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# Chileans' willingness to pay for protected areas

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ABSTRACT

Chile is one of the ten most underfunded countries for conservation of protected areas in the world. The COVID-19 pandemic aggravated protected areas' funding situation by severely reducing tourism revenues. This paper studies whether Chilean households would be willing to support protected areas through donations or tariffs. Using a contingent valuation approach, we find that the average willingness to pay ranges from US$ 3 to US$ 8 per household per month, depending on specification. Estimated willingness to pay is 23% to 36% lower when households are asked to pay via tariffs instead of donations. We discuss our results relative to previous literature and evaluate its policy implications in the Chilean context. We find that a flat tariff sufficient for covering 70% of the current funding gap would be acceptable to 74% of Chile's households.

## 1. Introduction

Despite protected areas (PAs) importance in achieving conservation outcomes, studies have shown that countries do not allocate enough resources to effectively manage existing PAs and expand PA networks (Emerton et al., 2006; Flores and Bovarnick, 2016; Besancon et al., 2021; da Silva et al., 2021). This is the current context in Chile. The country has a well-known funding gap for protected areas (Ladron de Guevara, 2014; Petit et al., 2018). It has been listed among the ten most underfunded countries for conservation in the world (Waldron et al., 2013), and its expenditures per hectare of protected areas are lower than that of other countries in the region (OECD, 2016). The discussion about conservation finance is especially important nowadays as countries, including Chile, work to recover from the revenue loss caused by COVID-19 and to meet new conservation goals, such as the worldwide initiative to expand conservation areas to at least 30% of the planet by 2030 (CBD, 2021).

Researchers have been studying and proposing new financing mechanisms, but completely closing the funding gap remains an elusive goal (Dixon and Sherman, 1991; Spergel and Moye, 2004; Edwards, 2009; Mengarelli and Thelen, 2010; Dlamini and Masuko, 2013; Bonham et al., 2014; Cetara, 2015; Bohorquez et al., 2022). Because of the importance of tourism to PAs, several studies have focused on the feasibility of increasing entrance fees to augment revenues (e.g., Bruner et al., 2015; Platania and Rizzo, 2018; Iranah et al., 2018; Witt, 2019; Malky Harb et al., 2020). However, a common finding in this literature is that entrance fees, while important, might not be sufficient to cover the funding gap (Gelcich et al., 2013; Schuhmann et al., 2019; Maynard et al., 2019), especially in a post-pandemic context, where tourist flows continue to be below previous levels. Thus, alternative income streams beyond entrance fees are needed.

This study contributes to the literature on funding mechanisms by estimating households' willingness to pay for conservation in Chile, using the contingent valuation method. A key distinction between our study and previous work is that we estimate the willingness to pay for the wider Chilean population, instead of the subsample of households who choose to visit protected areas as tourists. This is important for two reasons. First, many households who do not frequently travel might still want to contribute to conservation goals, but they will remain an untapped resource if only entrance fees are considered. Second, the COVID-19 pandemic has reinforced the need for diversity of revenue sources for long-term solvency.

The second key distinction of our study relative to most existing work is that, following Jo et al. (2021), we evaluated willingness to pay separately for two payment vehicles: tariffs (as part of the electricity bill) and donations. There are theoretical reasons why estimated willingness to pay might differ based on the payment vehicle (Ackura, 2015) and why one might be preferable for policymakers. Because tariffs are mandatory, the elicited WTP might be perceived as more credible since respondents more easily internalize that they would be forced to pay regularly. Additionally, some studies suggest that tariffs should be used when valuing a public good such as PAs (Carson and Groves, 2007).

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From a public finance perspective, tariffs are preferable given their capacity to generate a stable revenue stream. On the other hand, tariffs are subject to protest responses due to the unpopularity of taxes and the skepticism that associated governmental entities will spend the tax revenue wisely (Moore et al., 2010).

As an alternative to tariffs, we also consider a voluntary monetary contribution, i.e., donations. This financing mechanism has been widely studied as a potential instrument to address PAs funding gap (Kubo et al., 2018). Voluntary contributions, however, are susceptible to issues of free-riding (Roesch-McNally and Rabotyagov, 2016) and strategic behavior (such as overstating respondents' true WTP) (Champ et al., 1997; Champ and Bishop, 2001; Bateman et al., 2004; Ivehammar, 2009). Thus because of the potential bias on the WTP estimate in both cases, we believe that providing both estimates in the same empirical context might offer bounds on the true willingness to pay of households in Chile.

## 2. Method

We conducted a Contingent Valuation (CV) survey to assess Chileans' willingness to pay for conserving protected areas. Contingent Valuation is a stated-preference method used to measure individuals' willingness to pay for non-market goods (McFadden and Train, 2017). Using survey questions, CV aims to elicit the monetary value of a specific good under a hypothetical scenario (Carson and Mitchell, 1993). Although some limitations of the CV method are well known by researchers (Diamond and Hausman, 1994; Shultz et al., 1998), the CV approach is the only method capable of measuring the total economic value, including the existence, bequest, and option values (Carson and Hanemann, 2005).

An on-phone questionnaire survey was conducted during the month of March of 2021 by a professional survey organization (named Datavoz). Despite the challenges associated with phone surveys (e.g., telephone coverage, no personal interaction, and absence of visual cues) (Holbrook et al., 2003; Kempf and Remington, 2007), we opted for this mode because of the impossibility of conducting an in-person survey at the beginning of 2021 due to the COVID-19 pandemic.[1]

The on-phone survey was done in three stages using the Random Digit Dialing (RDD) sampling frame. In the first stage, we conducted a pilot survey to test the understanding of the overall questions by respondents and to help determine the bid values. In this stage, the willingness to pay questions were open-ended questions. The sample size, in this stage, was 35 respondents, that were randomly selected by Datavoz using RDD. In the second stage, we conducted a second pilot survey. In this stage, we used close-ended questions on willingness to pay. For both payment vehicles, we assumed five different bid values. The minimum and maximum bid values were the ones found in the first pilot survey. The intermediary values were calculated in such a way that the intervals between two consecutive bid logarithms were always the same (Júdez et al., 2000). The final bids were rounded up to facilitate understanding. In this stage, we tested if the close-ended questions were well defined and comprehensible. In this stage, the number of respondents was 15. As before, they were selected randomly. In the third, and final stage, we conducted the full survey (see Supplementary Material for the questionnaire used). Datavoz contacted more than 16,000 households using the RDD sampling frame. Out of this total, about 10% agreed to participate in the survey. Given the whole adult population of Chile, this amount meant that the margin of error was 3%.

Specifically, about the survey, we divide it into three sections. In the first section, respondents were asked to answer a series of general information related to their knowledge of protected areas in Chile. These questions were important to be sure that respondents knew the subject and correctly understood what a protected area was. In the second section, respondents were read a paragraph briefly explaining the funding issues related to CONAF's capacity to manage protected areas, using neutral language. Respondents were also reminded to consider their overall budget and other spending obligations to increase the realism of the answers. After the paragraph and reminder, respondents were asked the willingness to pay questions and given a follow-up depending on their response. In the third, and last, section, we asked respondents a set of demographic questions.

Regarding the willingness to pay and follow-up questions, we asked respondents the following: (1) in the case of the tariff: *If the proposed fee added to your electricity bill were to cause your household expenses to increase by $X pesos per month, would you be willing to pay?* (2) in the case of the donation: *If this new provision were implemented and you were asked to make a contribution of $X pesos per month to Chile's Protected Areas, would you be willing to donate this value per month?* In both cases, the goal is to have an estimate of the average willingness to pay per household.

Depending on the answer to the willingness to pay questions above, a higher or lower value would be asked in the follow-up question. The use of follow-up questions to establish willingness to pay is justified by the literature that suggests that the use of the double-bounded dichotomous choice model is more efficient than the single-bounded model and that, on finite samples, it increases precision (Hanemann et al., 1991). When the sample is sufficiently large, however, the difference in terms of efficiency between single and double-bounded models tends to be reduced (Calia and Strazzera, 2000).

Table 1 shows the values of the first and second bids in each one of the surveys developed. In this study, we assumed five bid values resulting in five surveys that were randomly assigned to respondents. (See Table 2.)

As shown in Table 1, the value of the second bid is contingent upon the respondent's response to the first bid. If the response to the first bid is "yes", then the second bid is greater than the first one; if the response to

**Table 1**
Double-bounded dichotomous choice bid mechanism.

| Survey | First bid | Respondent's response | Second bid |
|---|---|---|---|
| Survey 1 | $ 1000 (US$ 1.4) | Yes | $ 2000 (US$ 2.7) |
| | | No | $ 500 (US$ 0.7) |
| Survey 2 | $ 2000 (US$ 2.7) | Yes | $ 3000 (US$ 4.1) |
| | | No | $ 1000 (US$ 1.4) |
| Survey 3 | $ 3000 (US$ 4.1) | Yes | $ 6000 (US$ 8.2) |
| | | No | $ 2000 (US$ 2.7) |
| Survey 4 | $ 6000 (US$ 8.2) | Yes | $ 10,000 (US$ 13.7) |
| | | No | $ 3000 (US$ 4.1) |
| Survey 5 | $ 10,000 (US$ 13.7) | Yes | $ 13,000 (US$ 17.8) |
| | | No | $ 6000 (US$ 8.2) |

Prices are in Chilean Pesos. In parenthesis, we included the prices in US dollars. The exchange rate used to make the conversion was USD $ 1 to CLP $ 729 (March 31st, 2021).

[1] We did not consider mail surveys as an alternative to phone surveys for three reasons. The first was time limitations. We made the decision to conduct a phone survey under the assumption that this method would provide data faster than the mail survey. We had some time constraints to conduct the research because of initial deadlines agreement with the funder of the project. The second reason was that, although we tried to develop simple and straightforward survey questions, we believe that having trained interviewers that could assist and provide clarifications (without biasing the answers) would be preferable. The third reason is that contingent valuation by mail is more likely to suffer from more selection bias, and we wanted to have results that would be representative of the Chilean population (after being reweighted).

**Table 2**
Number of respondents by survey.

| | Percentage of respondents | Number of respondents |
|---|---|---|
| Survey 1 | 19.7% | 304 |
| Survey 2 | 19.9% | 308 |
| Survey 3 | 20.3% | 313 |
| Survey 4 | 19.9% | 307 |
| Survey 5 | 20.3% | 313 |
| Total | 100% | 1545 |

the second bid is "no", then the amount asked in the follow-up question is smaller than the first one. Thus, there are four possible results: (a) "yes, yes"; (b) "yes, no"; (c) "no, yes"; and (d) "no, no". In the case respondents were unwilling to pay ("no, no"), we asked them to choose the primary reasons for their unwillingness from a set of possible alternatives (see Supplementary Material for the questionnaire used). The aim of this additional question is to distinguish possible protest responses from "real zeros". In the case of this study, we consider all options related to disbelief in government and other institutions as a protest response (for example, "I don't trust the government to give the money to the environmental/park management agencies" or "I don't think the park management agencies are effective"). Responders that selected one of these options were excluded from the sample.

To estimate the double-bounded model or dichotomous question with a follow-up question, we follow Lopez-Feldman (2013). The underlying assumption of this model is that WTP follows a linear function and that the error term is normally distributed:

$$WTP_i(Z,u_i) = Z_i \cdot \beta + u_i, u_i \sim N(0,\sigma) \quad (1)$$

Where $i$ corresponds to respondent, $Z_i$ is a vector of explanatory variables, and $u_i$ is the error term. Besides the bid values, we include the following demographic characteristics among the explanatory variables: gender, age, education level and income. We also include two additional explanatory variables: time that it takes to get to the closest protected area, and a dummy variable equal to 1 if the respondent has previously visited a protected area and 0 otherwise.

Under this model, the probability of each one of the four possible results is the following:

1. $Prob(yes,yes) = Prob(WTP \geq second\ bid)$
2. $Prob(yes,no) = Prob(first\ bid \leq WTP < second\ bid)$
3. $Prob(no,yes) = Prob(second\ bid \leq WTP < first\ bid)$
4. $Prob(no,no) = Prob(WTP < second\ bid)$

By substituting (1) into the probabilities above and under the assumption of normality, we estimate the WTP in two steps. In the first step, we estimate the parameters $\beta$ and $\sigma$ by maximum likelihood. The log-likelihood function is:

**Table 3**
Demographic characteristics of respondents.

| Characteristic | | Unweighted percentages | Weighted percentage | Number of respondents |
|---|---|---|---|---|
| Gender | Female | 53% | 51% | 655 |
| | Male | 47% | 49% | 573 |
| Household income[a] | Under 300,000 | 23% | 30% | 281 |
| | 300,001 - 600,000 | 30% | 32% | 374 |
| | 600,001 - 1,200,000 | 18% | 15% | 224 |
| | 1,200,001 - 1,800,000 | 7% | 5% | 85 |
| | 1,800,000 - 2,500,000 | 3% | 2% | 41 |
| | Over 2,500,001 | 4% | 2% | 50 |
| Education level | Without basic studies | 0.2% | 0.4% | 3 |
| | Primary (incomplete + complete) | 10% | 21% | 128 |
| | Secondary (incomplete + complete) | 48% | 53% | 584 |
| | University (incomplete + complete) | 37% | 23% | 452 |
| | Postgraduate | 5% | 2.6% | 61 |
| Age | 18–24 | 13% | 13% | 163 |
| | 25–34 | 26% | 21% | 315 |
| | 35–44 | 19% | 18% | 235 |
| | 45–54 | 15% | 16% | 186 |
| | More than 55 years old | 27% | 32% | 329 |

[a] About 14% of the respondents were not able to or did not want to respond to the household income question.

In the second step, the mean WTP is calculate as $E(WTP|\bar{z}) = \bar{z}'\hat{\beta}$, where $\bar{z}$ is a vector containing the weighted average demographic characteristics of the sample and $\hat{\beta}$ is the maximum likelihood parameter estimated in the first step. The inclusion of the sample weights is necessary to permit inferences to the Chilean population.

The demand curve is obtained calculating the shares of individuals with particular levels of $z$ that would make the payment (that is, WTP is larger than the price, p), and then integrating over the distribution of $z$:

$$D(p) = \int \int_{-\infty}^{\infty} 1\{z_i\beta + u_i \geq p\} f(u_i) du_i dz_i \quad (3)$$

Using the empirical distribution of $z$ as the approximation of the populational distribution, and some algebraic manipulations, the de-

$$L(\beta,\sigma) = \sum_{i=1}^{1,228} d_i^{y,y} ln\left(\phi\left(Z_i\frac{\beta}{\sigma} - \frac{Bid_2}{\sigma}\right)\right) + d_i^{y,n} ln\left(\phi\left(Z_i\frac{\beta}{\sigma} - \frac{Bid_1}{\sigma}\right) - \phi\left(Z_i\frac{\beta}{\sigma} - \frac{Bid_2}{\sigma}\right)\right) + d_i^{n,y} ln\left(\phi\left(Z_i\frac{\beta}{\sigma} - \frac{Bid_2}{\sigma}\right) - \phi\left(Z_i\frac{\beta}{\sigma} - \frac{Bid_1}{\sigma}\right)\right) + d_i^{n,n} ln\left(\phi\left(Z_i\frac{\beta}{\sigma} - \frac{Bid_1}{\sigma}\right)\right) \quad (2)$$

Where $d_i^{y,y}$ is a dummy variable equal to 1 if respondent answered yes to the first and second bids and 0 otherwise; $d_i^{y,n}$ is a dummy variable equal to 1 if respondent answered yes to the first bid and no to second bid and 0 otherwise; $d_i^{n,y}$ is a dummy variable equal to 1 if respondent answered no to the first bid and yes to second bid and 0 otherwise; and, finally, $d_i^{n,n}$ is a dummy variable equal to 1 in the case respondent answered no to both bids and 0 otherwise.

mand curve (as a fraction of the population who would make the payment) is estimated by Eq. 4:

$$\frac{D(p)}{N} = 1 - \frac{1}{N}\sum_{i}^{1,228} \omega_i \bullet \phi\left(\frac{p - z_i\hat{\beta}}{\hat{\sigma}}\right) \quad (4)$$

Where $p$ is the price, $\hat{\beta}$ and $\hat{\sigma}$ are maximum likelihood estimates, $\omega_i$ is the sample weight, and $N$ is the number of respondents.

**Table 4**
First step of the WTP estimation: maximum likelihood estimation of the parameters $\boldsymbol{\beta}$ and $\boldsymbol{\sigma}$.

| | (1) | (2) | (3) |
|---|---|---|---|
| *Beta* ($\beta$) | | | |
| Gender = Female | | 174.0 | 312.4 |
| | | (392.7) | (459.7) |
| Household income | | −57.24 | −13.68 |
| | | (102.2) | (126.1) |
| Education level | | 160.1* | 118.1 |
| | | (96.35) | (115.5) |
| Age | | −61.43*** | −56.00*** |
| | | (12.47) | (14.85) |
| Previously visited protected areas | | 117.1 | 460.9 |
| | | (445.6) | (657.5) |
| Time it takes to get to the closest protected area | | | −27.68 |
| | | | (48.78) |
| Constant | 5340*** | 6928*** | 6504*** |
| | (195.0) | (949.1) | (1201.5) |
| *Sigma* ($\sigma$) | | | |
| Constant | 6025*** | 5891*** | 5678*** |
| | (212.5) | (209.6) | (239.4) |
| Number of observations | 1228 | 1193 | 810 |

This table presents the results from the first step of the estimation of the WTP model. Each column shows the maximum likelihood estimates of $\beta$ (which determines how covariates affect the mean WTP of an individual, along with an intercept) and $\sigma$ (which determines the variability of WTP for individuals with the same set of covariates). The models in different columns differ in the set of covariates used. Standard errors are reported in parentheses. *** represents coefficient significance at 1%, ** represents coefficient significance at 5%, and * represents coefficient significance at 10%.

## 3. Results

In total, 1545 people were fully interviewed by Datavoz. However, out of this total, 317 were removed from the sample for their protest response to the WTP questions. As a result, the final sample was composed of 1228 respondents. Table 3 shows the demographic characteristics of these respondents. Overall, the final sample seems to be a fair representation of the Chilean population (see Supplementary Material Table S1 for the population percentages). The comparison between the unweighted and weighted percentages shows that there is a small bias towards respondents with high income and education levels. Additionally, the sample has a higher proportion of women when compared to Chilean population.

Table 4 shows the results from the maximum likelihood estimation considering the combined sample. Under this specification, we do not differentiate WTP by payment vehicle. The first column of Table 4 shows an WTP model where we ignore covariates, such that the only element of $\beta$ is a constant. The second column shows the model considering most of the explanatory variables described in the methodological section. We included all demographic variables presented in Table 3 plus a dummy variable equal to 1 if the respondent has previously visited a protected area and 0 otherwise. The third, and last column, shows the model considering the same explanatory variables in (2) but with the additional variable of the number of hours that the respondent takes to get to the closest protected area. The reason for not including this variable in (2) is the higher number of missing data, and therefore a lower total number of respondents.

Table 5 shows estimates of the average WTP for each of the three specifications above. Comparing the results from Columns (1) and (2) in Table 5, we have that the model is robust to the inclusion of explanatory variables. This result should be expected given the random sampling process that we took to survey Chileans. However, we find a lower WTP when including the variable number of hours. Although this variable is not statistically significant to explain changes in the probability (Table 4), its introduction considerably reduces the sample leading to a less precise estimate. Because of that, comparisons between the previous results and the one in Column (3) are difficult. Our preferred specification, in this case, is given by the model in Column (2). Based on this, Chileans would be willing to pay approximately US$ 7 per month for the conservation of protected areas.

Using our preferred specification, Tables 6 and 7 show the first and second steps of the WTP estimation using separate models for each payment vehicleBased on the results, Chileans would be willing to pay either US$ 6 or US$ 8 per month for conservation of protected areas, depending on the payment vehicle. The lower value is associated with the extra tariff while the higher value is associated with the donation. Both are significantly different from zero, at the 1% confidence level.

Following Jo et al. (2021), to test whether the difference between the WTP between donation and tariff is significant, we performed a *t*-test. We can reject the null hypothesis that the estimates are the same at the 1% significant level. The WTP of respondents that were asked about donation is 1308 pesos chilenos (approximately US$ 1.8) greater than the WTP of respondents that were asked about the electricity tariff.

Fig. 1 shows the demand curves calculated from Eq. 4 considering the two payment vehicles. As expected, both demand curves slope downward. In the case of the tariff in the electricity bill, about 74% of

**Table 5**
Second step of the WTP estimation: mean WTP as a linear combination of the regressors.

| | (1) | (2) | (3) |
|---|---|---|---|
| WTP (in Chilean Peso) | 5340*** | 5079*** | 4812*** |
| | (195.05) | (214.72) | (475.90) |
| Number of observations | 1228 | 1193 | 810 |

This table presents the results from the second step of the estimation of the WTP. We calculate the mean WTP per household per month, among Chilean households, as $\bar{z}'\hat{\beta}$, where $\bar{z}$ is the vector of representative averages for the covariates (including a constant) and $\hat{\beta}$ is the maximum likelihood estimate from the corresponding column of Table 4. Standard errors are reported in parentheses. *** represents coefficient significance at 1%, ** represents coefficient significance at 5%, and * represents coefficient significance at 10%.

**Table 6**
By payment vehicle. First step of the WTP estimation: maximum likelihood estimation of the parameters $\boldsymbol{\beta}$ and $\boldsymbol{\sigma}$.

| | (1) | (2) |
|---|---|---|
| | Donation | Electricity bill tariff |
| *Beta* ($\beta$) | | |
| Gender = Female | 547.8 | −151.7 |
| | (555.5) | (551.3) |
| Household income | −300.3** | 209.0 |
| | (144.3) | (143.1) |
| Education level | 129.5 | 189.9 |
| | (136.9) | (134.0) |
| Age | −47.45*** | −70.01*** |
| | (17.78) | (17.39) |
| Previously visited protected areas | 28.25 | −2.90 |
| | (639.6) | (616.6) |
| Constant | 7697*** | 5984*** |
| | (1355) | (1311) |
| *Sigma* ($\sigma$) | | |
| Constant | 5929*** | 5741*** |
| | (289.2) | (298.4) |
| Number of observations | 607 | 586 |

This table presents the results from the first step of the estimation of the WTP models, estimated separately by payment vehicle (Donation vs. Tariff). Each column shows the maximum likelihood estimates of $\beta$ and $\sigma$ obtained from the appropriate subsample corresponding to each payment vehicle. It is analogous to Column 2 in Table 4. Standard errors are reported in parentheses. *** represents coefficient significance at 1%, ** represents coefficient significance at 5%, and * represents coefficient significance at 10%.

**Table 7**
By payment vehicle. Second step of the WTP estimation: mean WTP as a linear combination of the regressors.

| | (1) | (2) |
|---|---|---|
| | Donation | Electricity bill tariff |
| WTP (in Chilean Peso) | 5741*** | 4433*** |
| | (310.74) | (296.15) |
| Number of observations | 607 | 586 |

This table presents the results from the second step of the estimation of the WTP, separately by payment vehicle. We calculate the mean WTP per household per month, among Chilean households, as $\bar{z}'\widehat{\beta}$, where $\bar{z}$ is the vector of representative averages for the covariates (including a constant) and $\widehat{\beta}$ is the maximum likelihood estimate from the corresponding column of Table 6. Standard errors are reported in parentheses. *** represents coefficient significance at 1%, ** represents coefficient significance at 5%, and * represents coefficient significance at 10%.

the households in Chile would be expected to be willing to pay $ 500 Chilean Pesos per month (less than US$ 1), and 5% at $ 13,000 Chilean Pesos (US$ 18) per month. For donations, the percentage of people willing to pay increases to 82% and 14%, respectively.

## 4. Discussion

### *4.1. Magnitude of the estimates and the funding gap in Chile*

To understand the policy relevance of these estimates, we conduct two simple computations that compare them to the funding gap for protected areas calculated by Ladron de Guevara (2014). First, we multiply the average willingness to pay (US$ 6 per month), considering the tariff, by the total number of households in Chile (INE, 2021). We calculate a potential revenue at US$ 34 million per month, or approximately US$ 407 million per year. This annual amount would be enough to cover Ladrón de Guevara's figure for the funding gap estimated at US$ 231 million to fulfill all international commitments.

To compute the second benchmark, we note from the estimated demand curve that 50% of Chilean households would be willing to contribute with at least $ 6000 Chilean Pesos (US$ 8) per month. If we assume that half of households in Chile - about 2,825,818, based on the 2017 Census (INE, 2017) - would pay US$ 8 for conservation per month, then the amount of financial resources generated would be approximately US$ 23 million per month, or US $ 271 million per year (Table 8). That value would also be enough to cover the funding gap mentioned above. In Subsection 4.3 below, we provide concrete examples of policies that could be implemented based on our estimates, taking into account the differences between the two payment vehicles.

### *4.2. Comparison to the literature and the role of protest votes*

Previous international studies on citizens' willingness to pay for conservation differ regarding specific goals, samples, and model

**Table 8**
Potential monthly revenue from donation by price.

| Donation value | Percentage of households paying for conservation | Monthly revenue from donation (US $) |
|---|---|---|
| US $ 0.7 | 81.51% | 3,224,655 |
| US $ 3 | 74.24% | 12,587,326 |
| US $ 8 | 49.92% | 22,570,378 |
| US $ 18 | 13.57% | 13,804,689 |

This Table illustrates the revenue potential from donations. The first column shows hypothetical donation values, assuming that all households that donate would donate that value. The second column shows the share of households that would be willing to donate that amount based on the estimated WTP model, illustrated in Fig. 1. The third column translates the first two numbers into total revenues, assuming that there are 5651, 637 households in Chile based on the 2017 Census (Jo et al., 2021).

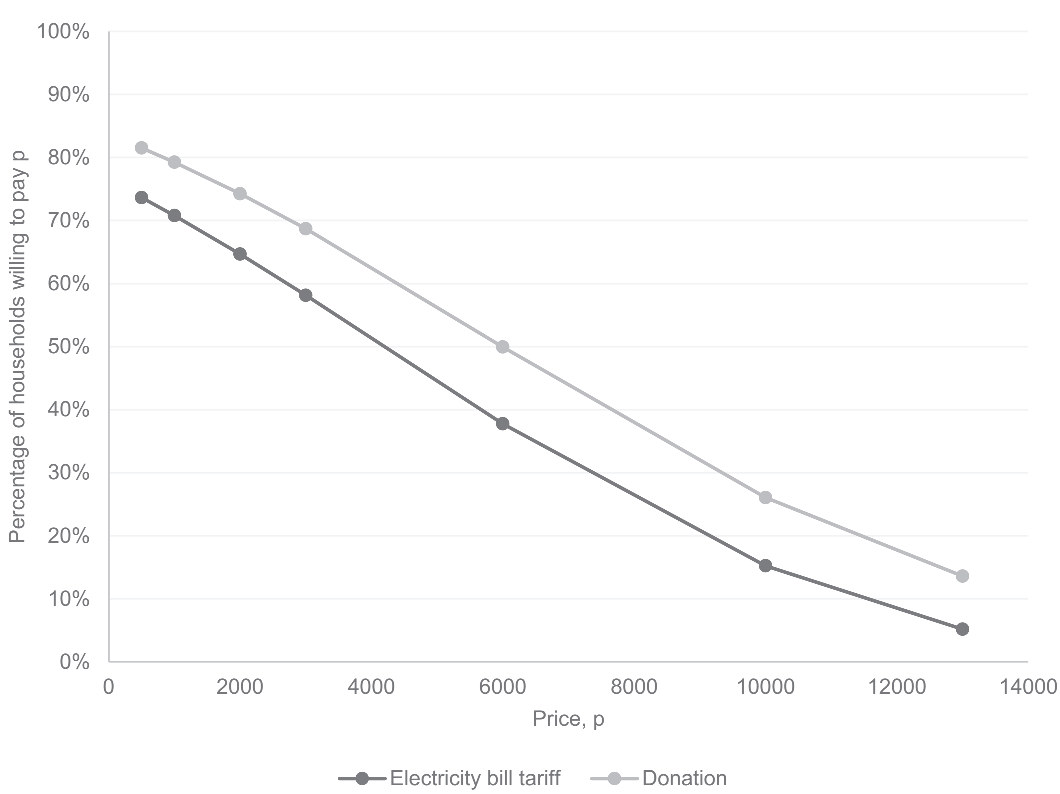


**Fig. 1.** Demand curve for improving management to better conserve protected areas in Chile.

specification. Our study, although not completely comparable, would be more closely related to the following studies conducted in South Korea, Ecuador, and Brazil. Jo et al. (2021) estimated South Korean citizens willingness to pay under two payment vehicles (donation and tariff) for the promotion of forest management activities through an online survey. They found a willingness to pay between US$ 13 and US$ 18 per year in the case of tariffs and US$ 11 and US$ 24 per year in the case of donations. Gordillo et al. (2019) used a nationwide contingent valuation survey of Ecuador to estimate households' willingness to pay for a proposed forest conservation program aiming to avoid deforestation in the country. In total, they surveyed 976 households and found a monthly average willingness to pay per household between US$ 3.17 and US$ 6.28. Finally, Adams et al. (2008) estimates residents' willingness to pay for a protected area in Brazil named Morro do Diabo located in São Paulo. The payment vehicle evaluated was a monthly tariff charged on the interviewee's water bill. The authors found a positive mean willingness to pay equal to US$ 0.06 per month for the conservation of the protected area.

In common among these studies is the underlying discussion about valid responses. As noted in Pakhtigian and Jeuland (2019), there is a precedent in the literature on contingent valuation for removing protest votes from the analysis, primarily to address concerns about a possible underestimation of the WTP as some respondents reject the hypothetical scenario but do have a positive WTP. However, some studies pointed out that the exclusion of these observations might lead to a self-selection bias (Calia and Strazzera, 2001; Ramajo-Hernández and del Saz-Salazar, 2012). Given the potential policy implication of this study, we opt to replicate the WTP calculation including protest responses. This exercise might be relevant especially in the case of the tariff – expected to be paid by all households in Chile.

Tables 9 and 10 Column (1) shows the mean WTP considering all respondents and under our preferable specification. Columns (2) and (3) show the results by payment vehicle. The results in Table 10 show a lower willingness to pay when compared to estimates from the main model (without protest bids). The mean WTP reduces from $ 5341 to $ 3222 Chilean Pesos (or from US$ 7 to US$ 4). The same occurs when restricting the sample to payment vehicles. In the case of donation, WTP changes from US$ 8 to US$ 5 while, in the case of the extra tariff in the electricity bill, the WTP reduces from US$ 6 to US$ 3 per month.

**Table 9**
Maximum likelihood estimation of $\beta$ and $\sigma$ including protest bid observations.

| | (1) Combined model | (2) Donation | (3) Electricity bill tariff |
|---|---|---|---|
| *Beta* ($\beta$) | | | |
| Gender | 100.3 | 433.0 | −160.9 |
| | (409.6) | (577.5) | (575.7) |
| Household income | −98.16 | −377.5** | 202.3 |
| | (105.1) | (147.6) | (148.0) |
| Education level | 151.2 | 141.5 | 152.4 |
| | (102.3) | (144.2) | (143.4) |
| Age | −65.01*** | −56.24*** | −69.26*** |
| | (13.13) | (18.44) | (18.51) |
| Previously visited protected areas | −116.1 | −122.8 | −262.8 |
| | (471.3) | (668.4) | (658.5) |
| Constant | 5581*** | 6601*** | 4448*** |
| | (993.2) | (1404) | (1388) |
| *Sigma* ($\sigma$) | | | |
| Constant | 6826*** | 6823*** | 6704*** |
| | (250.8) | (342.6) | (360.9) |
| Number of observations | 1499 | 753 | 746 |

This table presents the results from the first step of the estimation of the WTP models, estimated separately by payment vehicle (Donation vs. Tariff). If differs from Tables 4 and 6 because the models are estimated using the full sample, including ``protest bid'' observations (see discussion in Subsection 4.2). Each column shows the maximum likelihood estimates of $\beta$ and $\sigma$. Standard errors are reported in parentheses. *** represents coefficient significance at 1%, ** represents coefficient significance at 5%, and * represents coefficient significance at 10%.

**Table 10**
Mean WTP including protest bid observations.

| | (1) Combined model | (2) Donation | (3) Electricity bill tariff |
|---|---|---|---|
| WTP (in Chilean Peso) | 3222*** | 3948*** | 2530*** |
| | (230.27) | (325.06) | (325.84) |
| Number of observations | 1499 | 753 | 746 |

This table presents the results from the second step of the estimation of the WTP, separately by payment vehicle. It is analogous to Tables 5 and 7 but differs from them because the models are estimated using the full sample, including ``protest bid'' observations (see discussion in Subsection 4.2). Standard errors are reported in parentheses. *** represents coefficient significance at 1%, ** represents coefficient significance at 5%, and * represents coefficient significance at 10%.

Based on the results on Table 10, Chileans continue to be willing to contribute to better conserve protected areas in the country, although their willingness to pay falls almost by half. This result suggests that the Chilean government might be able to use one of these instruments as an additional revenue source to conserve protected areas even in a more adverse scenario with protest responses.

### 4.3. *Conservation policy in Chile: Tariffs or donations?*

Our results might help policymakers implement new revenue sources in Chile in two ways. First, they provide context-specific guidance on the differences of using tariffs or donations. Second, the estimated demand curves are useful for obtaining realistic estimates of how much could be raised under each payment vehicle.

An important aspect in deciding between payment vehicles is the expected amount of resources raised. At first sight, our results seem to give an edge to donations on this regard, since we find higher expected WTP using that payment vehicle. That result is consistent with what most papers in this literature find, as reviewed by Ackura (2015). However, the difference in expected WTP does not directly translate into a difference expected revenues because tariffs are mandatory, and donations are not. That is, tariffs have the advantage of a large "base:" even if the amount per household is small, the fact that most or all households will pay might compensate for the fact that note everyone might donate regularly (or they might choose to donate to other causes). Regular fundraising campaigns might help increase the share of households donating, but that probably requires significant overhead costs. Tariffs tied to the electricity bill, on the other hand, would lead to minimal overhead costs. Finally, there is the risk that the donation WTP is biased upwards due to free-riding. Given these points, and the fact that the differences in estimated mean WTP are not too large, it does not seem that donations have an edge on this regard.

In addition to the expected amount of revenues, the payment vehicles may also differ in the variability of the revenues over time. All else equal, a stable revenue stream is preferable to a highly fluctuating one. In the case of voluntary contributions, the revenue would vary throughout the year as households respond to negative income shocks. Tariffs are not subject to the same problem. The biggest concern, on a longer-term perspective, is if the government uses tariff revenues in areas other than conservation of protected areas. It is possible that this institutional risk may be attenuated by legal means, though that discussion goes beyond our expertise.

Now we turn to discussing the revenue potential of a tariff based on our estimated WTP curve and household data in the Chilean context. To start with, we consider a tariff equal to the mean WTP using tariffs. We will use the lower estimate from the sample including protest bids to obtain a conservative estimate of the revenue potential (Table 10, Column 3). In 2017, the median monthly income per household was $ 835,897 Chilean Pesos (MDSF, 2021). In the same year, the median expense was $ 810,315 Chilean Pesos (INE, 2017). If an extra tariff in the electricity bill of $2530 Chilean Pesos were implemented, the monthly median available income (i.e., income – expense) would fall by 10%. The percentage would be even higher for the most vulnerable households in Chile. As a result, the implementation of the tariff at US$ 3 per month does not seem to be feasible when considering the country's current economic condition.

One possibility to overcome this and still generate revenue to conserve protected areas would be to lower the value that would be charged from all households in Chile. If the tariff had the same size as the lowest bid in the survey (US$ 0.7), then the monthly revenue that would be generated to support protected areas would be approximately US$ 4 million per month (or US$ 48 million per year). Although under this scenario the funding gap would not be closed, the amount generated would represent almost 70% of the US$ 70 million funding gap. In this case, considering the median income and expense, the monthly available income would fall by only 2%.

We acknowledge that the decision to implement a tariff depends on other variables not considered in this study such as the cultural and social aspects. Our goal in this discussion is to encourage further discussion by conservationists, politicians, and policymakers on this topic, since it appears that tariffs might be a feasible means to contribute to close the funding gap. Based on the estimated WTP curve, about 74% households in Chile would be willing to pay US$ 0.7 per month to help conserve protected areas in the country, suggesting that such a proposal might not be politically viable. More progressive tariffs—for example, higher tariffs for consumers with more electricity consumption—could be equally easy to implement and find even higher political support, conditional on the same amount of revenues being collected.

## 5. Conclusions

Chile's current constitutional debate presents a unique opportunity for government institutions and society to discuss how best to manage public lands and resources. These conversations are likely to include measures to protect and conserve the existing protected areas in the country in an effective way. Chile continues to be one of the most underfunded countries for conservation, and, as a result, protected areas are poorly managed. To support the permanent management and sustainable long-term revenue generation, the inclusion of additional finance sources is necessary, and where possible have these additional funds allocated to relevant management agencies.

Most studies have focused on entrance and user fees, which primarily target foreign tourists. Due to the repercussions of COVID-19 on protected area budgets globally, this study focused on two alternative revenue sources focused on the local population: donations and tariffs. By using a contingent valuation approach and applying a survey to households in Chile, we found a positive and statistically significant willingness to pay. The estimate ranges from US$ 6 to US$ 8 per month depending on the payment vehicle. To guarantee a constant revenue generation, our study suggests that tariffs would be a better option for the Chilean government to implement. However, considering protest responses and the median household income and expense, we propose to lower the tariff value to US$ 0.7 per month. Based on the demand curve, this amount is acceptable by 74% of Chile's households and would cover about 70% of the current funding gap, considering the basic daily needs.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

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