070	0.011

R^2 of .1764 (df=11, Prob. F= 0.000)

Table 8 indicates environmental concern, treatment, and price to be key motivators in a person's WTP for BFT. This can be modeled combined into a reduced model based on Table 9 below:

Table 9: WTP reduced regression

wtp	Coefficient β	Std. Err.	p-value
t	0.67735	0.22250	0.003
env	0.56963	0.11352	0.000
price	0.32651	0.10841	0.003
_cons	-1.86213	0.53860	0.001

R^2=0.1572 (df=3, Prob. F= 0.000)

$$WTP = -1.86213 + .67735t + .56963env + .32651price + u$$

This indicates that people who received treatment were willing to pay up to 68¢ more for BFT compared to the control group. For each point the person rated their environmental

concern, they gained 57¢ in WTP and for each $10 the person increased their price of tequila, they were willing to pay about 33¢ more for the bat-friendly version.

As the regressions indicate, the key factors in determining participation in the bat-friendly tequila market are access to information, pre-existing environmental concern, a person's price preference for tequila, and their notion of bats being pests or not. While these are great for building the models of WTP & WTB that have already been shared, some other interesting statistics were also gathered outside of these indicators.

For participation in WTB, out of the 165 total who were willing to buy a competing bat-friendly brand compared to their preferred choice of tequila, 97 (59%) were from the group shown the bat-friendly video while the remaining 68 (41%) were in the control group who were shown the video about micro-plastics in the ocean. For participation in WTP extra for a bat-friendly tequila, 95 out of 215 respondents indicated they would pay extra. Of these people, 60 (63%) were shown the treatment video while 35 (37%) were shown the control. This means that of the people who were willing to pay extra, more than half were exposed to the treatment which has been shown to significantly influence a person's WTP. Of all the people surveyed, 90% indicated that if their brand were to become bat-friendly, they would continue buying that brand. For the 16 people who stated that they had prior knowledge of BFT, six of them had knowledge of the issue from multiple forms of media, with social media and a documentary/video being the most common sources. News articles were the second and friends/family served as the third most common source of information regarding BFT.

5 Reflection

5.1 Discussion

As found in the results of this survey, there is a WTB and a WTP for bat-friendly tequila which has been modeled using OLS estimates. One may notice how only a certain percentage of the total number of respondents made it all the way to the question asking about how much extra they would be willing to spend on the bat-friendly brand. There are ways to model this probability using a logit model or a Weibull survival regression, which has been used in other studies as described, OLS estimates is an appropriate level of analysis for the scope of this study. Another thing that could not be accommodated into the survey was a specific ranking of preferences in a full discrete-choice analysis that would clarify preference for more variables other than brand and bat-friendly status. Work may be continued on this topic with the help of Dr. Dilek Uz in order to carry out these more advanced techniques in order to contribute to the academic discussion on the topic.

Quality of responses and research integrity were able to be maintained throughout the data collection and analysis process. The survey, after being deemed exempt by an IRB (Internal Review Board), was conducted using Qualtrics and the sample came from Amazon Mechanical Turk (MTurk). For data cleaning and quality assurance purposes, IP addresses were collected and a number of attention and bot checks were used to ensure that participants were actively engaged in the survey and that they were humans in the United States. The bot check was the video summary while the attention check followed it that are shown in appendix B. MTurk was chosen due to its diverse pool of relatively anonymous respondents (Casler et al., 2013). In order to maintain respondent anonymity,

each respondent was assigned a randomly generated number so that their response could be separated from their worker identification. All IP address information was discarded after the data was cleaned as well as their worker IDs.

One thing that could not be controlled for during the study period was the outbreak of COVID-19 which could have effects on the study in numerous ways. After all, this is a survey asking about a bat-friendly product during a crisis that was caused by bats. As people were facing unemployment, they could have turned to MTurk as a means of substituting income which could affect their statement of WTP, especially since they were reminded of their budget constraint. This crisis could have positive effects though by offering a larger, more diverse pool to sample.

Since this is intended as an initial insight into this particular issue using stated preference, more research should be conducted regardless of these limitations. This study was able to provide evidence that there is a willingness to pay for a bat-friendly tequila. Next steps would include revealed preference research to measure discrete choice that involves more than just a cross-brand comparison, such as price, type, perceived taste differences, and WTP within brand that were observed in the case study of shade-grown coffee. As far as who would be conducting this research, academics and tequila producers alike would benefit from investigating this topic further. Tequila companies may have an untapped market to discover, and, given that they understand their costs best, they could benefit substantially from gaining more data through focus groups. Experts on WTP should partner with agricultural scientists to maximize benefits of genetic diversification of seeds and reveal price points that could sustain the costs of these practices. They may

also be able to model and estimate the risk tequila companies face as a result of not incorporating these practices into their production.

5.2 Conclusion

Bats have been found to play a crucial role in the pollination of the agave used to make tequila. Modern farming practices have put the bats and tequila producers at risk because the bats have lost their food supply and the farmers have lost the genetic diversity of the agave provided by the bats. Through bat-friendly practices, tequila producers can reduce this risk by allowing some of their crop to be naturally pollinated, thus providing a reserve of genetically diverse seeds to protect against threats to the agave crops. The study found using discrete choice, treatment, and OLS estimation that access to information about bat-friendly tequila, along with a person's environmental concern and their price preference, greatly influence a person's willingness to pay for bat-friendly tequila. Those who receive information are likely to pay $0.68 more than their uninformed counterparts. As concern for the environment increases, WTP also raises by $0.57. For every extra $10 someone spends on tequila, their WTP increases by $0.33. This should open up avenues for further research for tequila producers and academics alike as the industry faces a risk of losing their crops in mass.

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Appendix A: Tables & Figures

Figure 1: Tequila volume in the U.S. (2003-2019)

Source: The Distilled Spirits Council of the U.S.

Table 1: Variable Descriptions

Variable	Value(s)
years	numeric
frequency of tequila consumption	1=1-3 times per year 2=1-3 times per month 3=1-3 times per week 4=4-6 times per week 5=Every day
treatment dummy	1=bat video 0=control video
gender identity	male=0 female=1 other=2
white respondents	1=white, 0=other
per household	US Dollars
education	1=no ed 2=12th grade or less, no diploma 3=HS diploma or GED 4=Some college, no degree 5=Associates 6=Bachelor's 7=Master's 8=Doctorate/PhD
personal rating of environmental concern	scale of 1-5 w/ 1 being "not concerned' & 5 being "very concerned
amount spent on 750 ml bottle	1=$10-$19.99 2=$20-$29.99 3=$30-$39.99 4=$40-$49.99 5=$50-$59.99 6=$60 or more
prior knowledge of BFT	1=yes, 0=no
view bats as pests	1=yes, 0=no

Table 2: Dependent Variable Description

Description	Values
Willingness to Pay for BFT	0=$0 1=$1 2=$2 3=$3 4=$4 5=$5 6=Other amount (fill in the blank required)
Willingness to Buy BFT	1=yes 0=no

Table 3: Comparison of covariates between groups

	Control Group	Treated Group	Difference	P-value
age*	37.19	34.08	3.11	0.0438
tfreq	1.80	2.16	-0.36	0.2245
gender	0.45	0.36	0.09	0.2295
race	0.69	0.66	0.03	0.5948
inc	2.12	2.26	-0.14	0.1488
educ	5.58	5.75	-0.17	0.2769
env	3.88	3.77	0.11	0.4161
price	2.03	2.10	-0.07	0.6021
pk*	0.11	0.04	0.07	0.0367
pests	0.30	0.28	0.02	0.7319

Table 4: Two-sample t-test

t group	observation	mean	std.err.	std. dev
Control (0)	107	1.00935	0.15684	1.62234
Treated (1)	108	1.64815	0.17714	1.84094
total	215	-0.63880	0.23674	
Results:				
diff = mean(0) - mean(1)	t = -2.6984	df=213		
$H_A<0$	$H_A\neq0$	$H_A>0$		
p=.0038	p=.0075	p=.9962		

Table 5: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
age	215	35.62791	11.28025	21	79
tfreq	215	2.18140	0.95194	1	5
t	215	0.50233	0.50116	0	1
gender	214	0.40654	0.51106	0	2
race	215	0.67442	0.46969	0	1
inc	213	2.19249	0.68373	1	3
educ	215	5.66512	1.14771	3	8
env	215	3.82326	0.98892	1	5
price	215	2.06512	1.03465	1	6
pk	215	0.07442	0.26306	0	1
pests	215	0.28837	0.45406	0	1

Table 6: WTB regression

wtb	Coefficient β	Std. Err.	p-value
age	-0.00313	0.00245	0.203
tfreq	0.02714	0.02946	0.358
t	0.25928	0.05422	0.000
gender	0.02978	0.05393	0.582
race	0.00184	0.05976	0.975
inc	0.01100	0.04155	0.791
educ	0.02721	0.02531	0.284
env	0.06764	0.02804	0.017
price	-0.00084	0.02665	0.975
pk	0.14543	0.10614	0.172
pests	-0.22789	0.06117	0.000
_cons	0.29544	0.20704	0.155

R^2 of .2226 (df=11, Prob. F= 0.000)

Table 7: WTB reduced regression

wtb	Coefficient β	Std. Err.	p-value
t	0.26585	0.05219	0.000
env	0.07205	0.02710	0.008
pests	-0.22124	0.05894	0.000
_cons	0.42223	0.11634	0.000

R^2 of .1987 (df=3, Prob. F=0.000)

Table 8: WTP regression

wtp	Coefficient β	Std. Err.	p-value
age	0.00220	0.01054	0.835
tfreq	0.17999	0.12675	0.157
t	0.69481	0.23325	0.003
gender	0.30387	0.23203	0.192
race	-0.07014	0.25708	0.785
inc	0.15873	0.17874	0.376
educ	-0.06744	0.10889	0.536
env	0.56752	0.12061	0.000
price	0.30322	0.11466	0.009
pk	0.21291	0.45665	0.642
pests	-0.16358	0.26318	0.535
_cons	-2.28263	0.89070	0.011

R^2 of .1764 (df=11, Prob. F= 0.000)

Table 9: WTP reduced regression

wtp	Coefficient β	Std. Err.	p-value
t	0.67735	0.22250	0.003
env	0.56963	0.11352	0.000
price	0.32651	0.10841	0.003
_cons	-1.86213	0.53860	0.001

R^2=0.1572 (df=3, Prob. F= 0.000)

Appendix B: Survey

The survey on the following pages is the survey issued to respondents on MTurk. The survey flow precedes the actual survey where one can see where people were filtered out for either not meeting the demographics or for failing the attention check. People were also asked to not exit the survey and obtain external information, if they did not want to continue under those circumstances, they had the option of exiting the survey.

Visual for the bottle comparison from " 2643x1009 Alcohol Bottles Clipart" from Get Drawings.com. Full link: http://getdrawings.com/liquor-bottle-silhouette#liquor-bottle-silhouette-6.jpg

Bat-friendly logo from http://www.tequilainterchangeproject.org/bat-friendly/

¡Tequila! The alcohol behind many memorable (or perhaps not so memorable) stories is in need of your help. By taking this survey, you could be saving the future of tequila by letting us know your purchasing habits. This survey is considered minimal risk, and your responses will not be linked to anything personally identifying. There are always risks you should take into consideration when participating in online surveys. If you would like to read the full disclosure statement that describes your risks, please click here: Consent Information Sheet.pdf .

There are attention checks throughout the survey, so please read the entire question before answering.

You will not be able to go back and change your answers once you click through the page.

The survey will take approximately 6-7 minutes to complete and should hopefully be a fun one. There will also be a video with optional subtitles if you cannot listen to it.

⭘ I consent and wish to proceed

⭘ I do not consent

Please enter your age.

How often do you drink alcohol?

How often do you drink tequila?

What is your gender identity?

◯ Male

◯ Female

◯ Other (you may specify)

What is your race?

○ Black/African American

○ Asian or Pacific Islander

○ Hispanic or Latino

○ Native American

○ White

○ Mixed race

○ Prefer not to answer

○ Other (please specify)

What is your annual household income? (US Dollars)

○ Less than $30,000

○ $30,000-$70,000

○ More than $70,000

What is the highest level of education you have received?

[▲▼]

How would you rate your concern for the environment on a scale of 1 "not concerned" to 5 "very concerned"?

| 1 | 2 | 3 | 4 | 5 |

Environmental Concern

Please watch the following video (56 seconds) and read the short statement below. Once you have done this, briefly summarize what you learned:

What it means for a tequila to be "Bat-Friendly":

"This project aims to promote and incorporate Bat Friendly practices in the agave management and spirit production derived from the plants by allowing 5% of the agave population to flower to ensure there is food for the nectar feeding bats" (from batfriendly.org, the official website for the Bat Friendly Project)

Please provide a brief summary of what you just learned to ensure you understand the material:

Here is a link to the video: https://www.youtube.com/watch?v=DMHcLWZjQXI

Please watch the following video (1:19) and provide a brief summary below:

Please provide a brief summary of what you just learned to ensure that you understand the material:

Here is a link to the video: https://www.youtube.com/watch?v=RMkkYAf18Xk

Attention Check:

How often do you smoke?
Do not answer this question. Proceed to the next one.

○ Very often

○ Often

○ Sometimes

○ Rarely

○ Never

Ex-Ante approach to mitigate overstatement of WTP:

0|0

An important note about your **budget**:

Every dollar you spend on the following questions means that it is one less dollar you can spend on other things in your life.

Many of these types of surveys can be inaccurate because people may say they will spend their money in a certain way, but if given the opportunity, would not actually act like they said they would. Ask yourself:

Would I actually act on the answer I provide if this was a real situation?

We are hoping to be able to share this research as a policy recommendation, so your opinion and its accuracy are incredibly valuable.

For the following section, **it is very important that you DO NOT exit the survey**.

You will be given all the necessary information in order to answer the questions. If you do not know or are unsure about something, that is ok. We are trying to measure whether people would buy the following product as it is marketed.

○ I will not look up any additional information

○ Exit survey

You go to the store to buy a bottle of tequila because you ran out at home and want some more.

How much are you looking to spend on a normal-sized* (750 ml) bottle? (all amounts in US dollars)

If you are unsure of how much you pay, here is a list of some popular brands and their prices ranging from budget to premium tequilas: Pricing guide

*For reference: a standard-sized bottle of tequila (750 ml) is the same amount of liquid that is in a normal bottle of wine

Remember your answer because you will need to apply it in the next section.

[▲▼]

The following section contains the three BFT scenarios people faced. They only proceeded to the next image/scenario if they indicated "yes…" on the previous quesiton. The final section begins with asking them their prior knowledge.

Think of a price ($X) that is within the price range that you selected in the previous question. Write it down if you need to.

On the store shelf there are two bottles: the brand you typically buy (your "go-to" brand) and a different brand ("other brand"). This other brand has a sticker on it that says it is bat-friendly:
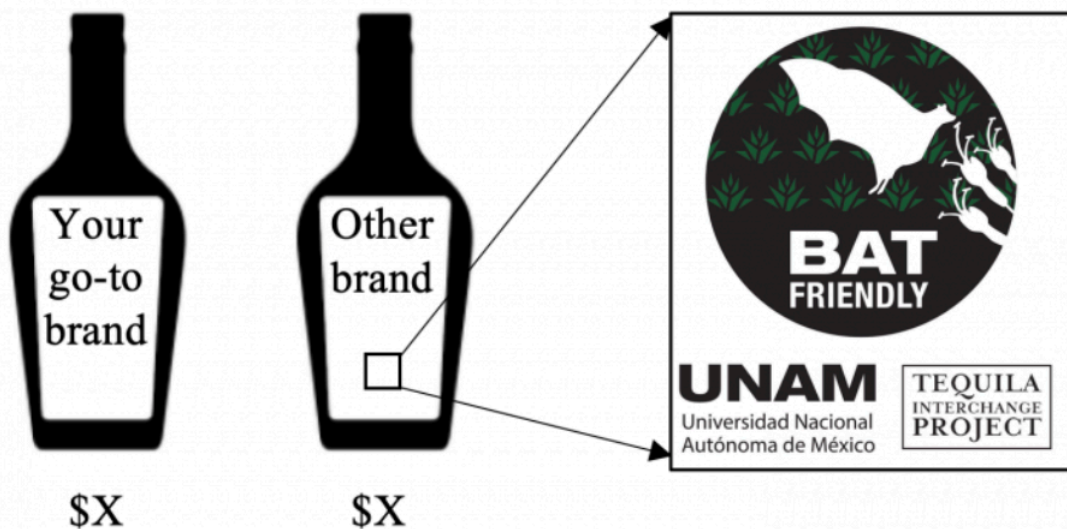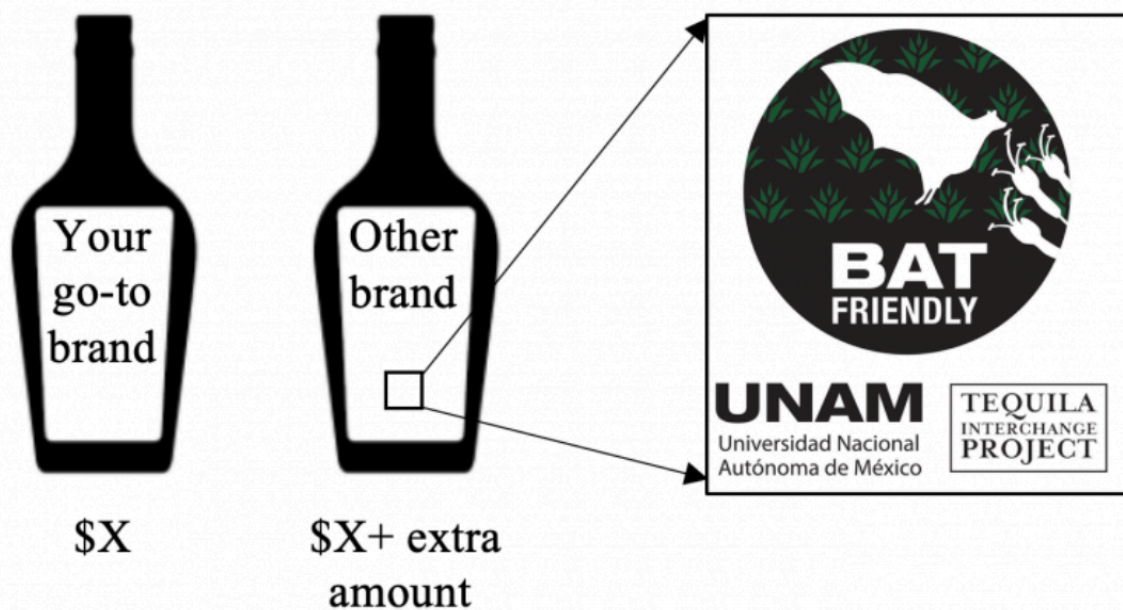

You can assume both are the same quality.

Both are listed for the same price ($X) that you are thinking of.

Would you be willing to buy the bat-friendly tequila?
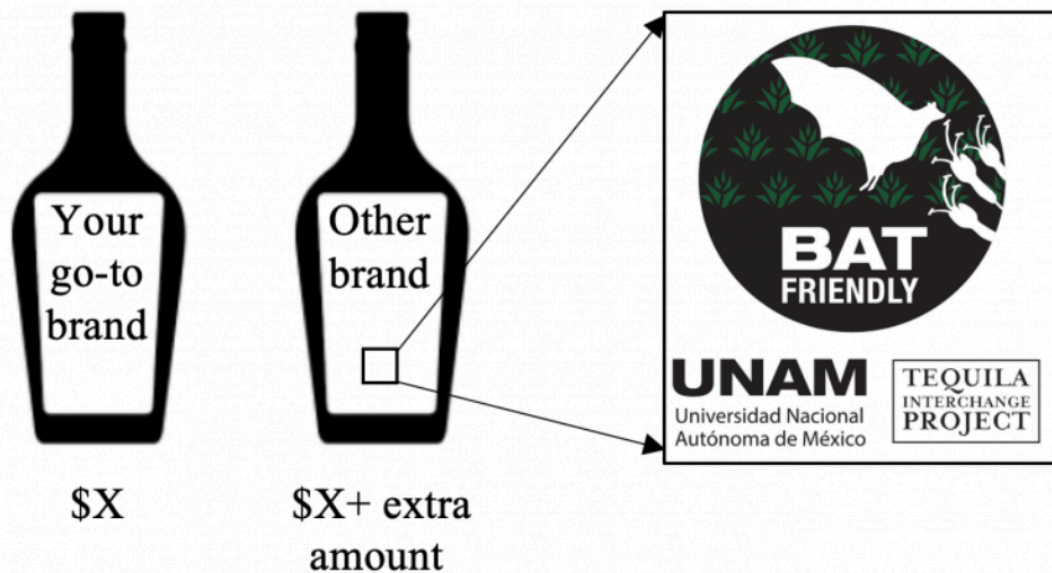
○ Yes, I would buy the bat-friendly tequila

○ No, I would not buy the bat-friendly tequila

Would you be willing to pay extra for the bat-friendly tequila (in addition to the amount $X you are already spending)?

○ Yes, I would pay extra for the bat-friendly tequila

○ No, I would not pay extra for the bat-friendly tequila

Please select the extra amount that you would be willing to pay. (US dollars)

○ $1 extra

○ $2 extra

○ $3 extra

○ $4 extra

○ $5 extra

○ Other amount (you must specify an amount)

Had you ever heard about bat-friendly tequila prior to this survey?

○ Yes

○ No

Do you consider bats to be pests?

○ Yes

○ No

Where did you hear about bat-friendly tequila? (Select all that apply)

- ☐ Social Media
- ☐ News Article
- ☐ News Broadcast
- ☐ Friend/Family
- ☐ Documentary/Video
- ☐ School
- ☐ Book/Magazine
- ☐ Other (please specify)

Please copy this ID into MTurk: ${e://Field/Random%20ID}

Once you have done this, please click the next button to submit your survey in order to get paid.

If your preferred brand were to become bat-friendly, would you continue buying that brand?

- ○ Yes
- ○ No

Appendix C: Pricing

Pricing Guide

Brand/Type*	Pricing	Logo Picture
Sauza Blue Silver	$13.99-$19.99	
Jose Cuervo Especial (Gold & Silver)	$16.99-$18.99	
Camarena (all types)	$17.99-$27.99	

Hornitos Plata/Reposado	$19.99-$24.99	
Hornitos Anejo	$25.99-$35.99	
1800 Silver/Reposado	$24.99-$29.99	
Patrón Silver	$36.99-$39.99	

Patrón Reposado/Anejo	$44.99-$52.99	
Don Julio Blanco/Reposado	$41.99-$46.99	
Tequila Ocho (all types)	$54.99-$64.99	

*Silver=lower price/quality, reposado=mid-price/quality, anejo=high price/quality
All prices received from https://www.bottledprices.com/tequila/ or totalwine.com
All pictures obtained from Google Image Search and were marked available for non-commercial reuse.