The Efficiency Of Tax Deductions For Charitable Donations Reevaluated: Evidence From Environmental Groups

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Abstract

Deductibility of charitable donations makes giving less costly, but comes at the opportunity cost of forgone tax revenue. The deduction is considered efficient if it generates at least as much in additional donations as the government forgoes in revenue, or if the tax price elasticity of giving is at least one. However, efficiency depends not only on additional donations, but also on the value of the public goods produced by those donations. We reevaluate the efficiency of the tax deduction in the context of environmental nonprofits producing water quality as a public good. First, we estimate the price elasticity of giving. Second, we estimate public good provision models to measure to measure the impact of contributions on water quality. Third, we use existing estimates of the value of water quality improvements to calculate the value of the public good generated by each additional dollar donated. We then calculate the efficiency of the tax deduction in terms of the change in value of public good produced relative to a change in the price of giving. Our results suggest that the contributions generate insufficient public good values to render tax deductions efficient.

Keywords: Public Goods, Tax Deduction, Nonprofits, Water Quality

JEL Codes: L31, Q53

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1 Introduction

In the U.S., taxpayers may deduct their donations to nonprofit organizations registered with the Internal Revenue Service (IRS) as public charities. Controversy has plagued this tax deductibility policy since its inception in 1917. Legislators argued then that preferential treatment would boost private giving by the wealthy, a primary source of financial support for worthy causes that would otherwise suffer (Aprill, 2000). Lacking further compelling rationale, current government officials regularly debate the advantages of the charitable deduction, calling for amendments that range from capping the deduction to abolishing it. Deductibility makes giving less costly for donors, proportional to their marginal tax rate. For instance, if an individual's tax on their last dollar of income is 35%, donating $100 to a nonprofit costs $65; the "price" of giving a dollar is 65 cents. However, there is a trade-off, as deductions of charitable donations come at the opportunity cost of collecting tax revenue. The deduction is considered treasury efficient if it generates at least as much additional donations to nonprofits as the government forgoes in tax revenue. Accordingly, much of the empirical research on tax deductibility estimates the effects of changes in tax rates on donors' contributions, measured as the price elasticity of giving. Most of this literature finds the deduction is at least treasury neutral; that is, one dollar of tax revenue forgone generates at least one dollar of contributions.

Yet, the 1.5 million nonprofit organizations in the U.S. do more than collect contributions (National Center for Charitable Statistics, 2019). Many of them supply public goods and services, stepping in to fill gaps left by markets, government agencies, and the political process. Treasury efficiency neglects the actual provision of public goods by implicitly assuming that one additional dollar of donations translates into an additional dollar of public good provision. The efficiency of the tax deduction needs to consider not only the donations generated, but also the amount of public goods produced by those donations, as measured by the value of those public goods.

The purpose of this paper is to examine whether considering the outcomes of charitable giving can alter conclusions about efficiency. We reevaluate the efficiency of the tax deduction by calculating a price elasticity for the value of the public good: the percentage change in the value of the public good induced by a one percent decrease in the price of giving. We use donations to environmental nonprofits focused on water resources, which affects the public good of the water quality of rivers, streams, lakes and other surface water bodies. Currently, over 25,000 environmental groups exist within the U.S., as registered by the Internal Revenue Service (Guidestar 2019). In 2020, donors gave over $16 billion to these nonprofits, an increase of 10% relative to the preceding year (Center on Philanthropy at Indiana University, 2021). We focus on the value of public goods provided by contributions to these nonprofits, and do not set out to compare it with public goods generated by additional tax revenue. Measuring the effects of government expenditures on water quality is beyond the scope of this paper, but we examine how assumptions about the use of the marginal dollar of tax revenue affect our conclusions in the Discussion section.

We build on seminal work by Duquette (2016), who examines how tax incentives affect donations to nonprofits using a panel of reported contributions from the organizations' IRS filings. We implement two sets of econometric models. The first set provides panel estimates of the price elasticity of giving to environmental nonprofits. The second set estimates public good provision, using instrumental variable techniques to measure the impact of these contributions on water quality. We then turn to other literature, finding estimates of the value of water quality improvements measured through their impact on home prices and on demand for water recreation. We multiply the impacts to calculate the total effect of changes in the price of giving on the value of the public good.

This paper makes several contributions. First, the paper contributes to the literature that evaluates the tax deductibility of donations; we provide a summary in the next section that expands on the meta-analysis by Peloza and Steel (2005). To our knowledge, we are the first to extend the traditional analysis of efficiency to include the value of public goods generated by nonprofits. We also contribute to the growing literature on environmental nonprofits and provision of public goods. Sundberg (2006) examines the relationship between public goods provided by preservation of open space and land trust membership. He finds evidence that members of most trusts are motivated by reasons related to the public good nature of preservation, such as members' unwillingness to free-ride or because of impure altruism. Albers et al. (2008) analyze the relationship between land trust conservation decisions and the location of public conservation land. They find evidence that privately protected areas are clustered in space, and that public protection can either stimulate or stifle nearby conservation. Parker and Thurman (2011) examine the effects of federal land programs on private conservation by land trusts. They find evidence of crowding-in of private conservation by federal conservation programs, and crowding-out by federal landholdings. Kosnik (2006) investigates the sources of regulatory delay in dam relicensing by the Federal Energy Regulatory Commission. She finds that environmental groups slow down the relicensing process, because some groups may trade off increased regulatory speed for additional environmental mitigation requirements. Grant and Grooms (2017) find evidence that the presence of environmental groups reduces regulatory inspections and increases compliance in the context of the Clean Water Act. Grant and Langpap (2020) present evidence that local water quality affects contributions to environmental nonprofits, as well as their fundraising expenditures. We expand on previous work, which shows that environmental group presence and expenditures increase water quality in a watershed (Grant and Langpap, 2019). In this paper, we estimate the effects of contributions to environmental nonprofits on a broader set of water quality measures and we bring in values from the environmental valuation literature to calculate the value of the water quality improvements generated by contributions.

Our first set of results indicate that contributions to these environmental nonprofits are price elastic: A one percent decrease in the price of giving translates into as much as a two percent increase in contributions. The traditional interpretation of treasury efficiency would hence indicate that tax deductibility for contributions to these nonprofits is efficient. However, our remaining results illustrate how considering the value of the public good could modify this conclusion. A one percent increase in contributions improves water quality by less than a one percent. Furthermore, a one percent increase in water quality translates into less than a one percent increase in home prices and water recreation values. Putting these effects together, a one percent decrease in the price of giving results in less than a one percent increase in the value of the public good. This interpretation hinges on existing estimates of the value of water quality, which come with some caveats. Therefore, we are careful not to claim precisely estimated price elasticities of the value of the public good, or conclusive evidence of inefficiency. Rather, we demonstrate with an empirical example that conclusions about the tax deduction efficiency can hinge on whether we ignore or account for changes in the value of the public good.

The rest of the paper proceeds as follows. In the next section we provide background on the relevant literature and present a simple conceptual framework to motivate our research question. In section 3 we discuss our empirical approach. Then we provide details about the data used in section 4. Section 5 presents our results and sensitivity analysis. In section 6, we interpret and discuss our results. Finally, we summarize and conclude in section 7.

2 Background and Conceptual Framework

Here we present the modeling framework and distinguish previous approaches from ours. Economic theory suggests that subsidizing charitable giving through tax incentives is efficient if the resulting increase in donations is larger than the decrease in tax revenue (Saez, 2004). The standard theory models g as the gift or contribution to a nonprofit, and tax as the marginal tax rate. When a taxpayer can deduct g from their taxable income, their tax obligation decreases by $tax \times g$. The price of giving is $1 - tax$. The net benefit of deductibility for a given tax rate is $B(tax) = g(tax) - tax \times g(tax) = (1 - tax) \times g(tax)$. Therefore, the marginal benefit due to a change in the tax rate is

$$\frac{\partial B(tax)}{\partial tax} = \frac{\partial g(tax)}{\partial tax} - \left[g(tax) + tax \times \frac{\partial g(tax)}{\partial tax} \right].$$

This is positive if and only if

$$\frac{\partial g(tax)}{\partial tax} > g(tax) + tax \times \frac{\partial g(tax)}{\partial tax}.$$

Or equivalently,

$$\frac{\partial g(tax)}{\partial(1 - tax)}(1 - tax) < -g(tax) \implies \frac{\partial g(tax)}{\partial(1 - tax)} \left(\frac{1 - tax}{g(tax)} \right) = \varepsilon < -1,^{1} \qquad (1)$$

which indicates that when contributions are elastic in the price of giving, the marginal benefit of deductibility is positive. If this condition is satisfied, a dollar of tax revenue forgone by the government because of the tax deduction results in more than one dollar of additional contributions: The tax deduction is considered treasury efficient.

[1] Note that $\frac{\partial g(tax)}{\partial tax} = -\frac{\partial g(tax)}{\partial(1-tax)}$

A sizable literature examining tax deductibility focuses on measuring whether contributions are price elastic; that is, whether a 1% decrease in the price of giving results in more than a 1% increase in contributions. Much of this work is reviewed in Peloza and Steel (2005), a meta-analysis covering 70 studies, which finds elasticities ranging from -0.4 to -4, with a median of -1.2. The authors conclude that the tax deduction is treasury efficient. More recent literature finds mixed effects. Bradley et al. (2005) find a price elasticity of -0.8 using contributions to all charities, and conclude that the tax deduction is inefficient. Then they separately estimate an elasticity of -1.3 using only social welfare organizations, and conclude that the deduction for these contributions may be treasury efficient. Bakija and Heim (2011) estimate price elasticities of -1.4 and -1.5. Fack and Landais (2010) estimate the effect of tax incentives for charitable contributions in France. Their estimated elasticities range from -0.2 to -0.6. They argue this is below the optimal level for the French tax credit. Duquette (2016) estimates a price elasticity of -4 using contributions to all nonprofits. When he estimates separate models for different nonprofit subsectors, elasticities range from 0 to -6. Finally, Galle (2017) estimates an elasticity of -1.4 for donations, which also provides evidence of the treasury efficiency of the tax deduction. While results vary, tax deductibility for donations hovers around treasury neutrality.

However, unitary elasticity may be an inappropriate benefit-cost threshold for policy evaluation (Andreoni, 2006). A shortcoming on the benefit side is the implicit assumption that an additional dollar of donations translates into one additional dollar of public good provision. The assumption can fail for several reasons. First, competition for donors can increase fundraising and non-program expenses to the detriment of program expenses (Aldashev and Verdier, 2010; Castaneda et al., 2008; Rose-Ackerman, 1982). Second, the incentive structure of nonprofits is different from that of for-profit firms because no one has claim over residual earnings. As a result, nonprofit managers may have little incentive to manage their organizations efficiently. For instance, residual earnings may be spent on perquisite benefits, at the expense of program operations. Such managerial shortcomings cannot be penalized given there is no market in ownership shares. Furthermore, the tax deduction for donations can reduce donors' incentives to monitor the output resulting from their contributions (Castaneda et al., 2008; Glaeser and Shleifer, 2001; Rose-Ackerman, 1996; Werker and Ahmed, 2008).

A primary function of nonprofit organizations is to provide public goods considered beneficial for society. The goal of the tax deduction for contributions is to support provision of these public goods (Almunia et al., 2020; Okten and Weisbrod, 2000). Regardless of whether a dollar of contributions generates more or less than a dollar of public goods, the efficiency of the tax incentive should be evaluated relative to the value of public goods provided.

To see this, let $G(tax) = \nu \times f(g(tax))$, where $f(g)$ is the production function for the public good, with $f'(g) = \frac{\partial f(g)}{\partial g} \geq 0$, and $\nu \geq 0$ is the per-unit (dollar) value of the public good. Additionally, let $\alpha = \nu \times f'(g) \geq 0$ be the unit value of the public good generated by donation g. The net benefit of deductibility for a given tax rate is $B(tax) = G(tax) - tax \times g(tax)$, and the charitable contribution deduction is efficient if and only if

$$\frac{\partial g(tax)}{\partial(1 - tax)} \left(\frac{1 - tax}{g(tax)}\right) = \varepsilon < -\frac{1 - tax}{\alpha - tax}. \tag{2}$$

If $\alpha = 1$ and each dollar of contributions yields a dollar of public good, this reduces to equation (1). However, if $\alpha > 1$ and a dollar of donations generates more than a dollar of public good, the deduction can be efficient even if the elasticity is less than one. On the other hand, if $\alpha < 1$, efficiency requires an elasticity larger than one. In either case, focusing on a unitary price elasticity of giving is misleading. This implicitly assumes that the unit value of the public good generated by tax revenue is one. As argued in the Introduction, estimating a value for public goods provided from tax revenue is beyond the scope of this study, and not feasible given data availability. We explore implications of relaxing this assumption in the Discussion section.

We layer in the effects of changes in the price of giving on the actual provision of public goods using a four-step process. First, we estimate a model of contributions to water-focused environmental nonprofits as a function of the price of giving. This yields an estimate of the price-elasticity for contributions. Following the standard criterion, we would assess treasury efficiency based on the estimated price-elasticity. We add three further steps to the analysis. As a second step, we estimate models of water quality near environmental groups as a function of the contributions received by those groups. This step provides an estimate of the amount of public good provided by the contributions given to these nonprofits. Third, we draw from the non-market valuation literature to find estimates of the impact of water quality on home values and willingness to pay for water recreation.

This step gives us a measure of the value of the public good generated by contributions to environmental nonprofits. Finally, we combine these estimates to calculate the effect of changes in the price of giving on the value of the public good provided. This process suggests a way to reevaluate the desirability of the tax deduction.

3 Empirical Approach

Our goal is to examine how a change in the price of giving impacts the value of the public good provided, and to compare this result with the traditional price-of-giving-elasticity measure. To do so, we estimate two distinct sets of models. First, we estimate the price elasticity of giving. Second, we estimate public good provision models to measure the impact of contributions on water quality.

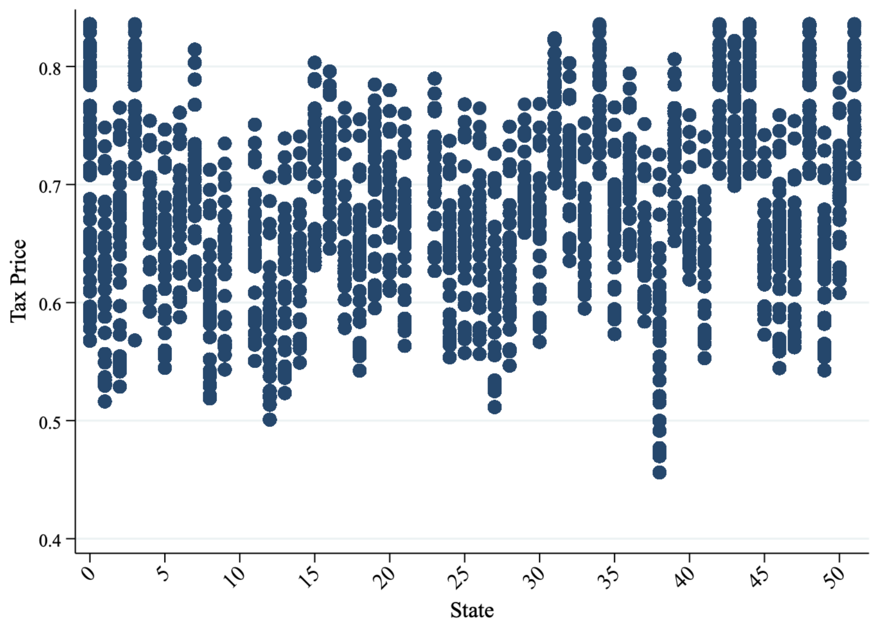
3.1 Price Elasticity of Giving

We estimate the following regression model to measure the price elasticity of giving:

$$\ln \text{Contributions}_{ist} = \delta_0 \ + \delta_1 \ln \text{Price}_{st} + \mathbf{G}'_{ist}\Gamma + \mathbf{X}'_{st}\Psi + \eta_i + \tau_t + \epsilon_{ist} \tag{3}$$

where giving is the dependent variable, measured as the (log of) contributions received by environmental group i, located in state s, in year t. We follow Duquette (2016) and construct Price_{st}, the price of giving for state s in year t, using a nationwide representative sample of households' tax returns, which includes the returns of non-itemizers. State and federal tax rules for every state and year in our study period are applied to this sample of taxpayers to calculate their tax obligations with and without charitable contributions, while keeping taxpayer characteristics constant (more details are provided in the next section). We identify our coefficient of interest, δ_1, the price elasticity of giving, using variation in tax price shown in Figure 1. Numerous changes in federal and state tax rules occur over the study period: Between 1989 and 2017 there were 29 changes in the federal tax code that could impact the price of giving (an average of 3.6 per year). Some are significant changes, such as the Economic Growth and Tax Relief Reconciliation Act of 2001 or the American Recovery and Reinvestment Act of 2009. While these changes affect

Figure 1. Distribution of Tax Prices, by State



Note: All years.

all taxpayers, they interact with state-level tax rules in idiosyncratic ways that generate state-specific variation in the price of giving. Additionally, changes in each state's tax rules generate further variation. For instance, in Oregon, a state with substantial variation in the price of giving over time, there are 26 state-level changes during the study period, or approximately three per year. In contrast, Florida has little variation, changing tax rules ten times during the study period, an average of 1.3 times per year.

$\mathbf{G}_{ist}$ is a matrix of environmental group characteristics (age, fundraising expenditures, assets and liabilities, program revenues); the matrix $\mathbf{X}_{st}$ contains state characteristics (gross state product, per-capita income, poverty rate, unemployment, population and population density, educational attainment, political inclination, ethnicity); and η_i and τ_t are group and year fixed effects. One of our specifications also includes state-level trends.

3.2 Public Good Provision

We estimate the impact of contributions on public good provision. Our setting is giving to environmental groups and the effect on water quality, using the following model:

$$\ln \text{Water Quality}_{it} = \beta_0 \; + \beta_1 \ln \text{Contributions}_{it} + \mathbf{X}'_{ct}\psi + \sigma_s + \tau_t + \upsilon_{it}. \qquad (4)$$

For the dependent variable, we interchange four characteristics of water quality: dissolved oxygen, temperature, and nitrogen and phosphorus concentrations. Federal agencies monitor water quality at thousands of sites throughout the U.S. We aggregate the data from monitors near group i to construct metrics for each water quality characteristic specific to year t. We define nearby in two ways, to test for robustness to our choices. One metric is the average of each water quality type for all monitors in the county where the group is located. For the second metric we determine the 40 water-quality monitors that are nearest to each group, based on the latitude-longitude Euclidean distance. In areas where the network of monitors is less dense, we limit the distance between groups and monitors to 150 miles. We then calculate nearest monitor-average water quality using measurements of each type for the entire year. In the sensitivity section we estimate the models using measurements only from the summer, when water quality tends to worsen. The parameter of interest, β_1, is the percentage change in water quality resulting from a one percent increase in contributions to the environmental group.

The matrix $\mathbf{X}_{ct}$ contains annual county characteristics for county c where group i is located: land use, per-capita income, educational attainment, population density, ethnicity, political inclination, unemployment, precipitation, and the number of Clean Water Act violations in a year. We also include state-level government expenditures on water quality. Finally, σ_s and τ_t are state and year fixed effects.[2]

One concern with identifying causal effects of contributions on water quality in Model (4) is that contributions to water groups are distributed non-randomly across watersheds. For instance, it is possible that contributions are higher where water quality is poorer and

[2]The state is the appropriate level to introduce fixed effects because water quality management decisions are made annually by each state. We also avoid using group fixed effects because they remove the signal we wish to measure in the data (for example, see `www.g-feed.com/2012/12/the-good-and-bad-of-fixed-effects.html`)

there is a greater perceived need for the activity of these groups. Alternatively, people who care more about the environment give more and live in cleaner places. We address these concerns using an instrumental variables approach, with the price of giving as the instrument for contributions. Donations respond to tax incentives; hence, we expect this to be a relevant instrument. The instrument is also plausibly exogenous, as it changes with modifications to federal and individual state tax rules. Contributions to environmental groups are orthogonal to changes in tax code because these represent a small subset of all donations to nonprofits. Therefore, the instrument should satisfy exclusion restrictions for Model (4).[3]

4 Data

Data on environmental groups comes from the National Center for Charitable Statistics (NCCS) (`https://nccs-data.urban.org/index.php`). We use the NCCS Core files, which are released annually and represent the entire population of active, reporting organizations filing tax form 990 within a given year. The Core files are subject to NCCS validation before release. For each organization we obtained the Employer Identification Number (EIN), which is the federal tax identifier, contributions received, fundraising expenditures, year-end assets and liabilities, program revenue, government grants received, address and location (latitude-longitude), and date of incorporation. These data are available for the years 1989-2017.

To measure the state-level price of giving we follow Duquette (2016) and use TAXSIM to calculate the first-dollar marginal cost of a contribution in each state and year (`http://www.nber.org/taxsim/`).[4] TAXSIM is a program maintained at the National Bureau of Economic Research (NBER) and used to calculate federal and state income tax liabilities (Feenberg and Coutts, 1993). We start with a nationally representative sample of tax returns from the 1984 IRS Public Use File.[5] We calculate the first-dollar marginal cost

[3]We estimate coefficients using two-stage least squares (2SLS), with a first stage that parallels Model (3).

[4]The first-dollar marginal cost uses the marginal tax rate that applies to the first dollar donated, which is uncorrelated with the amount of giving deducted. This avoids endogeneity in the price of giving caused by contributions reducing taxable income to the point where the taxpayer is pushed into a lower tax bracket.

[5]We use 1984 to include contributions by non-itemizers, whose giving is observed in that year due to the presence of an above-the-line contribution deduction introduced by the Economic Recovery Tax Act of

Table 1. Summary Statistics

	Mean	SD	Min	Max
Contributions (USD)	426,926.19	1,072,843.00	0.00	7,406,065.00
Age of Group (years)	14.58	12.08	0.00	53.00
Fundraising Expenditures (USD)	9,819.13	37,323.85	0.00	267,704.00
Assets (USD)	1,706,175.65	5,045,436.94	3,796.00	35,277,874.00
Liabilities (USD)	165,598.94	624,976.35	0.00	4,703,507.00
Program Revenue (USD)	92,572.71	309,943.71	0.00	2,266,087.00
Price of Giving (USD)	0.66	0.07	0.46	0.84
Dissolved Oxygen-County-Yr (mg/l)	8.85	1.64	0.04	14.97
Dissolved Oxygen-Nearest Monitors-Yr (mg/l)	8.86	1.60	0.04	14.97
Temperature-County-Yr (deg C)	14.84	5.04	0.00	30.73
Temperature-Nearest Monitors-Yr (deg C)	14.90	4.71	0.00	30.50
Nitrogen-County-Yr (mg/l)	0.72	0.68	0.10	4.70
Nitrogen-Nearest Monitors-Yr (mg/l)	0.68	0.46	0.10	4.70
Phosphorus-County-Yr (mg/l)	0.14	0.18	0.00	1.60
Phosphorus-Nearest Monitors-Yr (mg/l)	0.15	0.17	0.00	1.60
Gross State Product (USD)	535,635.15	601,645.61	10,645.00	2,680,917.00
Population Density, State	378.88	1,221.64	0.83	10,230.75
Per Capita Income, State (USD)	45,717.41	8,100.87	24,525.89	77,475.00
Unemployment Rate, State	0.06	0.02	0.02	0.14
Poverty Rate, State	0.13	0.03	0.06	0.25
College, State (%)	0.17	0.05	0.08	0.39
Republican, State (%)	0.49	0.15	0.00	1.00
White, State (%)	0.86	0.12	0.30	0.99
Population Density, County	1,389.88	5,256.11	0.00	48,576.69
Per Capita Income, County (USD)	40,952.58	17,756.73	8,940.00	227,753.00
Unemployment Rate, County	0.06	0.02	0.01	0.29
College, County (%)	0.23	0.08	0.03	0.60
Republican, County (%)	0.44	0.17	0.00	1.00
White, County (%)	0.82	0.16	0.11	1.00
Ag Land, County (%)	0.26	0.23	0.00	1.00
Urban Land, County (%)	0.24	0.23	0.00	0.93
Mean Precipitation, County (1000mm)	1,035.17	448.79	12.24	4,132.92
CWA Violations, County	68.18	156.06	0.00	2,111.00
Government Expenditures, State (USD)	34,570,849.43	43,627,804.86	0.00	322,013,792.00

of a contribution for each return in each state-year as follows: First, we set the charitable contribution to zero and calculate the combined federal and state tax liability of each return in that state and year. All other dollar-valued variables (such as adjusted gross income or salaries and wages) are adjusted for inflation. Then we replace the zero itemized cash contribution with a small, positive contribution ($10) and recalculate the combined federal and state tax liabilities. Next, we compute the marginal tax cost by dividing the change in combined tax liability by the change in cash contribution. Finally, we calculate the mean price of giving for every state and year, weighted by total reported contributions to avoid overrepresentation of taxpayers with smaller or no contributions. Calculating the price of giving this way ensures that the price measure changes only in response to changes in federal and state tax laws. Figure 2 shows tax prices in three selected states: Contributing to nonprofits is relatively cheap in Oregon, and relatively expensive in Florida, with California in between. Oregon and California have more variation in the price of giving than Florida.

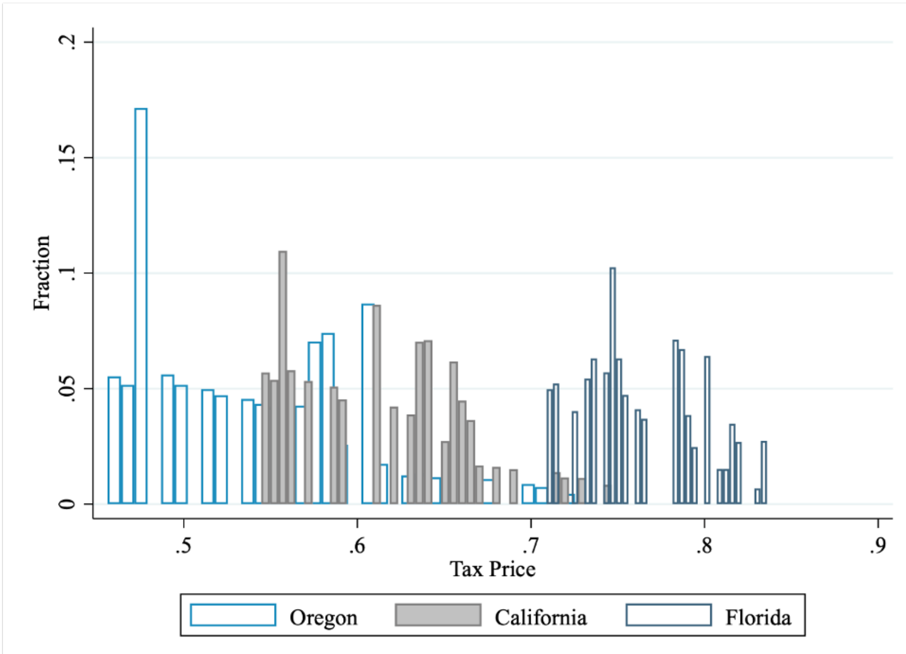
Water quality measurements come from two databases accessed through the Water Quality Portal: STORET and the National Water Information System (NWIS).[6] STORET is managed by the US Environmental Protection Agency (EPA) and contains water quality data collected by federal agencies, states, tribes, volunteer groups, and universities. NWIS, which is administered by the US Geological Service (USGS), contains data from all 50 states, the District of Columbia, and US territories. We obtained monitor-level measurements for dissolved oxygen (DO), temperature, nitrogen, and phosphorus. We follow previous research (Grant and Langpap, 2019; Keiser and Shapiro, 2019) to construct our variables from the data. We choose total measurements from rivers, streams, and lakes. We keep routine samples, dropping measurements from non-routine hydrologic events like floods, storms, and hurricanes. We also drop estimated and calculated measurements and those missing observation date. We winsorize at the 1st and 99th percentiles of the measurement distribution to minimize the impact of outliers. Finally, we convert all measures to standard units and drop measurements with units that lack conversions.

We obtain state and county economic characteristics and demographic information from a variety of sources. Gross state product and state- and county-level per-capita income

1981, and later abolished. This provides a more accurate picture of price of giving. The sample includes 79,556 individual income tax returns.

[6]See `https://www.waterqualitydata.us/`.

Figure 2. Tax Price Distributions for Selected States



Note: All years.

data are from the Bureau of Economic Analysis. State and county population and college graduation rates for population over age 25, which measures educational attainment, as well as state poverty rates, are from the US Census Bureau. State and county unemployment rates come from the Bureau of Labor Statistics. NBER provides ethnicity information, measured as percent of white population. We measure political preferences, environmental and otherwise, using election outcomes, namely the proportion of votes for Republican candidates in US Senate races. County and state-level data on election results are from the CQ Press Voting and Elections Collection. We interpolate for years in which there were no Senate races. Land use data come from the Natural Resources Conservation Service National Resources Inventory (NRI), which we use to calculate proportions of agricultural and urban land in a county. Precipitation data are from the PRISM Climate Group, which provides point measurements of precipitation for the entire U.S. in a continuous 4 km. grid. We obtain information on Clean Water Act violations from the EPA's Enforcement and Compliance History Online (ECHO) database. Finally, the government expenditures variable includes payments made under the Environmental Quality Incentives Program

(EQUIP), the Conservation Reserve Program (CRP), and the EPA 319 Grant Program. EQUIP payments data are from the Environmental Working Group; CRP payments come from the USDA Farm Service Agency; and data on payments made under the EPA 319 program are from the Grants Reporting and Tracking System. Summary statistics are in Table 1.

5 Results

5.1 Price Elasticity of Giving

Table 2 gives the results for the effect of changes in tax price on charitable giving to water-related nonprofits. The table shows four different specifications for the model. Our preferred specification, in column (1), follows that of Duquette (2016). The specification in column (2) adds state-specific trends to control for additional time-varying state heterogeneity that could affect contributions. The model in column (3) instead includes additional state-level demographic characteristics to make the specification consistent with those of the water quality models. Finally, the specification in column (4) incorporates additional group characteristics.[7] Contributions and tax rules that change the price of giving may be affected by common state-level shocks. Hence, standard errors are clustered at the state level.[8]

The estimated elasticity ranges from -1.55 to -2.07, which implies that the tax incentive produces larger increases in giving than the loss in revenue. The effects of other covariates follow intuition. Several are associated with more giving: higher gross state product, college attendance, fundraising, assets, and liabilities. The latter often represent capital expenditures, and other literature also finds it moves with higher giving. Lower contributions are correlated with higher unemployment, age of the charity, and program revenue. Program revenue is a stream of income for nonprofits, and often a partial substitute for contributions. The estimated elasticities, which suggest contributions are price-elastic,

[7] We omit these in our preferred specification because we are missing some observations of the group characteristics during our study period, causing the sample size to decrease. Using interpolated missing values yields similar results.

[8] Clustering at the state level removes the 4,555 groups that relocated across states during the study period. However, contributions remain price-elastic if we include these groups and cluster at the group level instead.

Table 2. Price Elasticity of Giving Model, ln(Contributions)

	(1)	(2)	(3)	(4)
ln(Tax Price)	-2.067***	-1.545**	-1.806***	-1.699***
	(0.595)	(0.705)	(0.586)	(0.570)
ln(Fundraise)				0.0254***
				(0.00322)
ln(Assets)				0.551***
				(0.0127)
ln(Liabs)				0.0456***
				(0.00341)
ln(Prog Rev)				-0.0546***
				(0.00519)
ln(Age)	-0.206***	-0.218***	-0.212***	-0.403***
	(0.0344)	(0.0343)	(0.0337)	(0.0342)
ln(Grs State Product)	0.836**	0.131	0.580	0.982***
	(0.357)	(0.325)	(0.368)	(0.269)
ln(Per-cap Income)	-0.870	-0.0351	-0.319	-1.589***
	(0.606)	(0.562)	(0.534)	(0.572)
Population, State	1.02e-09	-7.37e-08	-1.89e-09	-5.40e-09
	(2.64e-08)	(5.21e-08)	(3.60e-08)	(2.24e-08)
Unemployment Rate, State	-3.597**	-3.535**	-2.067	-4.659***
	(1.535)	(1.477)	(1.532)	(1.295)
Poverty Rate, State	0.618	-1.603	-1.513	-0.0919
	(2.279)	(2.422)	(1.940)	(1.843)
College, %			7.438***	
			(1.860)	
Population Density			0.000118	
			(0.000143)	
Republican, %			-0.0919	
			(0.159)	
White, %			1.619	
			(2.381)	
Group Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
State-specific Trends	No	Yes	No	No
Observations	90,508	90,508	90,508	84,828
R-squared	0.023	0.027	0.024	0.094
Number of Groups	11,809	11,809	11,809	11,562

Note: Robust standard errors in parentheses, clustered at state level; significance indicated as *** p<0.01, ** p<0.05, * p<0.1.

would lead to the conclusion that the tax deduction for giving to this set of nonprofits is treasury efficient.

5.2 Public Good Provision

Table 3. Impact of Giving on Water Quality - County Means

	DO	Temperature	Nitrogen	Phosphorus
ln(Contributions)	0.199***	-0.102**	-0.391***	-0.849***
	(0.0484)	(0.0437)	(0.122)	(0.253)
Ag Land (%)	0.172**	0.133*	0.839***	1.459***
	(0.0778)	(0.0764)	(0.227)	(0.401)
Urban Land (%)	0.202**	0.0784	0.719***	0.845**
	(0.0895)	(0.0886)	(0.215)	(0.406)
Population Density	-1.73e-05*	1.68e-05***	-9.61e-06	5.63e-05***
	(8.84e-06)	(6.33e-06)	(1.69e-05)	(2.18e-05)
Per Capita Income (USD)	-1.78e-06**	1.11e-06	1.57e-06	4.79e-06
	(8.70e-07)	(1.01e-06)	(2.77e-06)	(4.20e-06)
College (%)	-0.533**	-0.0799	-0.139	1.477
	(0.208)	(0.199)	(0.563)	(1.052)
Republican (%)	-0.0186	-0.0592	-0.443**	-0.629*
	(0.0606)	(0.0714)	(0.224)	(0.371)
Unemployment Rate	0.307	-1.015	-2.690	-7.720**
	(0.652)	(0.739)	(1.765)	(3.494)
White (%)	0.321***	-0.0872	-0.262	-0.752
	(0.109)	(0.125)	(0.272)	(0.586)
Mean Precipitation (1000mm)	1.37e-05	-0.000206*	-0.000451	0.000100
	(7.24e-05)	(0.000113)	(0.000327)	(0.000563)
(Mean Precipitation)^2	6.44e-09	6.06e-08	1.86e-07	-2.63e-09
	(2.39e-08)	(3.87e-08)	(1.17e-07)	(1.94e-07)
CWA Violations	4.92e-07	0.000147**	0.000460***	0.000292
	(5.38e-05)	(6.27e-05)	(0.000168)	(0.000251)
Government Expenditures (USD)	2.56e-10	3.87e-10	-8.40e-10	-2.76e-09
	(4.13e-10)	(5.84e-10)	(1.66e-09)	(3.08e-09)
Observations	64,626	47,518	46,821	54,530

Note: Second stage results. All independent variables measured at the county level, with the exception of state-level government expenditures. Robust standard errors in parentheses, clustered at county level; significance indicated as *** p<0.01, ** p<0.05, * p<0.1.

However, we need to consider the impact of contributions on provision of the public good, and then the value of this public good. We estimate the impact of contributions on water quality, our measure of public good provision. We present two sets of results for each water quality metric. One corresponds to the mean of all measurements in the county where an environmental group is located, and the other to the mean of measurements from the monitors closest to each group's location. The first-stage results are in Tables A.1 and A.2. Consistent with the results of the price elasticity model, the price of giving instrument has a negative impact on contributions. Kleibergen-Paap F-statistics range from 16.56 to 25.25 for the county-level measures, and from 19.96 to 34.91 for means from nearest monitors, indicating that there are no concerns about a weak instrument.

Table 4. Impact of Giving on Water Quality - Means for Nearest Monitors

	DO	Temperature	Nitrogen	Phosphorus
ln(Contributions)	0.156***	-0.0879***	-0.389***	-0.777***
	(0.0354)	(0.0294)	(0.0880)	(0.198)
Ag Land (%)	0.0756	0.137***	0.511***	1.127***
	(0.0528)	(0.0431)	(0.150)	(0.290)
Urban Land (%)	0.115**	0.116**	0.316**	0.769**
	(0.0562)	(0.0474)	(0.156)	(0.305)
Population Density	1.53e-06	2.81e-06***	8.53e-06**	2.91e-05***
	(1.26e-06)	(1.06e-06)	(3.55e-06)	(6.81e-06)
Per Capita Income (USD)	-1.71e-06***	2.50e-07	1.56e-06	3.91e-06
	(6.63e-07)	(5.43e-07)	(1.72e-06)	(2.93e-06)
College (%)	-0.339**	-0.0711	0.351	1.595**
	(0.153)	(0.114)	(0.412)	(0.790)
Republican (%)	0.0185	-0.0468	-0.479***	-0.500*
	(0.0452)	(0.0417)	(0.147)	(0.289)
Unemployment Rate	0.220	-1.572***	-2.241	-6.712**
	(0.439)	(0.438)	(1.373)	(2.701)
White (%)	0.310***	-0.0660	-0.338	-0.399
	(0.0811)	(0.0691)	(0.219)	(0.442)
Mean Precipitation (1,000s mm)	-4.40e-05	-8.09e-05	-0.000260*	-0.000233
	(5.28e-05)	(5.07e-05)	(0.000156)	(0.000318)
(Mean Precipitation)^2	2.25e-08	1.92e-08	9.11e-08*	1.07e-07
	(1.77e-08)	(1.72e-08)	(5.00e-08)	(1.03e-07)
CWA Violations	1.51e-05	5.98e-05**	0.000126	2.29e-05
	(3.32e-05)	(2.65e-05)	(0.000163)	(0.000306)
Government Expenditures (USD)	7.26e-10**	3.67e-10	-2.32e-09*	-3.23e-09
	(3.18e-10)	(3.79e-10)	(1.24e-09)	(2.00e-09)
Observations	73,936	73,623	67,869	71,145

Note: Second stage results. Outcome variable is ln(Water Quality). All independent variables measured at the county level, with the exception of state-level government expenditures. Robust standard errors in parentheses, clustered at county level; significance indicated as *** p<0.01, ** p<0.05, * p<0.1.

The second-stage elasticity results are in Tables 3 and 4, for county means and nearest monitor means, respectively. The estimates of primary interest are the effects of a one-percent change in contributions on each metric. Standard errors are clustered at the county level.[9] The results indicate that increases in contributions to environmental nonprofits improve water quality. A one percent increase in contributions leads to a 0.16% - 0.20% increase in dissolved oxygen, a 0.09% - 0.10% drop in water temperature, a 0.39% decrease in nitrogen concentration, and 0.78% - 0.85% lower phosphorus concentrations. While these effects are statistically significant, their magnitude is small. Water quality measures change by less than one percent for a one percent increase in contributions. This is partly because a 1% increase in contributions, the relevant magnitude of change for our purposes, is smaller than the average yearly growth of close to 3%. Additionally, water quality changes slowly over time and has improved considerably (Keiser and Shapiro, 2019). Hence, the scope for additional large improvements may be limited, and the estimated impacts are meaningful relative to underlying rate of change in water quality (Grant and Langpap, 2019).

5.3 Total Effect of Contributions on Value of the Public Good

Finally, we attach monetary values to these changes in water quality to assess how contributions impact the value of the public good. We start by assigning values to the public good provision associated with higher contributions. We rely on estimated values of water quality drawn from the non-market valuation literature. Most water quality valuation studies use hedonic models to measure the impact of changes in water quality on nearby home prices. We use estimates of the value of increases in DO and lower temperature (Netusil et al., 2014), as well as decreases in nitrogen and phosphorus (Poor et al., 2007; Walsh and Milon, 2016). There are several additional studies that estimate the effect of changes in Secchi-depth, a measure of water clarity, on home prices (Gibbs et al., 2002; Liu et al., 2019; Michael et al., 2000; Moore et al., 2020; Poor et al., 2001; Walsh et al., 2011). We lack data on Secchi-depth, and therefore cannot estimate a model for this measure of water quality. However, we use a relationship between Secchi-depth and temperature, nitrogen, and phosphorus estimated by Moore et al. (2020) to calculate how changes in contributions would affect Secchi-depth. Impacts of a 1% improvement in water quality on

[9] We use county-level clusters because most covariates are measured for the county where each group is located. We check for robustness to alternative clustering levels in the sensitivity section.

home prices are 0.61% for DO and temperature, 0.14% for nitrogen, 0.03% for phosphorus, and 0.02% - 0.49% for Secchi-depth.

We use two estimates of the effect of changes in water quality on recreation demand, one for phosphorus (Keiser, 2019) and one for Secchi-depth (Keeler et al., 2015), and estimates of the value of a water-recreation day (Rosenberger et al., 2017). A 1% reduction in phosphorus concentrations increases recreation benefits by 0.13% - 0.17%, and a 1% increase in Secchi-depth increases recreation benefits by 0.59% - 0.65%. Estimates of the value of water quality are summarized in Table A.3 in the Appendix.

Finally, we combine the estimates of price elasticity of contributions, impacts of contributions on water quality, and values of changes in water quality to reassess the efficiency of the tax deduction for contributions. To be conservative, we use the largest estimated price elasticity of contributions, which indicates that a 1% decrease in the price of giving increases contributions by 2%. Hence, we calculate the impact of a 2% change in contributions on each measure of water quality. We multiply the estimated coefficients of the water quality models by two, because each measures the impact of a 1% change in contributions. For Secchi-depth, we use the model estimated in Moore et al. (2020) to calculate the change resulting from 2% changes in nitrogen, phosphorus, and temperature. Finally, we multiply these changes in water quality by the corresponding 1% change in the value of water quality. The latter is given by changes in home prices for DO, temperature, and phosphorus, and by the sum of changes in home prices and recreation benefits for nitrogen and Secchi-depth. For example, from Table 3 we know that a 2% increase in contributions results in 0.398% higher DO. Given that a 1% increase in DO raises home prices by 0.61% (Table A.3), this change results in a 0.243% increase in the value of the public good.

Table 5. Total Effects: Contributions on the Value of Public Good

Metric of Water Quality	2% Change in Contributions on Water Quality: Nearest	County	1% Change in Water Quality on Home Prices: Min	Max	1% Change in Water Quality on Recreation Value: Min	Max	2% Change in Contributions on Value of Public Good: Min	Max
Dissolved Ox.	0.31%	0.40%	0.61%				0.19%	0.24%
Temperature	-0.18%	-0.20%	0.61%				0.11%	0.12%
Nitrogen	-0.78%	-0.78%	0.14%				0.27%	0.31%
Phosphorus	-1.55%	-1.70%	0.03%		0.13%	0.17%	0.25%	0.34%
Secchi Depth	1.07%	1.18%	0.02%	0.49%	0.59%	0.65%	0.65%	1.34%

Note: In our first set of estimations, we find a 2% elasticity of giving for a 1% change in tax price.

We show these calculations for all water quality measures in Table 5. We pull in the results from the previous section, the impacts of contributions estimated, for each the mean of nearest monitors and the county mean. The next columns have the minimum and maximum values of impacts on home prices and value of recreation. The last two columns calculate total effect with a range of minimum to maximum due to a 2% change in contributions, caused by a 1% decrease in price of giving, on the value of benefits from water quality improvements. The results in these columns suggest that, with the exception of the maximum impacts for Secchi-depth, a 1% decrease in the price of giving results in less than 1% increase in the value of the public good. For each water quality metric, the two effects that combine to produce the total impact of changes in contributions on value of the public good are relatively small. Changes in contributions have modest impacts on water quality. A 2% increase in contributions leads to less than 1% improvement in DO, temperature, and nitrogen. The impacts on phosphorus and Secchi-depth are larger than 1%, but fail to reach the requisite 2%. Additionally, improvements in water quality are associated with small increases in home prices and recreation benefits; the largest of these impacts is less than 1%. As a result, total effects on the value of the public good are small as well. The exception is for Secchi-depth. Here contributions have an impact that exceeds 1%, and increases in this measurement have large maximum effects on home prices and on recreation benefits. As a result, the total impact on the value of the public good is up to 1.3%. The estimated price elasticities of contributions are all greater than one. The standard criterion would therefore lead to the conclusion that the tax deduction for donations to these nonprofits is treasury efficient. However, the elasticity of the value of the public good relative to the price of giving could be less than one. Hence, these results suggest that, once we account for the effect of contributions on the value of the public good, the efficiency of the tax subsidy for these nonprofits may need to be reconsidered.

We can also reach this conclusion by focusing on the per-unit value of the public good generated by contributions to environmental groups. The estimated price elasticity is 2.1%, the mean price of giving in our sample is 0.66, and the corresponding marginal tax rate is 0.34. Given these values, equation (2) indicates that efficiency requires a per-unit value of the public good (α) greater than 0.65. We obtain marginal effects of contributions on water quality by estimating the water quality models in levels rather than logarithms. We also get marginal values of changes in water quality from the valuation studies in levels rather than percentage changes. Finally, we multiply the marginal effect of contributions by the marginal value of water quality improvements for each measure of water quality. This yields estimates of the per-unit value of the public good generated by contributions. The results are shown in Table A.4. With one exception, these estimates are below 0.65 (they range from 0.01 to 0.67). This suggests that, given the price elasticity, contributions to these nonprofits generate insufficient public good values to render tax deductions efficient. Once again, this is due to a combination of small impacts of contributions on water quality and modest effects of quality improvements on value. The exception, a per unit value of 0.67, is for the larger estimates for Secchi-depth. This agrees with the conclusions reached above.

5.4 Sensitivity

We conduct a number of sensitivity checks of our econometric estimates. First, it is possible that the price of giving variable is measured with error if environmental groups receive contributions from out-of-state donors. This would bias the estimates of price elasticities and affect our instrument in the water quality models. To address this concern, we re-estimate all models with a sub-sample that excludes groups which probably receive out-of-state contributions. Specifically, we drop organizations with names that include the terms "international," "national," or "global," as well as large groups (those in the top 25^{th} percentile for assets). Contributions remain price-elastic, and the estimated elasticities are somewhat larger (ranging from -2.08 to -2.82). The results of the water quality models hold as well with this sub-sample. The impacts of contributions are somewhat larger than in our main specifications.

Our preferred specifications of the water quality models use means calculated from measurements for the entire year. Given that water quality can worsen during the summer due to dwindling water flows and less precipitation, we also estimate the models with means calculated using only measurements for the summer. The effects of contributions on water quality are generally larger than those reported in Tables 3 and 4. As a result, the total effects on the value of water quality are greater. However, with the exception of Secchi-depth, these total effects remain smaller than 1%.

We estimate the water quality models using one- and two-year lagged contributions. Results mirror those from the main specification, with somewhat smaller impacts when using the two-year lag. We also cluster standard errors at the watershed and state levels instead of at the county level. The statistical significance of our estimates is stable, but instruments are somewhat weaker with state clustering.

Finally, to mitigate concerns about non-classical measurement error of the dependent variable when averaging water quality at the county level, we estimated models that control for contributions to other groups in the county or total number of active groups in the county. The results for impact of contributions on water quality are similar to those for the main specifications.

6 Interpretation and Discussion

The price-elasticity estimates for contributions from the environmental groups in our sample range from -1.6 to -2.1. They all indicate that contributions are price elastic: a 1% drop in the price of giving leads to more than 1% increase in donations to these groups. Following the standard criterion, these estimates imply that tax-deductibility of contributions to these nonprofits is treasury efficient. However, additional results suggest how this conclusion might be reevaluated. Contributions to environmental groups have small impacts on water quality, and changes in water quality are associated with modest increases in home prices and recreation benefits. Hence, once we account for the effects of contributions on water quality, as well as the value of water quality improvements, we see that a 1% drop in the price of giving may not lead to more than 1% increase in the value of the public good. Alternatively, the per unit value of the public good generated by contributions to these nonprofits is not high enough given the estimated elasticity. Evaluated from either of these perspectives, we would infer that the tax deduction for contributions to these nonprofits is not efficient.

There are two further points to consider before reaching final conclusions on the efficiency of tax deductibility of contributions. First, our results depend on estimates of the value of water quality improvements. These estimates come from a relatively small number of studies; eleven for home prices and two for recreation. We are limited because much of this literature estimates values for broad changes in water quality, such as from impaired to not impaired or fishable to swimmable, rather than for the specific metrics we use in this paper.

Additionally, while our data cover the period 1989 - 2017, most of these studies are carried out for a single year, and they are more recent than a significant part of our data. The earliest one is from the year 2000, and most were published after 2010. Similarly, while our water quality measures come from water bodies located throughout the entire continental U.S., most of these studies use data for water bodies in single cities, counties, or states. Further, despite having few studies, there is considerable heterogeneity in data quality and methodological approach. Accordingly, the measured impacts of changes in water quality vary widely, both within and across metrics. Finally, the literature lacks recreation values for three of the five measures of water quality. Hence, we are underestimating values of water quality improvements. However, our conclusions still hold if we assume that the largest estimate for recreation value impacts we found (0.65% for Secchi-depth) applies to the water quality measures with missing recreation values. Our main objective is empirical analysis to illustrate how efficiency assessments change when we account for changes in output and value of the public good, not to estimate changes in the value of water quality resulting from contributions. Hence, we remain agnostic about potential shortcomings in the valuation studies, take the estimates at face value, and use them in our calculations. At the same time, we emphasize that this means the results in Table 5 should be taken as illustrative rather than as actual estimates of changes in the value of the public good.

Second, in accounting for the value of the public good generated by contributions, we are looking at one side of the issue. Another relevant question is what the impact of a marginal dollar to government tax revenue rather than as giving to a nonprofit. Assessing the public good value impacts of tax revenue changes is beyond the scope of this paper. Yet, we can speculate. One challenge is that we don't know the appropriate counterfactual for the marginal dollar going to a nonprofit. That is, we don't know what the government will do with that dollar if it becomes tax revenue instead. A reasonable assumption is that tax dollars may be directed to nonprofits as government grants.[10] In this case, an important consideration is whether such grants crowd in or crowd out contributions. If there is no crowding in or out of contributions, a decrease in government revenue means a decrease in government grants, but no changes in contributions, so the treasury efficiency threshold for elasticity remains at one. If there is crowding out, lower revenue means a decrease in

[10]The government can also spend the tax revenue directly on water quality programs. We have not found estimates of the impacts of such programs that would allow a comparison with our estimates of the impacts of contributions to nonprofits.

grants, but an increase in contributions. Hence the efficiency threshold for elasticity would be less than one in absolute value (greater than -1). Finally, if there is crowding in, a decrease in revenue means fewer grants, and a decrease in contributions. In this case, the efficiency threshold for elasticity is greater than one in absolute value (smaller than -1).

The empirical evidence provides little support for classical (direct) crowding out of donations by government grants (Andreoni et al., 2014). Andreoni and Payne (2011) find that all of the crowding-out is attributable to fundraising and argue that there is no evidence of classical crowding-out. Instead, they find a slight crowding-in effect of government grants. Similarly, Heutel (2014) finds some evidence of small crowding-in, which is statistically insignificant. Finally, if we include government grants in our contributions model, the estimated coefficient indicates crowding in.[11] Therefore, if we assume that tax revenue is given to environmental groups as grants, the evidence suggests these grants might, to a small extent, crowd in contributions. In this case, efficiency would require an elasticity (slightly) greater than one (in absolute value). This would strengthen our conclusion, given that the calculated elasticities for the value of the public good are less than one.

7 Summary and Conclusions

Providing tax deductions for donations to nonprofit organizations is intended to elicit additional contributions to these groups, but it comes at the cost of forgone tax revenue for the government. In light of this trade-off, an extensive economics literature has evaluated the efficiency of these tax deductions by measuring the price elasticity of contributions. The standard criterion is that tax deductibility is treasury efficient if contributions are price elastic. If a one percent decrease in the price of giving increases contributions by more than one percent, then a dollar of forgone tax revenue yields more than a dollar of additional contributions. The main argument we make in this paper is that higher contributions are not the end goal. They are meaningful if and only if they lead to an increase in the value of the public good provided by nonprofits. Hence, when evaluating the efficiency of the tax deduction, we should measure whether a one percent change in the price of giving results in less or more than a one percent increase in the value of the public good provided by

[11] Our data on environmental groups includes government grants since 1997. Hence, because of the reduced sample size, we omit results for a model with this variable.

nonprofits.

We do so in the context of environmental nonprofits focused on water resources. The public good they produce is improved water quality. We start by carrying out the traditional analysis, and estimate the price elasticity of contributions to these nonprofits. The estimated elasticites range from -1.6 to -2.1. Accordingly, by the standard criterion tax deductions for contributions to these nonprofits would be considered treasury efficient. We build on this first step by estimating public good provision models to measure the impact of contributions to environmental groups on water quality. Our estimates indicate that, while increases in contributions are associated with improvements in water quality, the magnitude of the impacts are relatively small. More precisely, a one percent increase in contributions leads to a less than one percent improvement in water quality measures. Finally, we use existing estimates of the value of water quality improvements from the non-market valuation literature. For each of our water quality measures, we calculate the percent increase in home values resulting from a one percent improvement in water quality. For phosphorus and Secchi-depth, we are also able to calculate percentage changes for recreational values. The impacts of changes in water quality on these values are also modest, all of them below one percent. This final step allows us to calculate the percentage change in the value of the public good associated with the increase in contributions that results from a one percent decrease in the price of giving. We find that, with the exception of the upper part of the range of values for Secchi-depth, a one-percent decrease in price of giving results in less than a one-percent increase in the value of the public good. Hence, while tax deductibility of contributions to these nonprofits would be considered efficient under the usual elasticity criterion, it may not be once we account for how contributions translate to public good provision and the value of that public good.

This conclusion is subject to an important caveat. The effects of water quality improvements on home prices provide a lower bound for the value of the public good for dissolved oxygen, temperature, and nitrogen, because values for recreation are not available for these measures. Additionally, we are not considering how tax revenues might impact the value of the public good if the marginal dollar is collected by the government rather than donated to environmental organizations. However, our intent is not to provide precise estimates of the efficiency of tax deduction, or to make a specific policy recommendation for these nonprofits. Rather, our point is to highlight that we should consider the effectiveness of nonprofits in producing public goods and the value of those public goods when thinking about the efficiency of tax deductibility of contributions. Our results provide proof of concept that conclusions about efficiency can be quite different when we do so.

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Appendix

A.1 Supplementary

Table A.1. Water Quality, First Stage - County Means

	DO	Temperature	Nitrogen	Phosphorus
ln(Tax Price) (%)	-3.777***	-4.547***	-3.933***	-3.622***
	(0.752)	(0.968)	(0.884)	(0.890)
Ag Land, County (%)	-0.806***	-0.585*	-0.569*	-0.577*
	(0.269)	(0.339)	(0.327)	(0.320)
Urban Land, County (%)	-0.875**	-0.762**	-0.548*	-0.502
	(0.342)	(0.349)	(0.323)	(0.339)
Population Density, County	4.80e-05	3.47e-05	3.04e-06	1.57e-06
	(3.87e-05)	(3.35e-05)	(1.23e-05)	(1.36e-05)
Per Capita Income, County (USD)	4.72e-06	6.39e-06	5.33e-06	4.51e-06
	(3.28e-06)	(4.06e-06)	(3.54e-06)	(3.24e-06)
College, County (%)	2.737***	1.980**	1.265	1.919**
	(0.761)	(0.929)	(0.840)	(0.805)
Republican, County (%)	0.0126	-0.173	-0.0257	-0.144
	(0.266)	(0.321)	(0.297)	(0.284)
Unemployment Rate, County	-5.096**	-7.258***	-7.479**	-6.480**
	(2.495)	(2.794)	(2.981)	(2.717)
White, County (%)	-0.945**	-1.213**	-0.751	-0.907*
	(0.451)	(0.520)	(0.498)	(0.486)
Mean Precipitation, County (1,000mm)	8.49e-05	1.14e-05	0.000296	0.000322
	(0.000313)	(0.000409)	(0.000445)	(0.000365)
(Mean Precipitation)^2	-1.41e-08	2.23e-08	-5.01e-08	-8.07e-08
	(1.05e-07)	(1.44e-07)	(1.66e-07)	(1.30e-07)
CWA Violations, County	-9.05e-05	-0.000117	-0.000205	-0.000151
	(0.000219)	(0.000223)	(0.000233)	(0.000197)
Government Expenditures, State (USD)	-8.92e-10	2.61e-10	-7.59e-11	-3.46e-10
	(1.79e-09)	(2.33e-09)	(2.25e-09)	(2.61e-09)
Observations	64,626	47,518	46,821	54,530
Kleibergen-Paap Wald rk F-statistic	25.25	22.07	19.81	16.56
Prob > F	0.0000	0.0000	0.0000	0.0000

Note: Robust standard errors in parentheses, clustered at county level; significance indicated as *** p<0.01, ** p<0.05, * p<0.1.

Table A.2. Water Quality, First Stage - Means for Nearest Monitors

	DO	Temperature	Nitrogen	Phosphorus
ln(Tax Price)	-4.050***	-4.756***	-3.872***	-3.417***
	(0.722)	(0.805)	(0.773)	(0.765)
Ag Land, County (%)	-0.554**	-0.522*	-0.528*	-0.520*
	(0.266)	(0.270)	(0.274)	(0.276)
Urban Land, County (%)	-0.604**	-0.571*	-0.524*	-0.598**
	(0.289)	(0.292)	(0.293)	(0.294)
Population Density, County	-4.50e-06	-3.18e-06	1.02e-06	-2.50e-06
	(6.55e-06)	(6.47e-06)	(6.79e-06)	(6.62e-06)
Per Capita Income, County (USD)	5.56e-06*	5.29e-06*	5.31e-06*	4.77e-06
	(3.04e-06)	(3.12e-06)	(3.11e-06)	(3.03e-06)
College, County (%)	2.347***	1.991***	1.661**	2.044***
	(0.694)	(0.743)	(0.715)	(0.691)
Republican, County (%)	-0.308	-0.298	-0.467*	-0.433*
	(0.247)	(0.246)	(0.251)	(0.246)
Unemployment Rate, County	-4.856**	-5.648**	-6.380***	-6.289***
	(2.271)	(2.378)	(2.378)	(2.392)
White, County (%)	-0.949**	-0.927**	-0.802*	-0.766*
	(0.423)	(0.435)	(0.445)	(0.439)
Mean Precipitation, County (1,000s mm)	0.000292	0.000140	0.000355	0.000184
	(0.000294)	(0.000281)	(0.000298)	(0.000279)
(Mean Precipitation)^2	-8.44e-08	-2.60e-08	-1.09e-07	-4.59e-08
	(1.01e-07)	(9.70e-08)	(1.03e-07)	(9.41e-08)
CWA Violations, County	-0.000157	-0.000242	-0.000130	-0.000189
	(0.000225)	(0.000247)	(0.000251)	(0.000234)
Government Expenditures, State (USD)	-2.76e-09	-1.58e-09	-0	-1.28e-09
	(1.86e-09)	(1.96e-09)	(2.16e-09)	(1.96e-09)
Observations	73,936	73,623	67,869	71,145
Kleibergen-Paap Wald rk F-statistic	31.51	34.91	25.11	19.96
Prob > F	0.0000	0.0000	0.0000	0.0000

Note: Robust standard errors in parentheses, clustered at county level; significance indicated as *** p<0.01, ** p<0.05, * p<0.1.

Table A.3. Value Of The Public Good:
Effects Of Water Quality On Home Prices and Water Recreation Benefits

Metric of Water Quality	Impact of 1% change: Home Prices	Impact of 1% change: Recreation Benefits	Location	Sources
Dissolved Ox. (increase)	0.61%		OR	Netusil et al. (2014)
Temperature (decrease)	0.61%		OR	Netusil et al. (2014)
Nitrogen (decrease)	0.14%		MD, FL	Poor et al. (2007),
				Walsh and Milon (2016)
Phosphorus (decrease)	0.03%	0.13%-0.17%	FL	Walsh and Milon (2016)
			US	Keiser (2019)
Secchi Depth (increase)	0.02%-0.49%	0.59%-0.65%	32 states	Gibbs et al. (2002),
			IA, MN	Walsh et al. (2011), Liu et al. (2019),
				Moore et al. (2020), Keeler et al. (2015)

Note: Direction of effect on value in (parentheses).

Table A.4. Per Unit Value of the Public Good Generated by Contributions

Metric of Water Quality	Marginal Effect of Contributions on Water Quality	Marginal Value of Changes in Water Quality	Per Unit Value of Public Good (α)
Dissolved Ox. (County)	0.0000103	20,466	0.21
Dissolved Ox. (Nearest)	0.00000698	20,466	0.14
Temperature (County)	-0.0000183	11,722	0.21
Temperature (Nearest)	-0.0000145	11,722	0.17
Nitrogen (County)	-0.00000204	23,598 - 57,162	0.05 - 0.12
Nitrogen (Nearest)	-0.00000168	23,598 - 57,162	0.04 - 0.10
Phosphorus (County)	-0.000000689	531,974	0.37
Phosphorus (Nearest)	-0.00000065	531,974	0.35
Secchi Depth (County)	0.00000654	2,036 - 102,114	0.01 - 0.67
Secchi Depth (Nearest)	0.00000519	2,036 - 102,114	0.01 - 0.53

Note:

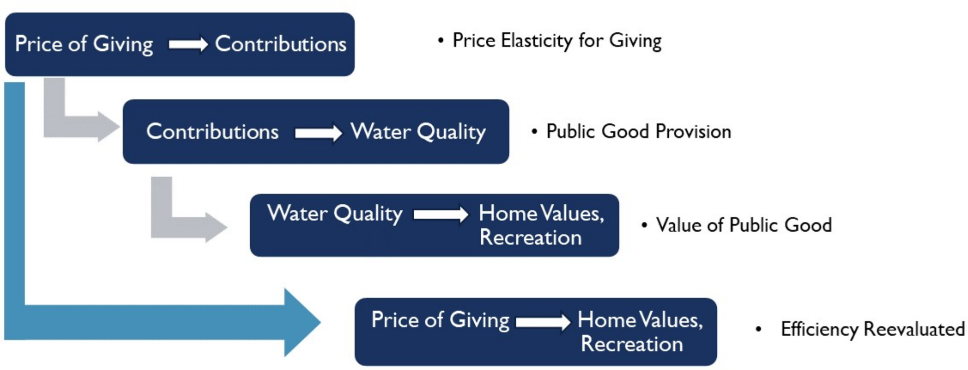

Figure A.1. Flow chart of conceptual framework