Social Efficiency in the Tax Deductibility of Charitable Donations

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February 2025

Abstract

U.S. tax law allows deductibility of charitable donations. *Treasury* efficiency exists if donor responses exceed forgone government revenue, in elasticity. We improve the metric by introducing *social* efficiency, focusing on the public benefits from changes in the tax price of giving. We derive our metric from changes in charities' public-good provision and the associated marginal value, benchmarking it against treasury efficiency. A compelling empirical example estimates the elasticity of water quality and its social value relative to tax price changes. Findings show that social efficiency can diverge significantly from treasury efficiency, implying differing policy recommendations.

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

JEL Codes: H41, L31, Q53, K34

We appreciate feedback from Anna Abatayo, Judson Boomhower, Garth Heutel, Robert Johnston, seminar attendees at Oregon State University, and participants at the Association of Environmental & Resource Economists 2021 Summer Conference, the ASSA-AEA 2022 Meeting, the 2022 Southern California Conference on Applied Microeconomics, the European Association of Environmental & Resource Economists 2022 Summer Conference, and the 20th Occasional Workshop in Environmental and Resource Economics, 2023. We thank Dan Bigelow and Dave Lewis for sharing land use data.

1 Introduction

Tax laws governing charitable donations have been a source of controversy since their introduction in 1917. Early proponents argued that preferential tax treatment would incentivize private donations from wealthy individuals, who were seen as essential for supporting causes that might otherwise go unfunded (Aprill, 2000). This debate persists today, with proposals ranging from imposing stricter caps on deductions to eliminating them altogether. Under current U.S. law, taxpayers can deduct donations made to nonprofit organizations, provided the organization is registered as a public charity with the IRS. These deductions effectively reduce the cost of giving, proportional to a donor's marginal tax rate – for a taxpayer in the 35% tax bracket, a $100 donation to a nonprofit has an effective cost of $65, reducing the *price* of giving to 65 cents per dollar. However, this incentive comes at the cost of foregone tax revenue, up to $82 billion in 2024, according to the Joint Committee on Taxation. Empirical research in public finance examines how changes in the tax rate influence charitable contributions by measuring the price elasticity of giving; see Bakija (2024) for a comprehensive review. A charitable deduction is deemed *treasury efficient* if it generates as much or more in donations as the government loses in tax revenue. Most studies suggest the deduction achieves at least treasury neutrality, such that a 1% decrease in the price of giving leads to at least a 1% increase in contributions (Bakija, 2013; Bakija and Heim, 2011; Duquette, 2016). In contrast, Han et al. (2024) use recent data from the Tax Cuts and Jobs Act and find inefficiency, with an average elasticity of -0.6.

The concept of treasury efficiency, however, implicitly assumes that a 1% increase in donations results in at least a 1% increase in public good provision. This perspective overlooks the value of the activities and impact of the nonprofits receiving these funds. The 1.5 million nonprofits operating in the U.S. do more than simply collect donations; they provide critical public goods and services, often addressing gaps left by markets, government agencies, and political institutions (National Center for Charitable Statistics, 2019). Thus, any assessment of the charitable deduction's efficiency must also account for the amount and value of public goods and services produced through these contributions. This research shifts the focus from treasury efficiency to an evaluation of a broader measure of societal value generated by donations, *social efficiency*.[1]

[1] Andreoni and Smith (2021) independently developed a similar concept of social efficiency in parallel work.

We define and calculate this social efficiency criterion as the price elasticity of the public good's value, which measures the percentage change in the value of the public good induced by a 1% decrease in the price of giving. Expanding from previous theoretical frameworks, we derive a simple measure of social efficiency, benchmarked against the traditional metric of treasury efficiency (Bradley et al., 2005; Heim, 2025). Importantly, social efficiency neither implies nor is implied by treasury efficiency.

We provide an empirical illustration to contextualize this framework. Our focus is on environmental nonprofits, which number over 25,000 in the U.S. In 2021, donors contributed more than $16 billion to these organizations (Center on Philanthropy at Indiana University, 2022). We narrow our analysis to local environmental nonprofits whose activities affect water quality in rivers and streams. These organizations engage in various activities to address firms' pollution from any given pipe or outlet. These activities include litigation, permit evaluation, water quality sampling, and investigations of regulatory violations. For example, the Willamette Riverkeeper litigates state wastewater permit decisions. Nonprofits also work toward mitigating pollution emanating from large land areas, like rain washing pesticides off many fields into a river. For instance, the James River Association and Shenandoah Riverkeeper create forest buffers and promote cost-sharing programs for landowners. Other organizations, such as the Genesee River Watch, reduce sediment and fertilizer loads by stabilizing agricultural fields along riverbanks.

We focus on these nonprofits for several reasons. In contrast to other nonprofits that provide goods or services with private characteristics (Chang and Tuckman, 1996), those in out dataset produce local public goods (Grant and Langpap, 2019). Water-related nonprofits are numerous, homogeneous in mission, and geographically dispersed across the U.S., providing an ideal sample for robust empirical study.

We implement two sets of empirical models to examine these relationships. The first set estimates the price elasticity of giving, following seminal work on how tax incentives influence charitable contributions (Duquette, 2016). The second set expands on prior literature by estimating public good provision, using instrumental variable techniques to measure the effect of donations on nearby water quality. We then incorporate external estimates of the value of water quality improvements. This allows us to calculate how changes in the price of giving affect both the quantity and value of the public good.

This paper makes two main methodological contributions. First, we extend the existing framework of treasury efficiency to derive social efficiency, which explicitly includes the amount and value of public goods generated. Second, we provide an approach for empirically evaluating social efficiency for specific public goods. In our application, we demonstrate how environmental nonprofits improve water quality and estimate the associated value of these improvements. By moving beyond traditional measures of donation deductibility, we advance the analysis toward a social measure of efficiency.

Thus, our work contributes to two key literatures. First, we expand the toolkit of public finance for evaluating tax policy and its implications for government expenditures. We extend approaches for estimating the effectiveness of tax incentives, particularly the charitable deduction; see Roberts (1987), Bradley et al. (2005), and the meta-analysis by Peloza and Steel (2005). Our method establishes a new standard for evaluating charitable giving tax policy. Our social efficiency framework complements existing tools: cost-benefit analysis (CBA) and the Marginal Value of Public Funds (MVPF). Cost–benefit analysis (CBA) typically evaluates whether a program's social benefits outweigh its costs (Drèze and Stern, 1987; Liscow, 2025), but it has not been applied to tax deductibility or tax-induced giving. Heim (2025) shows that analyzing the treasury efficiency of tax incentives is equivalent to a cost-effectiveness test, a narrower variant of CBA. Our framework extends this by adding estimated public good benefits and focusing on marginal impacts, making it more directly relevant for tax design. The MVPF evaluates policies by combining willingness to pay with fiscal costs (Finkelstein and Hendren, 2020; Hendren and Sprung-Keyser, 2020). Our framework parallels MVPF in incorporating both willingness to pay and budgetary costs, but extends it by emphasizing the marginal productivity of public good provision. Unlike CBA or MVPF, our approach applies this metric to compare nonprofit and government provision directly. The second literature that our paper enriches is the growing body of work on nonprofits and their provision of public goods, as Grant and Langpap (2024) review for environmental nonprofits. Prior studies have examined the public goods provided by land trusts preserving open space (Albers et al., 2008; Parker and Thurman, 2011; Sundberg, 2006) and by nonprofits improving water quality (Grant and Langpap, 2019). We build on this work by calculating an elasticity capturing the value of water quality improvements generated through donations to nonprofits due to changes in tax rates.

Our first set of results challenges the findings of most previous literature, showing that contributions to these environmental nonprofits are not treasury efficient: A 1% decrease in the price of giving results in only a 0.64% to 0.93% increase in contributions. However, the second set of results, the extension to a measure of social efficiency, demonstrates that conclusions about efficiency can reverse when accounting for changes in the public good and its value. We find that charitable contributions lead to small but statistically and economically meaningful improvements in water quality. When these public benefits are valued, what looks inefficient from a treasury perspective can be efficient socially: incorporating these benefits justifies the charitable deduction.

Thus, our framework demonstrates that reliance on treasury efficiency alone can misrepresent policy impacts. The process we develop to compare treasury efficiency and social efficiency is broadly applicable to other types of nonprofits that provide public goods. For example, public and social benefit organizations aim to broaden citizen participation in the political process. These nonprofits may increase voter turnout in local referendums, resulting in measurable outcomes such as improved provision of local public goods like open spaces, or enhanced community services such as police and fire protection. Similarly, organizations focused on community improvement contribute to better neighborhood quality, which can be assessed through metrics like redevelopment rates or increases in home ownership. In these cases, changes in real estate prices often reflect the value of public good provision. Another example is consumer protection organizations, which provide information and assistance to mitigate harmful products and services. The benefits of such nonprofits are typically health-related, including reduced lost wages, improved infant birth weights, and developmental outcomes in the targeted communities.

In the next section we present a conceptual framework to motivate our research question. In Section 3 we discuss our empirical application, beginning with details about the data. Section 4 presents our results and sensitivity analysis. We conclude by discussing our results and further implications.

2 Conceptual Framework

Subsidizing charitable giving through tax incentives is considered treasury efficient if the resulting increase in donations outweighs the decrease in tax revenue (Roberts, 1987; Saez, 2004). In standard theory, g represents the gift or contribution to nonprofits, and tax denotes the marginal tax rate. When taxpayers can deduct their contributions, g becomes a function of tax, and their gifts reduce their tax obligation by $tax \cdot g(tax)$. Consequently, the price of giving is $1 - tax$. For a given tax rate, deductibility creates a fiscal-policy tradeoff: additional charitable contributions of $g(tax)$ versus lost tax revenue of $tax \cdot g(tax)$, yielding a net fiscal impact of $(1 - tax) \cdot g(tax)$.

The marginal impact of a change in the tax rate is

$$\frac{\partial g(tax)}{\partial tax} - \left[g(tax) + tax \cdot \frac{\partial g(tax)}{\partial tax} \right]$$

which measures the change in giving due to a tax change, minus the foregone revenue from that tax change. This is positive if and only if

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

Noting that $\frac{\partial g(tax)}{\partial tax} = -\frac{\partial g(tax)}{\partial (1-tax)}$, the price of giving elasticity implies treasury efficiency if

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

A sizable literature examines the effect of tax changes on contributions. Peloza and Steel (2005) review 70 studies and provide a meta-analysis that finds elasticities ranging from -0.4 to -4, with a median of -1.2. The authors conclude that the tax deduction is treasury efficient — lowering the tax burden by one percent may raise donations by a percent or more. Recent literature finds mixed effects (Bakija, 2024; Bakija and Heim, 2011; Bradley et al., 2005; Duquette, 2016; Fack and Landais, 2010; Galle, 2017; Han et al., 2024).

2.1 Social Efficiency

One goal of the tax deduction for contributions is to support the provision of public goods (Almunia et al., 2020; Okten and Weisbrod, 2000). Yet, the implicit assumption may fail – a one percent change in donations may not translate into at least an additional percent of public good provision.[2] Given that nonprofit organizations provide public goods beneficial for society, the value of these goods, with respect to the elasticity of tax rate *and* production of said goods, is of significant interest. The efficiency of the tax incentive needs to be evaluated relative to the value of public goods provided, i.e. whether a percent of revenue foregone generates more or less than an additional percent of public benefit.

We advance the current understanding by incorporating production of the public good by nonprofit organizations and by the government. We begin by assuming that nonprofits and the government provide the same public good. Therefore, the marginal social value of a dollar's worth of output is comparable across both providers – a unit of public good is equivalent in benefit regardless of its source; we relax this below. Let the total value of public goods generated by contributions be $G(tax)$ and those by tax revenue be $R(tax)$. The appropriate net social benefit to assess is that of the net contribution to the public good: $B(tax) = G(tax) - R(tax)$, where $G(tax) = \nu \cdot f(g(tax))$, $R(tax) = \nu \cdot h(tax \cdot g(tax))$, and $\nu \geq 0$ is the per-unit dollar value of the public good. Thus, $B(tax) = \nu \cdot f(g(tax)) - \nu \cdot h(tax \cdot g(tax))$, representing the net social benefit from charitable tax incentives. The function $f(g(tax))$ is the nonprofit's production function; it quantifies how nonprofits translate donations into the public good. The function $h(tax \cdot g(tax))$ is the government's production function; it gives the public good provided publicly, as a function of tax revenue.

To determine whether changes in the price of giving increase net benefits, we differentiate $B(tax)$ with respect to the price of giving, $1 - tax$. We find the necessary condition for social efficiency is

$$\varepsilon_G < \frac{h(tax \cdot g(tax))}{f(g(tax))} \varepsilon_R$$

[2]Competition for donors increases fundraising costs, an opportunity cost for program spending (Aldashev and Verdier, 2010; Castaneda et al., 2008; Rose-Ackerman, 1982). The tax benefit can reduce donors' oversight of the uses of contributions (Castaneda et al., 2008; Glaeser and Shleifer, 2001; Rose-Ackerman, 1996; Werker and Ahmed, 2008). Nonprofit managers may engage in self-interested spending on perks as their objective is not profit maximization. Government provision, directly or through grants to nonprofits, may crowd-in or -out provision by nonprofits (Andreoni, 2006; Andreoni et al., 2014; Heutel, 2014).

where $\varepsilon_G = \frac{\partial G}{\partial(1-tax)}\frac{1-tax}{G}$ and $\varepsilon_R = \frac{\partial R}{\partial(1-tax)}\frac{1-tax}{R}$.[3] This condition indicates that tax deductibility of charitable contributions is socially efficient if the value of the public good provided by nonprofits is more responsive to changes in the price of giving than the value of the same public good provided by the government, weighted by the relative production of public good by the two sectors. Next, we decompose this expression into its component parts, aiming to provide analytical solutions for each component and to describe each corresponding empirical measurement.

Elasticity of the Public Good's Value, as Produced by Nonprofits

We rewrite ε_G in terms of the traditional measure of ε_g:

$$\varepsilon_G = f'(g(tax)) \cdot \frac{g(tax)}{f(g(tax))} \cdot \varepsilon_g.$$

Let $\varepsilon_{fg} = f'(g(tax)) \cdot \frac{g(tax)}{f(g(tax))}$. This term measures the responsiveness of the public good production function $f(\cdot)$ with respect to changes in the level of contributions $g(tax)$, and hence is an elasticity-like measure of public good provision by nonprofits. It tells us how the marginal product of public good provision, given by $f'(g(tax))$, is scaled by the effectiveness of converting the contributions g into the public good $f(g(tax))$. If ε_{fg} is greater than one, it suggests that the public good provision is highly responsive to changes in g, whereas a value less than one indicates a lower responsiveness. In sum, $\varepsilon_G = \varepsilon_{fg} \cdot \varepsilon_g$.

Elasticity of the Public Good's Value, as Produced by Government

Noting that $\varepsilon_R = \frac{\partial R(tax)}{\partial(1-tax)} \cdot \frac{(1-tax)}{R(tax)}$, we find:

$$\varepsilon_R = h'(tax \cdot g(tax)) \cdot \frac{tax \cdot g(tax)}{h(tax \cdot g(tax))} \cdot \left(\varepsilon_g - \frac{1-tax}{tax}\right).$$

Let $\varepsilon_{hg} = h'(\cdot)\frac{tax \cdot g(tax)}{h(\cdot)}$. This represents the responsiveness of the government's public good production function with respect to changes in the underlying level of tax revenue. Again, it is an an elasticity-like measure of public good production, through government

[3] All derivations can be found in Appendix A.1.

spending. It measures the proportional change in the government's production of the public good $h(\cdot)$ in response to a proportional change in the underlying level of revenue, $tax \cdot g$. The final term, $\frac{1-tax}{tax}$, is the ratio of the price of giving to the tax rate. Thus,

$$\varepsilon_R = \varepsilon_{hg} \cdot \left(\varepsilon_g - \frac{1 - tax}{tax} \right).$$

The Condition for Social Efficiency

By combining the above components and simplifying, we derive a condition for social efficiency. This inequality provides a threshold that determines when subsidizing charitable giving nets a social benefit. The first-order condition for $B(tax)$ can be rewritten as

$$\varepsilon_{fg} \cdot \varepsilon_g < \frac{h'(tax \cdot g(tax))}{f'(g(tax))} \cdot \varepsilon_{fg} \cdot tax \left(\varepsilon_g - \frac{1 - tax}{tax} \right).$$

The term ε_{fg} cancels from both sides.[4] The simplified expression provides an elasticity benchmark for social efficiency, as a comparison to standard treasury efficiency, ε_g:

$$\varepsilon_g < -\frac{1 - tax}{\frac{f'(g(tax))}{h'(tax \cdot g(tax))} - tax}. \tag{2}$$

We define the ratio $\frac{f'(g(tax))}{h'(tax \cdot g(tax))}$ as the *donation dividend*. It compares the marginal effectiveness of private contributions, $g(tax)$, with the marginal effectiveness of foregone government spending, $tax \cdot g(tax)$, that would have occurred in the absence of the tax deduction. This ensures theoretical consistency: we compare the marginal productivity of the actual donation, for instance \$10,000 to nonprofits, against the marginal productivity of the corresponding foregone tax revenue, e.g., \$3,500 at a 35% tax rate. The donation dividend is central to determining whether tax-deductible giving produces more public good per dollar of fiscal cost than direct government provision. Because government forfeits only the tax revenue per dollar donated, the cost basis for private charitable provision is lower than for public provision – so the donation dividend mechanically favors charitable provision unless government is substantially more productive. A high donation dividend

[4] The parameter ν also cancels out under the assumption that the government and nonprofit provide the same public good. We relax this assumption below.

indicates that nonprofit organizations are more effective at generating public goods at the margin, justifying the tax deduction on efficiency grounds. Conversely, a low donation dividend suggests that government provision may be more effective, and the rationale for subsidizing charitable giving becomes weaker. Expression 2 formalizes the condition under which this cost-adjusted tradeoff delivers a net gain in social value.

When an additional dollar of contributions or revenues is assumed to generate an additional dollar of public goods, meaning $\frac{f'(g(tax))}{h'(tax \cdot g(tax))} = 1$, the right-hand side simplifies to -1, which gives the standard treasury-efficiency condition. This implies that private donations and government spending are equally effective, even though donations exceed the potential government spending, by a factor of $1/tax$. If this is true, donations are preferable if the elasticity of giving is larger than one in absolute value, as noted by previous literature.

In contrast, social efficiency requires the right-hand side to exceed the tax-price elasticity of giving, ε_g. As the donation dividend $\frac{f'(g(tax))}{h'(tax \cdot g(tax))}$ increases, the condition for social efficiency becomes easier to satisfy. This implies that, as private donations become more effective relative to government spending, the elasticity of giving, ε_g, can be smaller in absolute value for social efficiency to hold. In practical terms, when private donations are highly effective, encouraging charitable giving through tax deductions becomes more socially efficient, and more so if donations are also highly responsive to tax incentives.

This analysis informs policymakers on whether to rely on taxation or to incentivize private donations for public good provision. Social efficiency reflects the balance between the marginal benefit of public goods from private donations and the forgone benefits of government provision relative to the responsiveness of charitable giving to changes in the tax rate. This framework represents a critical advancement in the field, offering a rigorous and comprehensive method for evaluating the efficiency of charitable giving deductions. The approach improves upon traditional approaches that rely solely on tax revenue impacts (e.g. Bradley et al. (2005); Roberts (1987); Saez (2004)).

2.2 Implementation Conditional on Data Availability

Empirical evaluation of the social efficiency condition depends on data availability for the specific context of a given public good. Ideally, researchers can estimate each component

of Equation 2. Finding ε_g is straightforward; the tax rates and giving to nonprofits, g, are publicly available. However, estimating the marginal products $f'(g(tax))$ and $h'(tax \cdot g(tax))$ requires data on the production of public goods by both nonprofits and government. The latter is particularly challenging given limited government revenue data disaggregated by specific purposes. We address this challenge through three approaches, conditional on data availability.

Base Case: Bureau of Economic Analysis Normalization

For government provision, we adopt the Bureau of Economic Analysis (BEA) convention of valuing output at \$1 per dollar spent. This tractable assumption is reasonable given the wide range of government activities and allows us to focus on nonprofit production, where we explicitly estimate public good provision. The BEA describes government consumption expenditures as "services produced by government that are valued at their cost of production," providing a principled, nationally consistent basis for our baseline comparisons.[5] Moreover, this normalization is conservative regarding nonprofit efficiency: if government programs yield less than one dollar of value per dollar spent, our approach understates nonprofit efficiency. Evidence suggests this holds for several programs (e.g., job training, disability insurance, unemployment insurance, or housing vouchers; Hendren and Sprung-Keyser (2020)), as well as environmental tax policies such as gasoline taxes, peak pricing, or cap-and-trade (Hahn et al., 2024). Some programs may yield more than a dollar per dollar spent, but fixing the government benchmark at one is not systematically favorable to nonprofits.

The social efficiency condition becomes

$$\varepsilon_g < -\frac{(1 - tax)}{\nu \cdot f'(g(tax)) - tax}. \tag{3}$$

This removes the need to estimate government productivity, requiring only nonprofit productivity and the public good value ν. Larger ν values, reflecting higher social value per dollar, lower the efficiency threshold – as intuition would suggest.

[5] See National Income and Product Accounts, Table 3.9.5., Government Consumption Expenditures and Gross Investment.

Same Public Good: Differing Marginal Productivity

Moving beyond the BEA convention of valuing government output at \$1 per dollar spent, we return to the donation dividend $\frac{f'(g(tax))}{h'(tax \cdot g(tax))}$, which captures the relative marginal productivities of nonprofit and government provision of the same public good. This provides the cleanest basis for efficiency comparisons, but it requires estimating h' for government provision, which is rarely possible for specific public goods. Meaningful comparisons further require that $f'(\cdot)$ and $h'(\cdot)$ be estimated from data with comparable target populations, geographic scope, time periods, and intervention types, since differences in program scope or scale can confound inference. We illustrate these challenges using recent literature on government conservation spending and water quality outcomes, which shows how variation in scope and targeting complicates efficiency comparisons.

Different Public Goods: Generalized Framework

Most realistically, nonprofits target particular public goods such as water quality improvement, while government would use the foregone tax revenue for a mix of expenditures across defense, education, infrastructure, and other priorities. We introduce parameter ρ representing the social value per dollar of government's portfolio, yielding the condition:

$$\varepsilon_g < -\frac{(1 - tax)}{\frac{\nu \cdot f'(g(tax))}{\rho \cdot h'(tax \cdot g(tax))} - tax}. \tag{4}$$

The generalized donation dividend $\frac{\nu \cdot f'(g(tax))}{\rho \cdot h'(tax \cdot g(tax))}$ compares the social value generated per marginal dollar by nonprofits, $\nu \cdot f'$, to the social value generated per marginal dollar by government, $\rho \cdot h'$. This ratio accounts for both the productivity differences between sectors and the differences in the social value of their respective outputs. When this ratio exceeds one, nonprofits generate more social value per dollar than government, making the efficiency threshold easier to achieve. Empirical implementation of this framework is even more challenging, as it would require estimates of production and values across the spectrum of public goods provided by the government.

3 Empirical Application to Water Quality

In our application we ask how a change in the price of giving impacts the value of the public good provided and how social efficiency compares with traditional treasury efficiency. We estimate contributions to environmental nonprofits as a function of the price of giving, then estimate how those contributions affect water quality, and incorporate values from non-market valuation studies to calculate social efficiency thresholds. Our baseline estimates assume both nonprofits and the government provide the same good, thus $\rho = \nu$, and apply the BEA normalization.

3.1 Data

The two main datasets are a panel of financial metrics for environmental nonprofits and a panel of water quality measures. We merge these and bring in additional, relevant covariates. Summary statistics are in Table 1.

Financial information for environmental nonprofits comes from the National Center for Charitable Statistics. From this universe of reporting nonprofits, we create a subset that keeps local and water-quality related groups: We drop all parent organizations and other nonprofits with large asset values. To ensure these nonprofits are water-focused, we cross-reference two additional sources. We obtain a comprehensive list of nonprofits working in "Water Resource, Wetlands Conservation, and Management" from GuideStar (www.guidestar.org). We supplement this with lists from the U.S. Environmental Protection Agency (EPA) and River Network, a national organization supporting local water protection groups. The remaining nonprofits in our sample are small, within-state organizations focused on their local region or river basin.[6] The mean contributions corroborate their size, with average annual giving at $228,000.

We calculate the annual state-level price of giving – the after-tax cost of donating one dollar – using TAXSIM, an NBER program for calculating tax liabilities (Feenberg and Coutts, 1993), and following Duquette (2016). We use the 1984 IRS Public Use File, a

[6] Only 2% of groups in our preferred estimation sample may, based on their name, receive out-of-state contributions. Results are robust to omitting these observations.

nationally representative sample of 79,556 individual income-tax returns. This dataset captures heterogeneity in income and other factors influencing marginal tax rates, and thus the price of giving. It includes contributions by itemizers and non-itemizers, the latter observed due to a temporary tax code amendment in 1984. Including non-itemizers ensures accurate state-year averages by avoiding underestimation of the mean price of giving. Using TAXSIM, we compute the first-dollar marginal cost of a contribution for all state-years by simulating tax liabilities with and without charitable contributions for representative taxpayers, yielding an average price of giving of $0.65 per dollar donated.

Water quality measurements come from two databases in the Water Quality Portal: STORET and NWIS. STORET is managed by the U.S. 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 USGS, contains data from all 50 states, the District of Columbia, and US territories. We obtained monitor-level measurements for dissolved oxygen (DO), 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 only rivers and streams. We follow standard protocols to clean the water quality data, dropping non-routine measurements and winsorizing outliers.

We obtain sociodemographic covariates from standard government sources. 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. We obtain information on Clean Water Act violations from the EPA's Enforcement and Compliance History Online (ECHO) database. Government expenditures on environmental projects include 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.

Table 1. Summary Statistics for Key Variables, 1998–2017

	Obs	Mean	SD	Min	Max
Contributions, USD	55,355	228,338.80	355,250.40	0.00	1,979,788.00
Age of Group, Years	52,592	13.07	10.71	0.00	53.00
Fundraising Expenditures, USD	50,887	3,304.33	15,159.61	0.00	282,680.00
Program Revenue, USD	52,592	41,144.89	144,604.33	0.00	2,419,140.00
Share of 1997 Total State Contributions	55,355	0.004	0.03	0.00	1.19
Assets, USD	52,592	174,993.97	199,079.80	3,796.00	844,917.00
Government Grants, USD	35,638	47,621.48	153,157.35	0.00	2,167,401.00
Price of Giving, USD	1,000	0.65	0.07	0.46	0.82
Dissolved Oxygen, County, mg/l	55,355	8.88	1.64	0.04	14.97
Dissolved Oxygen, Nearest, mg/l	63,717	8.87	1.57	0.04	14.97
Nitrogen, County, mg/l	40,379	0.72	0.69	0.10	4.70
Nitrogen, Nearest, mg/l	58,347	0.69	0.46	0.10	4.70
Phosphorus, County, mg/l	47,853	0.14	0.18	0.00	1.60
Phosphorus, Nearest, mg/l	62,505	0.15	0.17	0.00	1.60
Gross State Product, USD Millions	1,000	272,777.43	343,243.64	16,294.00	2,680,917.00
Per Capita Income, State, USD	1,000	44,291.32	8,010.72	29,713.75	77,475.00
Unemployment Rate, State	1,000	0.06	0.02	0.02	0.14
Poverty Rate, State	1,000	0.13	0.03	0.06	0.24
Government Expend., State, USD 10,000	1,000	3,860.99	4,667.79	0.00	32,201.38
Population, State	1,000	6,002,907	6,666,078	479,602	3.94e+07
GDP, County, USD Millions	12,668	14.27	36.04	33.26	69.97
Population, County	13,979	249,487.73	542,659.09	594.00	10,085,416.00
Per Capita Income, County, USD	13,979	36,607.51	12,038.78	13,084.00	227,753.00
Unemployment Rate, County	13,979	0.06	0.03	0.01	0.29
Poverty Rate, County	13,979	0.13	0.05	0.02	0.42
College Graduation Rate, County	13,979	0.18	0.07	0.03	0.57
Proportion Republican, County	13,979	0.52	0.16	0.03	0.99
Proportion White, County	13,979	0.86	0.13	0.11	1.00
Proportion Ag Land, County	13,979	0.33	0.26	0.00	0.99
Proportion Urban Land, County	13,979	0.15	0.18	0.00	0.93
Precipitation, County, 1,000 mm	13,979	1,037.29	419.02	12.24	3,672.00
CWA Violations Count, County	13,979	48.82	94.30	0	1,786

Note: Largest estimation sample for each variable used for calculations. Observations are at nonprofit group-by-year, unless noted. Price of giving is constructed from TAXSIM using a nationally representative IRS sample.

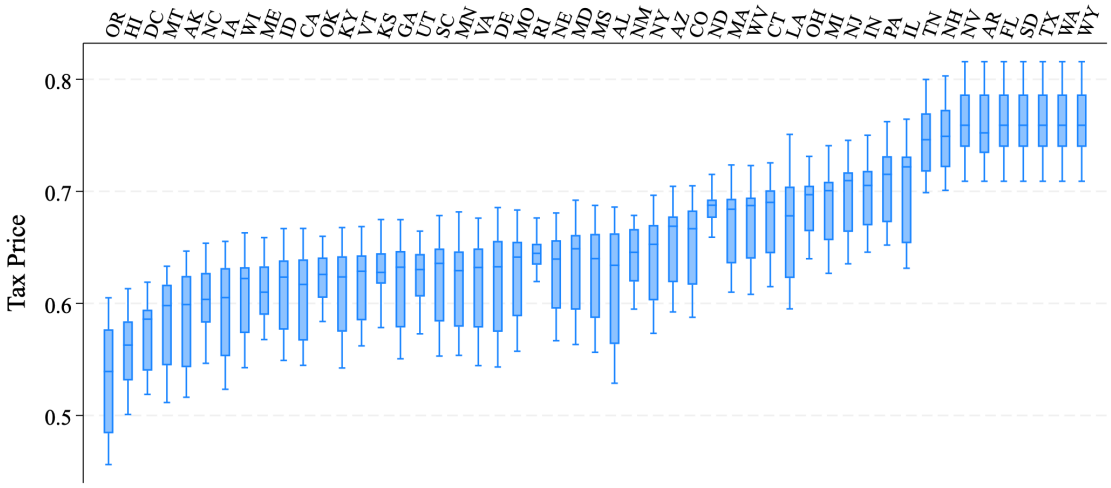
3.2 Price Elasticity of Giving

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

$$\text{Contributions}_{ist} = \delta_0 \ + \delta_1 \ln \text{Price}_{st} + \mathbf{G}'_{ist}\Gamma + \mathbf{X}'_{st}\Psi + \eta_i + \tau_t + \varepsilon_{ist} \tag{5}$$

where giving is the dependent variable, measured as contributions received by environmental nonprofit i, located in state s, in year t.[7] We construct Price_{st}, the price of giving for state s in year t, using a nationwide representative sample of households' tax returns. 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. Figure 1 indicates the distribution of tax price, shown by the box and whisker plots, for each state.

Figure 1. Distribution of the Price of Giving Across States, 1998–2017



Note: Price of giving by state over the years 1998–2017. Y-axis is after-tax cost per dollar donated. Box plots show median, p5, p25, p75, and p90, indicating within-state tax-price variation; sorted by ascending median. FL, NV, SD, TX, WA, and WY do not have state income tax and vary only due to federal changes.

We identify the coefficient of interest, δ_1, the price elasticity of giving, using the variation in tax price within state, over time, shown by annual changes in Figure A.1. Numerous

[7] We use Poisson regression to handle zeros in contributions; coefficients are interpretable as elasticities (Chen and Roth, 2024).

changes in federal and state tax rules occur over the study period. Between 1998 and 2017, seventy-one changes in the federal tax code impacted the price of giving, on average over three times per year. Some are significant changes, such as the Economic Growth and Tax Relief Reconciliation Act of 2001 and the American Recovery and Reinvestment Act of 2009. While these changes affect all taxpayers, preexisting differences in state tax rules and further state-level changes interact with the federal changes, generating considerable variation in the price of giving across states (Duquette, 2016).[8] For instance, Oregon made numerous and substantial changes to its tax code, with eighty-nine changes during the study period. Combined with federal changes, that is eight per year on average. Contributing to nonprofits is relatively cheap in Oregon, because their taxes are high. Donating is more expensive in Wyoming as they have no state income tax. Maryland has moderate state taxes and a deduction for giving, so the price of giving is in the middle of the pack.

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

3.3 Public Good Provision

Next we estimate the impact of contributions on public good provision:

$$\text{Water Quality}_{it} = \beta_0 \ + \beta_1 \text{Contributions}_{it} + \mathbf{X}'_{ct}\psi + \sigma_s + \tau_t + \upsilon_{it}. \tag{6}$$

For the dependent variable, we interchange three characteristics of water quality: dissolved oxygen (DO), and nitrogen and phosphorus concentrations. DO is beneficial for aquatic life, and thus water quality. The latter two are pollutants that degrade water quality. These measures capture key dimensions of aquatic ecosystem health that affect both environmental and economic outcomes. Federal agencies monitor water quality at thousands of sites throughout the U.S. We aggregate the data from monitors near environmental

[8] Mean year-to-year within state variation over time ranges from -28% to 39%, with a median of -1.1%. Further, the interactions of changes in federal and state tax rules are potentially highly nonlinear. This means that much of the variation is not eliminated by state fixed effects.

nonprofit i into metrics for each water quality characteristic specific to year t. We define nearby in two alternative ways, to address our uncertainty about the nonprofits' sphere of influence. One metric is the annual average of water-quality monitors most proximate to each nonprofit, up to 40 sites. We base proximity on the latitude-longitude Euclidean distance between nonprofits and monitors and limit it to 150 miles. The distance is likely farther than a nonprofit's influence; however, this allows us to match nearly all nonprofits to water quality and provides a conservative, lower-bound estimate. We then calculate annual, nearest-monitor average for each type of water quality. The second metric is the average of each water quality type for all monitors in the county where the nonprofit is located. The parameter of interest, β_1, is the change in water quality resulting from a one unit ($10,000) increase in contributions to the environmental nonprofit.

The matrix $\mathbf{X}_{ct}$ contains annual county characteristics for county c where nonprofit i is located: land use, per-capita income, educational attainment, population density, race, political inclination, unemployment, precipitation, and the number of Clean Water Act violations in a year. The use of county-level demographic regressors mitigates concerns about sub-state heterogeneity that could cause spurious correlation between contributions and water quality. For instance, county-level per capita income controls for within-state variation in wealth that could be correlated with both water quality and contributions to environmental nonprofits. We also include state-level government expenditures on water quality. Vectors σ_s and τ_t are state and year fixed effects.[9]

We wish to identify causal effects of contributions on water quality. One requirement is that contributions to water-related nonprofits are randomly located, conditional on covariates. This may fail for a couple of reasons. Contributions may be higher where water quality is poorer, due to a greater perceived need for the activity of these nonprofits. Alternatively, people who care more about the environment give more and live in cleaner places. We address these concerns using an instrumental variables approach. This approach builds on evidence that changes in price of giving affect contributions to nonprofits. Since the price of giving only varies at the state level and impacts all nonprofits in a state, we construct an instrument by interacting a nonprofit's baseline (1997) share of total contributions to all nonprofits in the state with the state's price of giving in each year (Boustan et al.,

[9]We use state and year fixed effects because states make annual water quality decisions, whereas nonprofit fixed effects would eliminate our signal of interest.

2013; Nakamura and Steinsson, 2014; Nunn and Qian, 2014). Our instrument exploits the idea that nonprofits with larger historical market shares should be more responsive to state-level tax changes. We thus use two sources of variation: plausibly exogenous, annual state-level variation in price of giving and nonprofit-level variation in initial share of total state contributions.

Our identification assumption requires that tax policy changes are exogenous to environmental nonprofit activity – that is, policymakers do not set tax rates in response to environmental contributions. This assumption is plausible because environmental nonprofits receive less than 1% of total charitable giving, making them too small to influence tax policy decisions. We test this assumption by estimating models of price of giving in a given year on lagged price of giving and up to three-year lagged contributions. Table A.1 shows no effect of lagged contributions, supporting our identification assumption that tax policy changes are exogenous to environmental nonprofit contributions. Additionally, fixing the initial share of contributions in 1997, before our study period begins, mitigates concerns about contributions depending on contemporaneous water quality conditions. We evaluate this assumption by regressing the baseline share of contributions to environmental nonprofits on five leads of each water quality measure, county covariates, and state fixed effects. The estimates, available in Table A.5, suggest no correlation between baseline shares and future dissolved oxygen, nitrogen, or phosphorus measures. Hence, the instrument is likely not affected by local water quality, as it isolates the part of change in contributions driven by state trends in taxes and, therefore, price of giving and incentives to contribute.[10]

4 Results

4.1 Price Elasticity of Giving

Table 2 provides results for the price elasticity of giving, ε_g — the impacts of changes in tax price on charitable giving, for our case of water-related nonprofits. The estimates for our preferred specification are in Column (1), as it provides a conservative reference point and follows from previous literature such as Duquette (2016). A notable exception

[10]We address potential persistence in baseline water quality shocks in the sensitivity analysis section.

is that he follows the convention in the literature to use a natural log transform that adds a constant (commonly \$10 or \$100) to contributions before taking logarithms. Instead, we use Poisson regression to handle zeros in contributions. In the table, Column (2) adds state-specific trends to control for additional time-varying state heterogeneity that could affect contributions. Columns (3) and (4) incorporate additional group characteristics. Column (5) includes county- rather than state-level controls to account for the possibility that the price of giving changes in response to local economic conditions.[11] Standard errors are clustered at the state level because that is the relevant level of variation for price of giving (Abadie et al., 2023).

The estimated elasticity ranges from -0.93 to -0.64, all below the -1.0 threshold required for treasury efficiency, indicating that the tax incentive lacks enough additional donations to justify lost revenue. These estimates fall at the lower end of the literature range of -0.4 to -4.0 reported in previous studies, though alternative log transformations yield estimates from -1.32 to -2.39, emphasizing the importance of robust Poisson estimation (Chen and Roth, 2024). The findings indicate that the tax deductibility of donations to these nonprofits is not *treasury* efficient. These results underscore a critical need to reconsider how tax incentives align with promoting charitable giving to maximize public benefit rather than treasury income.

The effects of other covariates align with intuition. Several factors are positively associated with higher levels of giving, including higher gross state and county product, greater age of the charity, more active fundraising efforts, and higher levels of assets. Conversely, lower contributions are correlated with higher population, unemployment rates, and larger program revenue.

We conduct several robustness tests for potential endogeneity concerns, finding no evidence of pre-trends or reverse causality; see Appendix Tables A.1 to A.4 for details.

[11] Our preferred specification omits group characteristics and county-level controls due to missing observations. Robustness checks using interpolated values yield similar results.

Table 2. Poisson Estimates of the Effect of Tax Price on Contributions

	(1)	(2)	(3)	(4)	(5)
ln(Tax Price)	-0.930**	-0.772**	-0.701**	-0.639*	-0.929**
	(0.389)	(0.352)	(0.335)	(0.383)	(0.420)
ln(Grs State Product)	0.308	0.251	0.385*	0.554***	
	(0.219)	(0.159)	(0.201)	(0.178)	
ln(Per Cap Income)	-0.505	0.0798	-0.566*	-0.964***	
	(0.367)	(0.317)	(0.327)	(0.365)	
Population, State	-2.68e-08**	-8.00e-08***	-2.41e-08*	-4.70e-08***	
	(1.33e-08)	(2.76e-08)	(1.35e-08)	(1.25e-08)	
Unemployment Rate, State	-2.492**	-1.504*	-2.164**	-1.394	
	(1.085)	(0.827)	(0.943)	(0.969)	
Poverty Rate, State	-0.00758	-0.549	0.109	-0.625	
	(1.255)	(1.340)	(1.141)	(1.585)	
ln(Age)	0.141***	0.141***	0.0398	0.0251	0.135***
	(0.0302)	(0.0307)	(0.0320)	(0.0383)	(0.0334)
ln(Fundraise)			0.0144***	0.0108***	
			(0.00207)	(0.00183)	
ln(Assets)			0.293***	0.243***	
			(0.0143)	(0.0151)	
ln(Prog Rev)			-0.0206***	-0.0205***	
			(0.00211)	(0.00234)	
Government Grants				0.0547***	
				(0.00349)	
GDP, County					2.07e-09***
					(3.60e-10)
ln(Per Cap Income), County					-0.0249
					(0.139)
Population, County					-1.20e-07***
					(2.29e-08)
Unemployment Rate, County					-1.922***
					(0.712)
Poverty Rate, County					0.484
					(0.443)
College, County					-0.0550
					(0.518)
White, County					0.0225
					(0.164)
Observations	52,592	52,592	50,649	33,382	45,639
Number of Groups	7,402	7,402	7,144	5,411	6,664

Note: Dependent variable is group-level contributions. Coefficients interpreted as elasticities. All models include group and year fixed effects. Column (2) adds state trends; columns (3) and (4) vary covariates; column (5) includes county-level controls. Standard errors clustered at state level. *** p<0.01 ** p<0.05 * p<0.1.

4.2 Public Good Provision

Social efficiency evaluates the impact of tax changes on contributions, the resulting change in public good provision, and the marginal value of the additional public good. Here, we estimate the second component: the relationship between contributions and water quality, our measure of public good provision. We present two sets of results for each water quality metric in Tables 3 and 4. One set uses the mean of measurements from monitors nearest to each group's location, while the other uses the mean of all measurements within each county. Kleibergen-Paap F-statistics suggest the instrument is sufficiently strong to mitigate concerns about bias. Standard errors are clustered at the watershed level; robustness checks with clustering at the county and state levels show stable significance.[12]

Increases in contributions to environmental nonprofits improve water quality in U.S. streams and rivers. A \$10,000 increase in contributions leads to a $0.003-0.006$ mg/L rise in dissolved oxygen. It also results in a $0.0007-0.001$ mg/L decrease in nitrogen concentration and a 0.0003 mg/L reduction in phosphorus concentration at county-level monitors. However, no statistically significant effect is observed for phosphorus at monitors near a group's location. While these changes are small in magnitude, they are economically significant.

Large improvements in water quality are constrained by its slow rate of change and substantial prior improvements (Keiser and Shapiro, 2019). Our estimates are meaningful relative to the mean annual changes in water quality during the study period. For dissolved oxygen, marginal effects represent 12.51% and 47.92% of annual changes at nearby and county-level monitors, respectively. For nitrogen, marginal effects account for 10.56% of annual change at nearby monitors and 61.56% at the county level. Finally, the marginal effect for phosphorus at the county level constitutes 28.7% of the mean annual change. Having estimated both the price elasticity of giving and the marginal productivity of nonprofit contributions, we now turn to calculating social efficiency by incorporating the economic value of these water quality improvements.

[12] First-stage results are in Tables A.6 and A.7. For comparison to second-stage results, we estimate OLS models; these coefficients are small and insignificant except for county-level DO ($p = 0.06$), reflecting non-random locations and spending by nonprofits. Available on request.

Table 3. IV Estimates of the Effect of Contributions on Water Quality: Nearest Monitors

	DO	Nitrogen	Phosphorus
Contributions (10,000 USD)	0.00284**	-0.000707***	-4.27e-05
	(0.00116)	(0.000250)	(8.33e-05)
Prop Ag Land, County	-0.246	0.535***	0.166***
	(0.192)	(0.0626)	(0.0206)
Prop Urban Land, County	0.0941	0.349***	0.163***
	(0.220)	(0.0738)	(0.0289)
Population Density, County	4.46e-06	5.79e-06***	4.83e-06***
	(4.12e-06)	(1.19e-06)	(4.66e-07)
Per Capita Income, County (USD)	-7.98e-06***	-8.08e-07	-1.19e-07
	(2.28e-06)	(6.87e-07)	(2.41e-07)
College, County	0.354	0.0157	-0.0143
	(0.467)	(0.200)	(0.0616)
Republican, County	-0.307*	-0.191***	-0.0348
	(0.181)	(0.0678)	(0.0311)
Unemployment Rate, County	-4.384***	1.077**	0.0105
	(1.436)	(0.535)	(0.234)
White, County	1.681***	0.0467	0.107***
	(0.298)	(0.103)	(0.0388)
Mean Precipitation, County (1,000s mm)	-0.000132	-0.000262***	-9.94e-05***
	(0.000178)	(6.86e-05)	(3.58e-05)
Mean Precipitation^2, County	1.22e-07**	9.13e-08***	3.12e-08***
	(5.61e-08)	(2.09e-08)	(1.10e-08)
CWA Violations, County	-0.000142	0.000122*	3.03e-05
	(9.16e-05)	(6.64e-05)	(2.40e-05)
Government Expenditures, State (10,000 USD)	3.32e-05**	-1.80e-05***	-1.70e-06
	(1.34e-05)	(6.40e-06)	(2.43e-06)
Observations	63,717	58,347	62,505
Number of Clusters	1,217	1,203	1,215
Kleibergen-Paap F stat.	24.72	19.04	23.25
Prob > F	0.0000	0.0000	0.0000

Note: Second stage results. Outcome is labeled at the top of each column, measured as the annual mean of nearest water-quality monitors, up to 40, to each nonprofit. Estimations use an instrument of 1997 group share × state tax price. All models include state and year fixed effects. Robust standard errors, clustered by watershed. *** p<0.01 ** p<0.05 * p<0.1.

4.3 Total Effect of Contributions on Value of the Public Good

This subsection demonstrates how our theoretical framework translates into concrete policy guidance when applied to real data. We calculate social efficiency thresholds for environ-

Table 4. Impact of Giving on Water Quality - County Means

	DO	Nitrogen	Phosphorus
Contributions (10,000 USD)	0.00556***	-0.00117***	-0.000316***
	(0.00112)	(0.000401)	(0.000109)
Prop Ag Land, County	-0.177	0.803***	0.231***
	(0.215)	(0.0977)	(0.0283)
Prop Urban Land, County	0.118	0.560***	0.136***
	(0.313)	(0.120)	(0.0329)
Population Density, County	-5.06e-05*	5.29e-07	9.83e-06***
	(2.76e-05)	(8.78e-06)	(1.82e-06)
Per Capita Income, County (USD)	-8.71e-06***	2.05e-07	-1.74e-07
	(2.32e-06)	(1.13e-06)	(2.94e-07)
College, County	0.140	-0.427	-0.0565
	(0.542)	(0.354)	(0.0813)
Republican, County	-0.205	-0.491***	-0.0733**
	(0.189)	(0.142)	(0.0324)
Unemployment Rate, County	-5.786***	0.620	-0.0485
	(1.783)	(0.855)	(0.274)
White, County	1.675***	0.124	0.0749
	(0.332)	(0.157)	(0.0557)
Mean Precipitation, County (1,000s mm)	4.54e-05	-0.000540***	-6.70e-05
	(0.000171)	(0.000130)	(4.84e-05)
Mean Precipitation^2, County	9.87e-08*	2.09e-07***	2.17e-08
	(5.61e-08)	(4.79e-08)	(1.62e-08)
CWA Violations, County	-0.000291	0.000423***	3.25e-05*
	(0.000182)	(8.57e-05)	(1.92e-05)
Government Expenditures, State (10,000 USD)	9.65e-06	-8.84e-06	-5.39e-06
	(1.51e-05)	(8.03e-06)	(3.62e-06)
Observations	55,355	40,379	47,853
Number of Clusters	1,155	1,071	1,095
Kleibergen-Paap F stat.	22.67	43.14	26.70
Prob > F	0.0000	0.0000	0.0000

Note: Second stage results. Same specification as Table 3, but outcomes are the means of water quality, for all monitors in the county of the nonprofit's location. Estimations use an instrument of 1997 group share × state tax price. All models include state and year fixed effects. Robust standard errors, clustered by watershed. *** p<0.01 ** p<0.05 * p<0.1.

mental nonprofit contributions using Equation 3, which requires three components: the price elasticity of giving from our preferred specification, $\varepsilon_g = -0.93$, marginal products of contributions $f'(g)$ from our water quality models, and the value of the public good, ν. We derive the value of the public good from a meta-analysis of stated preference studies for wa-

ter quality improvements (Johnston and Bauer, 2020), aggregating household willingness-to-pay estimates to the county level. Detailed valuation methodology, pollutant-specific considerations, and alternative approaches are discussed in Appendix A.4. We focus on county-level results from Table 4 as they provide significant effects for all three water quality measures and enable tractable valuation calculations.

Table 5. Social Efficiency by Pollutant, Indicated by $\varepsilon_g <$ Threshold

Price Elasticity of Giving, ε_g	Tax Rate, ***tax***	Metric of Water Quality	Marginal Product of Contributions, ***f'(g)***	Value of Public Good per $10,000 in Contributions, ν	Social Efficiency Threshold
		Dissolved Ox.	0.0056	743.56	**-0.17**
-0.93	0.35	Nitrogen	0.0012	1,048.06	**-0.74**
		Phosphorus	0.0003	2,443.18	**-1.55**

Note: Calculated using Equation 3, assuming government converts tax revenue dollar-for-dollar into public goods. Marginal effects are from Table 4. Value of the public good is in 2017$ and includes use and non-use values, from stated preference meta-analysis (Johnston and Bauer 2020). Contributions meet the social efficiency threshold for DO and nitrogen, but not phosphorus.

Table 5 presents our key findings. Given our estimated elasticity of -0.93, dissolved oxygen and nitrogen achieve social efficiency with thresholds of -0.17 and -0.74, while phosphorus fails with a threshold of -1.55. This contrasts sharply with treasury efficiency, which required $\varepsilon_g < -1.0$ and deemed all these contributions inefficient.[13]

These divergent results reflect systematic differences in nonprofit effectiveness across pollutants. Dissolved oxygen shows the strongest response to nonprofit interventions at 0.0056 mg/L per $10,000, yielding the most achievable threshold. Nitrogen balances lower marginal effects of 0.0012 mg/L per $10,000 with higher public valuation. Phosphorus proves most challenging with minimal marginal effects of 0.0003 mg/L per $10,000 despite high public value.[14]

These differences reflect nonprofits' comparative advantage. Dissolved oxygen and nitrogen respond to restoration activities that local nonprofits typically pursue. Phosphorus requires costly, large-scale interventions often beyond nonprofit capacity. Furthermore,

[13] Under BEA normalization, nonprofit marginal value $\nu \cdot f'(g)$ versus assumed government value of 1 yields: 4.16 (DO), 1.26 (nitrogen), 0.73 (phosphorus), confirming our efficiency conclusions.

[14] We calculate confidence intervals for social efficiency thresholds using 10,000 random draws from 95% confidence intervals for price elasticity, marginal products, and water quality values. Results (Table A.8) confirm our conclusions.

these social efficiency estimates likely represent conservative lower bounds, as they capture only current-year effects and do not account for potential temporal accumulation of water quality benefits or spatial spillovers beyond county boundaries.

The results demonstrate that social efficiency depends on matching tax incentives to areas where nonprofits have comparative advantage relative to government provision. When policymakers consider actual public benefits rather than just donation responsiveness, efficiency conclusions change dramatically. This suggests that efficient charitable tax policy requires targeted approaches rather than uniform treatment across all environmental outcomes.

Alternative Assumption: Same Public Good, Differing Productivity

To evaluate social efficiency using real-world government productivity data, we relax the BEA normalization assumption and instead estimate $h'(tax \cdot g(tax))$, the marginal effect of government spending on public good provision. Because detailed, purpose-specific data on government investments in water quality are not publicly available, we rely on external estimates from the literature. To our knowledge, the only national-scale study is Liu et al. (2023), which examines the impact of the Environmental Quality Incentives Program (EQIP), a federal program that pays farmers to adopt conservation practices, on water quality outcomes across US watersheds from 2005 to 2015. They estimate the effect of EQIP payments on several pollutants, including dissolved oxygen deficiency, nitrogen, and phosphorus. Government expenditures are associated with improvements in dissolved oxygen and reductions in nitrogen, but also with increases in phosphorus concentrations – a deterioration in water quality likely caused by certain conservation practices that disturb soil and increase runoff.

While informative, these estimates are not perfectly aligned with our context for two reasons. First, EQIP focuses exclusively on agricultural lands and nonpoint source pollution, while the nonprofits in our sample address a broader range of water quality issues. Second, Liu et al.'s data cover different time periods and geographic scales than our analysis. Still, these results allow us to illustrate how Equation (2) can be implemented using empirical estimates of government marginal productivity. A \$10,000 donation at a 35% tax rate costs \$3,500 in forgone revenue. We rescale Liu et al.'s estimates to reflect this spending level.

The rescaled estimates yield $h'(\cdot) = 0.000487$ for dissolved oxygen, 0.00309 for nitrogen, and -0.000243 for phosphorus. Substituting these into Equation (2) produces social efficiency thresholds of:

$$\text{Dissolved oxygen: } \varepsilon_g < -0.058, \quad \text{Nitrogen: } \varepsilon_g < -17.1, \quad \text{Phosphorus: } \varepsilon_g < 0.41.$$

Note that phosphorus has a positive threshold because government spending worsens water quality, making any nonprofit improvement efficient by comparison. Given our estimated price elasticity of giving, $\varepsilon_g = -0.93$, the deduction is socially efficient for dissolved oxygen and phosphorus. For nitrogen, the elasticity is above the threshold, reversing our baseline result that nitrogen was socially efficient. This reflects EQIP's focus on nonpoint source pollution from agriculture and its strong performance in reducing nitrogen runoff, relative to the broader scope of work of the nonprofits in our data.

These calculations highlight that conclusions about efficiency depend not only on how responsive donations are, but also on how effective government provision is as a counterfactual. They underscore the pollutant-specific nature of both marginal effects and policy implications. While these results show how Equation (2) can be implemented empirically, our baseline BEA normalization remains appropriate and conservative given current data limitations. This exercise demonstrates how our framework can incorporate empirical government productivity estimates when available.

Alternative Outcome: Composite Water Quality Index

A key question is whether our pollutant-specific results reflect genuine differences or are artifacts of treating outcomes separately. Our main analysis treats each water quality outcome as a distinct dimension of environmental benefit, estimated separately for social efficiency. This avoids imposing strong assumptions about comparability or additivity across pollutants that differ in sources and ecological impacts. Further, it is not valid to sum marginal effects $f'(\cdot)$ estimated in separate regressions with different samples.

As an alternative to our pollutant-specific approach, we assess whether our results hold when using a composite index of water quality as the outcome variable. We follow Johnston and Bauer (2020) to construct a water quality index (WQI) from Water Quality Portal data.

The WQI aggregates multiple water quality measures into a standardized 0-100 scale, where higher values indicate better water quality. We construct a balanced panel by interpolating missing values of each pollutant. We then re-estimate the public good provision model using the WQI as the outcome. The estimated marginal effect is $f'(g) = 0.054$, and the implied social efficiency threshold is -0.02. This threshold of -0.02 is far less stringent than our individual pollutant thresholds of -0.17 to -1.55. At our estimated price elasticity of giving, $\varepsilon_g = -0.93$, the condition for social efficiency is satisfied by a wide margin, confirming that our main conclusion is robust to how we measure water quality benefits and supporting our framework even when optimal aggregation is unclear.

4.4 Sensitivity

We conduct extensive robustness checks to ensure our social efficiency conclusions are not artifacts of specific methodological choices or sample definitions. We test alternative variable measurements, model specifications, and identification assumptions. Across all specifications, the estimated impacts on water quality remain consistent with our main results, and conclusions about social efficiency are unchanged, reinforcing the robustness of our framework. Details of all robustness checks are in the Appendix, Section A.3.

We address potential measurement error by restricting our sample to water-focused nonprofits that receive primarily in-state donations, controlling for other local nonprofit activity, and using summer-only water quality measurements when environmental concerns are most acute. To examine timing effects, we estimate models using up to five-year lagged contributions, finding similar results except that nitrogen becomes marginally inefficient with three-year lags.

Most importantly, we conduct falsification tests using nonprofits focused on unrelated causes, including legal services, employment, food assistance, and religious organizations. These groups show no impact on water quality, confirming that our results reflect genuine environmental nonprofit activity rather than spurious correlations with general civic engagement. Finally, we verify our causal mechanism by showing that instrumented nonprofit expenditures also improve water quality, providing additional evidence that contributions translate into meaningful environmental programs.

5 Conclusions

The charitable deduction represents a substantial federal tax revenue loss. For 2024, the estimated cost ranged from $55 to $82 billion, according to the Joint Committee on Taxation and the Treasury Department, respectively. State revenue losses from charitable deductions add substantially to this total, as most states with income taxes allow similar deductions. The stated purpose of tax deductions for charitable giving is to elicit more value through additional contributions. Extensive economics literature evaluates this goal using treasury efficiency, typically measured by the price elasticity of giving. Our work addresses this significant fiscal tradeoff.

This work establishes a new standard for evaluating charitable giving tax policy by redefining how we measure the effectiveness of tax subsidies for donations. We argue that higher contributions alone should not be the ultimate objective and propose an alternative metric, the price elasticity of the public good's value, as the appropriate measure for social efficiency. The proposed metric highlights the need to evaluate not just the amount of contributions but also how effectively they translate into public goods and the value generated by those goods. This paper provides a methodological framework to guide this shift in focus.

In doing so, we make two novel contributions. First, the approach can be extended to other public goods where both nonprofits and government operate. These include healthcare, education, and social services, allowing identification of sectors where charitable tax incentives generate the highest social returns. Second, it provides guidance for evaluating social efficiency empirically for specific public goods.

We showcase an application of this framework to environmental nonprofits that impact water resources, where the public good is improved water quality. Our findings overturn traditional efficiency verdicts: despite appearing treasury inefficient with elasticities of $0.6 - 0.9$, these environmental contributions prove socially efficient when we account for their actual water quality impacts. This result underscores our main point: accounting for both provision of public goods and their value can yield different conclusions about efficiency compared to traditional metrics.

Our framework opens several avenues for future research and policy applications. First,

the approach can be extended to other public goods where both nonprofits and government operate – including healthcare, education, and social services – to identify sectors where charitable tax incentives generate the highest social returns. Second, our donation dividend concept provides a foundation for optimal tax policy design that moves beyond the binary question of whether charitable deductions "work" to determining optimal deduction rates across different sectors. Third, international applications could exploit variation in tax systems across countries to compare charitable tax incentives versus direct government funding for global public goods. Finally, the framework offers a new approach to evaluating other tax expenditures, providing an efficiency-based metric for comparing tax incentives to direct government spending when both private and public provision are possible.

Our application to water-related environmental groups demonstrates the relevance of our criterion, but is only one of many potential contexts to test this approach. The implications for other charitable sectors will vary depending on several factors: the price elasticity of giving, nonprofits' ability to effect change, measurable impacts, and the role of government in the same sector. In our context, contributions to environmental nonprofits have meaningful impacts on two measures of water quality, and the relatively high willingness to pay for water quality improvements lowers the threshold required for social efficiency. For phosphorus, the threshold is not met because the marginal impact of contributions is small. Despite the high value of this public good, the small impact raises the threshold and makes social efficiency harder to achieve.

We assess two extensions to illustrate how our framework adapts to varying data availability and empirical contexts. Using external estimates of government productivity, we show how conclusions depend on the relative effectiveness of nonprofit versus public provision. We also confirm that our main result holds when outcomes are aggregated into a composite water quality index. Together, these extensions demonstrate the flexibility and practical relevance of our framework.

Our model and analysis emphasize the importance of considering nonprofits' effectiveness in producing public goods and the value of those goods when evaluating the efficiency of tax deductibility. By incorporating these factors, our results show that conclusions about efficiency can differ significantly from traditional interpretations. This framework offers policymakers and researchers a more nuanced understanding of how to design and evaluate tax policies that support charitable giving while maximizing public good provision.

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