Efficiency and Equity of an Outdoor Recreation Equipment Tax to Fund Public Lands

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Abstract

We analyze the efficiency and equity implications of a federal excise tax on outdoor recreation equipment for funding U.S. public lands. Using micro-data on consumer expenditures, we estimate a two-stage Quadratic Almost Ideal Demand System for recreation equipment and simulate the impacts of a 5 percent tax. The tax generates a modest welfare loss as a share of tax revenues raised—$0.04 for every $1 of revenue. It is approximately proportional to income, across the entire income distribution, but households in the lowest income quintile pay more as a share of income than households in the other four income quintiles.

Appendix materials can be accessed online at:
https://uwpress.wisc.edu/journals/pdfs/LE-98-3-Walls-appA.pdf
https://uwpress.wisc.edu/journals/pdfs/LE-98-3-Walls-appB.pdf

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I. Introduction

National parks in the United States have a growing list of deferred maintenance projects. As of September 2018, the cost of these projects, which include repairs and upgrades to buildings, roads, water systems, and other infrastructure, stood at $11.8 billion (National Park Service 2018). The other federal land management agencies—the Forest Service, Fish and Wildlife Service, and Bureau of Land Management—face similar problems and together have a $7.5 billion deferred maintenance backlog (Vincent 2019).

By and large, the federal land management agencies are funded out of general fund revenues, through the annual appropriations process. Since 1980, appropriations have remained relatively flat in real terms; they have decreased as a share of non-defense discretionary spending and as a share of U.S. GDP (see Appendix A). At the same time, much of the infrastructure in the national parks is aging—some of it dating back to the construction projects of the Civilian Conservation Corps in the 1930s—and use of the parks is soaring. The four highest visitation years on record were 2016 through 2019, with lodging and campgrounds filled to capacity during peak seasons (Walls, Wichman, and Ankney 2018). Some of the most popular parks are also those with the largest maintenance backlogs: Yosemite ($646 million), Yellowstone ($563 million), Grand Canyon ($314 million), and urban National Park Service (NPS) sites such as the National Mall in Washington, DC ($655 million) (NPS 2018).

Chronic underfunding has led many observers to call for a dedicated funding source. In this paper, we analyze one dedicated funding option: a federal excise tax on outdoor recreation equipment. Using public use micro-data from the U.S. Bureau of Labor Statistics' annual Consumer Expenditure Survey (CEX), we estimate the demand for outdoor recreation equipment

using a Quadratic Almost Ideal Demand System (QUAIDS) framework (Deaton and Muellbauer 1980; Banks et al. 1997) and use the model to simulate the effects of a 5 percent excise tax. The QUAIDS model is a structural demand model derived from a consumer utility maximization framework, thus we can use the estimated parameters of the model to calculate the compensating variation (CV) and the excess burden per dollar of revenue generated. We also evaluate the incidence of the tax across household income quintiles. We use the recreation equipment spending categories in the CEX that include camping gear, hunting and fishing equipment, winter and water sports equipment, bicycles, canoes and kayaks, motorboats, recreational vehicles, and other products we describe in more detail below. Average annual spending by households on these goods over the 2005-2016 sample period in our study was $39 billion (in inflation-adjusted 2016 dollars), according to the CEX data. Ours is the first empirical study, to our knowledge, that uses household micro-data to estimate a model of outdoor recreation equipment demand and thus the first to examine, in an empirical setting, the efficiency and equity of the so-called "gear tax" for funding public lands.[1]

A gear tax is one of three options often suggested for a dedicated public lands funding stream. The other two are energy leasing revenues from federal lands and recreation fees, namely national park entrance fees. Offshore lease revenues have long supported the Land and Water Conservation Fund, and in June 2020, Congress passed a bill authorizing up to $9.5 billion of onshore and offshore lease revenues for a five-year period for use on projects in the deferred maintenance backlogs.[2] Entrance fees exist at many of the most popular national parks and have increased over time, but when the Secretary of the Interior proposed approximately doubling fees at 17 of the most highly visited national parks in 2017, there was a public backlash that led him to ultimately back off the proposal (Fears 2018).[3] The idea of an outdoor recreation equipment

tax was first introduced in the mid-1970s and has resurfaced from time to time since then. Supporters see it as a broadening of long-time federal excise taxes on hunting and fishing equipment, which are generally viewed by the conservation community and many others as quite successful at raising sustainable funds for wildlife conservation and related programs (Regan and Watkins 2020). The tax's appeal, like that of the hunting and fishing taxes, often centers on the "user pays" idea—i.e., that the main beneficiaries of the public good are the ones who pay the taxes that support it.

According to our results, a 5 percent tax on outdoor recreation equipment would impose a relatively small excess burden on U.S. households relative to the revenues raised for public lands. We estimate that the tax would generate revenues of approximately $1.6 billion per year from U.S. households, impose an annual CV of $12.50 per household, and lead to an excess burden of 4 percent of tax revenue—i.e., a $0.04 welfare loss for each dollar of tax revenue raised. The average household would pay only about $12 per year in taxes. Thus, the average tax burden on households is relatively small. And scaling the revenues collected from households to reflect revenues from all sources suggests the total tax revenues could be as high as about $4.6 billion per year. By contrast, we estimate that national park entrance fees would have to be 5 to 10 times current levels to raise the same amount of money. With these increases, entrance fees could go as high as $350 (for a single vehicle for a one-week visit). Our entrance fee calculations are back-of-the-envelope but serve as a useful benchmark for comparison.

Most sales taxes are regressive, but we estimate a Suits Index for the 5 percent outdoor recreation equipment tax of -0.019, indicating that the tax is close to being proportional to income. An average household in each of the top four quintiles pays approximately the same amount in taxes as a share of income. Households in the lowest income quintile, however, pay

twice as much as a share of their income, on average, as households in the other quintiles. Thus, while overall regressivity appears to be less than other sales taxes, the tax would still impose the largest burden on the poorest households.

The purpose of our study is to provide some empirical evidence on the price elasticity of demand for outdoor recreation equipment and use that evidence to assess, in a partial equilibrium setting, the efficiency and equity of a sales tax on such equipment. Ramsey (1927) showed that to raise a specific amount of revenue for a public good using taxes on consumer products, the tax rates should be inversely proportional to the price elasticity of demand—i.e. products with the least elastic demands have the highest tax rates. Without comparing to other product demands, we cannot say how an outdoor equipment tax fares against other options. But the use of dedicated taxes, in general, to fund public goods can have some drawbacks. Experience suggests they nearly always crowd out general fund revenues, and this means that the source of revenues for the public good dictates the level of spending, which can be problematic (Auerbach 2010; Dye and McGuire 1992; Walls 2013). On the other hand, as pointed out by Auerbach (2010), dedicated taxes develop a natural constituency of support for the public good the taxes pay for, which can be leveraged to accomplish social objectives. This seems to be the case with the hunting and fishing gear taxes, which have a strong constituency.

We abstract from these important considerations in our analysis. We also abstract, in our empirical setting, from how the uses of the revenues, especially potential public lands improvements, might affect demand for the taxed good. Banzhaf and Smith (2020) and Chan and Kotchen (2021), in theoretical models, show that if outdoor recreation equipment is a complement to public lands—i.e., increased spending on public lands leads to a positive feedback effect on the demand for the taxed good—this will decrease the welfare loss from the

tax. There may even be a tax that improves public lands enough to make consumers just as well off as without the tax. Two considerations arise in this framework, however. First, there may be nonuse values for public lands. Second, the degree of complementarity between outdoor recreation equipment and public lands could be tenuous—some taxed gear may never be used on public lands and some visitors to public lands may spend only minimal amounts on outdoor gear. In any event, it is challenging to develop empirical estimates of the relationship between public land quality and demand for outdoor gear, as Banzhaf and Smith (2020) point out, though this could be a useful topic for future research.

We begin in Section II with a discussion of the history of federal hunting and fishing excise taxes, the movement to broaden the base of those taxes, and the use of the outdoor gear tax approach in three states. We then describe the CEX data, QUAIDS model, and framework for evaluating the efficiency and equity of the recreation equipment tax. In Section IV, we show the results. Section V offers some discussion, comparing the gear tax to potential alternative approaches to raising revenues for public lands, and Section VI provides concluding remarks.

II. Outdoor Recreation-Related Taxes

II.1. Hunting and fishing federal excise taxes. Wildlife conservation programs have relied for decades on funding from federal excise taxes on hunting and fishing equipment coupled with revenues from state hunting and fishing licenses. The 1937 Pittman-Robertson Wildlife Restoration Act and the 1950 Federal Aid in Sport Fish Restoration Act (often called the Dingell-Johnson Act, or the Wallop-Breaux Act after sponsors of 1984 amendments to the Act) generate funds for state wildlife conservation from federal excise taxes on firearms, ammunition,

archery equipment, and fishing gear and import duties on gear, yachts, and motorboats. Since the 1984 Wallop-Breaux Amendments, some of the Highway Trust Fund money—the portion estimated to come from sales of fuel used in motorboats and outdoor power equipment—also goes to the sport fish fund.[4]

The Acts mandate that proceeds from the excise taxes go into accounts at the Department of the Interior, which then apportions most of the money to states using formulas based on land area and sales of state fishing and hunting licenses.[5] Both laws specify that annual federal spending in the programs must be outside of Congressional appropriations. To be eligible for the money, states have to pass their own laws to ensure that their license revenues support fish and wildlife programs and are not diverted to other uses. Lueck and Parker (2021) point out that prior to 1937, when Pittman-Robertson was passed, hunting and fishing license revenues were used to fund state wildlife agencies, but revenues were often diverted to other government programs. This motivated the law's passage and its language about required state laws and use of revenues.

Table 1 shows the current tax rates on various items in the two programs. Figure 1 shows annual funding from fiscal year 1965 through 2017. Although participation in hunting and fishing has fallen over the years, the taxes continue to generate a substantial amount of revenue and although there are some year-to-year fluctuations, they are relatively small and the trend is upward, even after adjusting for inflation. In FY2019, taxes in the two programs generated approximately $1 billion for spending on state wildlife conservation and related programs.

II.2. Broadening the base: tax proposals from the 1970s-1990s. The Wildlife Management Institute first proposed broadening the base of the federal excise taxes in a 1975 study for the Council on Environmental Quality (Wildlife Management Institute 1975). There was a concern that the needs of non-game wildlife species were not being met by the revenues

generated from hunting-related taxes, which in general are targeted to game species. The study looked at 45 potential excise taxes on various kinds of outdoor equipment such as backpacks and camping gear, cameras and other photographic equipment, binoculars, bird seed and feeders, and recreational vehicles. After the study, at least eight bills were introduced in Congress before 1980, none of which passed (Loomis and Mangun 1987).[6]

In the 1990s, hunters and anglers concerned about the decline in hunting and fishing participation and the possible drop in revenues for wildlife conservation programs resurrected the outdoor recreation equipment tax idea. State fish and wildlife agencies, through the International Association of Fish and Wildlife Agencies, launched the campaign, which eventually came to be known as the "Teaming with Wildlife" initiative and included federal excise taxes on a range of gear (Richie 1995; Peterson 1998). The proposal was supported by a large number of conservation organizations and state agencies and had the backing of Secretary of the Interior Bruce Babbitt, but the outdoor recreation industry was vigorously opposed.[7] The Teaming with Wildlife concepts were drawn into a larger conservation effort, the Conservation and Reinvestment Act (CARA), introduced in Congress in 1998 but with offshore oil and gas lease revenues replacing the gear tax and funding going to a broader set of activities (Franklin and Houston 1998). The bill had bipartisan support but ultimately did not pass.

II.3. Recreational equipment sales tax revenues in the states. Texas has allocated the portion of the state's general sales tax revenues that come from sporting goods to the Texas Parks and Wildlife Department since 1993. About half of the money goes to fund the state park system; most of the other half goes to local parks, with a small portion deposited into a capital fund. The total amount is capped at $32 million a year. Georgia passed a law similar to Texas's in 2018 but instead of estimating the tax revenue that comes from sale of particular goods,

Georgia bases its estimates on sales from particular retail establishments. In Georgia, the funds are to be used on land conservation projects while Texas's program uses the money to provide park operating funds. The Georgia program is estimated to generate between $20 and $40 million per year. These two states divert a portion of their general sales tax revenues, but they do not have dedicated product-specific sales taxes. Virginia has had a two percent dedicated sales tax on hunting and fishing equipment since 2000, the proceeds of which (up to $13 million per year) are deposited into the state's Game Protection Fund. A bill proposing a sales tax of 0.2 percent on outdoor recreational equipment that costs more than $200 was introduced in the Washington legislature in February 2019. It was met with vigorous opposition from the outdoor retail industry (Martinell 2019).

III. Estimating the Demand for Outdoor Gear

The efficacy of an excise tax with a broader base—i.e., one that encompasses not just hunting and fishing equipment but a wide array of other consumer products—depends critically on the demand function for those products and its responsiveness to changes in prices. We use 12 years of CEX micro-data to estimate that demand function for U.S. households. In the following sections, we describe the CEX and consumer price index data we use in the analysis and provide summary statistics for the sample. We then describe the structure of the QUAIDS model and show results of the estimation.

III.1. Data: *The CEX and Price Indexes*

The CEX is a survey by the Bureau of Labor Statistics (BLS) of randomly sampled households ("consumer units," in BLS parlance)[8] from 91 primary sampling areas across the

U.S. Its main use is for determining the relative importance of goods and services in the market basket of the Consumer Price Index (CPI). The CEX micro-data includes expenditures for each surveyed household for a wide set of individual durable and nondurable goods and a variety of services, along with income and demographic variables such as race, ethnicity, age, education, and household size. The survey is not longitudinal, rather it is a series of separate cross-sections. For the analysis here, we use data from 2005 through 2016.

The CEX is comprised of two separate surveys. One is the interview survey, in which a BLS administrator visits households every quarter and asks them about their purchasing behavior, and the other is the diary survey, in which households self-report expenditures over a two-week period. Typically, spending on food, various household items, apparel, and some services purchased on a regular basis are available in the diary, while spending on durable items and goods and services purchased intermittently is in the interview. In some cases, spending is available on individual items from both surveys. We rely on the interview data for the recreation equipment categories we use in our analysis.

The recreation goods of interest are in the "Entertainment" category in the CEX, in the sub-category labeled "other entertainment supplies, equipment, and services." Within this sub-category, we omit recreation services—vehicle and equipment rentals, boat docking and landing fees, and equipment repairs. This leaves spending on motorized and nonmotorized recreational vehicles, outboard motors, and "sports, recreation, and exercise equipment," which includes hunting, fishing, and camping equipment, water and winter sports equipment, other miscellaneous sports equipment, bicycles, GPS devices, and "athletic gear, game tables, and exercise equipment." This last sub-category includes some indoor recreation equipment, which means we may be overestimating consumer spending on outdoor recreation gear. On the other

hand, apparel is a separate category in the CEX, which means we are not including items such as rain gear, fleeces, and hiking boots that may be used in outdoor recreation activities and may be subject to a tax.

Our selection of CEX spending categories is also designed to match the appropriate consumer price index, which we need in our demand model. The "sporting goods" CPI, which resides within the broader "recreation" category, includes motorized and nonmotorized sports vehicles, various kinds of sports equipment such as hunting and fishing equipment, camping equipment, and water sports equipment, and a miscellaneous sporting goods category unsampled in the BLS price index survey. Together, the CEX sub-categories we use in the "entertainment" category do a good job of matching this sporting goods CPI.[9]

The CEX micro-data has some strengths and weaknesses for purposes of understanding the demand for outdoor recreation equipment. In general, the CEX is the best source for national data on consumer spending in the US on a wide array of individual goods and services. For our purposes, it provides a consistent national sample of individual household spending on recreation equipment over multiple years. The CEX has been used in several demand analyses, including studies of food and beverage demand (Boonsaeng and Carpio 2019), gasoline demand (Archibald and Gillingham 1980, 1981), and total nondurables (Attanasio and Watkins 1995; Fernández-Villaverde and Krueger 2007). Blow et al. (2015) use an AIDS model to estimate demand for six categories of expenditures, including entertainment spending (which includes recreation equipment). Hawkins (2002) uses the CEX data in an AIDS model of spending across a range of goods and services categories to model the effects of sales taxes.

One drawback of the CEX is that it has expenditures but not individual prices and quantities. This means, as in other studies, we must rely on the CPI for prices. Because the CPI

for recreational equipment is not available at a regional level, we use the national CPI and adjust it based on state sales taxes using an approach similar to Hawkins (2002). Specifically, using 2016 state and local sales tax rates from Drenkard and Kaeting (2016), we create prices for each household based on their state of residence, *j*, as follows:

$$P_{rj} = \frac{1+\tau_j}{1+\bar{\tau}} P_r \qquad (1)$$

where P_{rj} is the price of recreation equipment in state *j*, P_r is the national CPI for recreation equipment, τ_j is the average sales tax rate in state *j*, and $\bar{\tau}$ is the national average state sales tax rate.[10] There are some drawbacks to this approach as there may be inter-state or local price variation it does not capture. Moreover, households can make purchases across borders, thus it may not provide an accurate reflection of actual prices paid for every household. Nonetheless, we see it as the best option for capturing some of the spatial variability in prices across households.

III.2. Descriptive Statistics

Table 2 shows summary statistics from the CEX survey. An average household spends approximately $78 per quarter on outdoor recreation equipment, 0.4 percent of its total expenditures on all goods and services. Many households (approximately 85 percent of the sample) purchase none of the goods in this category, at least at the time they are interviewed by BLS, thus the median expenditure in the sample is zero. Because of this censoring of the data, we use a two-stage approach, modeling the choice to purchase any recreation equipment in a given quarter, followed by estimation of the adjusted QUAIDS model for the recreation equipment budget share. We describe the two-stage model in more detail below.

Figure 2 shows average quarterly household spending, in inflation-adjusted 2016 dollars, for each year of our sample. The effects of the Great Recession show up in outdoor recreation spending with a 31 percent drop between 2008 and 2010 and recovery not arriving until about 2014. Figure 3 compares trends in outdoor recreation equipment prices to trends in prices for all goods over the sample period, with each of the CPIs normalized to 1 for the year 2005. Recreation equipment prices have stayed roughly the same over the 12-year period at the same time that the general price level rose about 1.9 percent per year, on average.

III.3. Empirical Approach: Two-Stage QUAIDS Model

The linear approximate version of the Almost Ideal Demand System (AIDS) was originally developed by Deaton and Muellbauer (1980) and has been a popular functional form for demand analysis over the years because it has several desirable properties. It satisfies the axioms of choice, including transitivity and completeness, and the homogeneity and symmetry properties can be tested and imposed by parameter restrictions in the model. Also, because the budget shares are derived from duality theory, one can solve the underlying expenditure function and calculate welfare effects of price and other changes, which is important for our analysis. One limitation of the AIDS model is that the Engel curves are assumed to be linear. Banks et al. (1997) developed a quadratic version of the AIDS model (QUAIDS) that gets around this restriction, which we use here. In addition, in our setting, there are many households that have zero spending in a quarter. We thus adopt a two-stage approach, estimating the probability a household purchases any recreational equipment in a first stage Probit model and the household budget shares in an adjusted second-stage demand equation, conditional on the first stage. We use the method proposed by Shonkwiler and Yen (1999), in which the standard normal

probability density function (pdf) and cumulative distribution function (cdf) from the first stage regression are used to correct the budget share equations.

The QUAIDS model has an indirect utility function that takes the following form:

$$\ln V = \left\{ \left[\left[\frac{\ln x - \ln a(p)}{b(p)} \right] \right]^{-1} + \lambda(p) \right\}^{-1} \qquad (2)$$

where x is total expenditures, p is a vector of prices, and $a(p)$, $b(p)$, and $\lambda(p)$ are defined as follows:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j \qquad (3)$$

$$b(p) = \prod_{i=1}^{n} p_i^{\beta_i} \qquad (4)$$

$$\lambda(p) = \sum_{i=1}^{n} \lambda_i \ln p_i \qquad (5)$$

The subscript i indexes the n goods included in the demand system. $\lambda(p)$ is homogeneous of degree zero in prices. Applying Roy's Identity to equation (2) yields the expenditure share equation for good i:

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \left[\frac{x}{a(p)}\right] + \frac{\lambda_i}{b(p)} \left\{\ln \left[\frac{x}{a(p)}\right]\right\}^2 \qquad (6)$$

where w_i is spending on good i as a share of spending on all goods, and α_i, γ_{ij}, β_i, and λ_i are parameters to be estimated.

To be consistent with utility theory, we need the following restrictions to hold:

$$\gamma_{ij} = \gamma_{ji} \qquad \text{[Slutzky symmetry]} \qquad (7)$$

$$\sum_{i=1}^{n} \gamma_{ij} = 0 \qquad \text{[Homogeneity of degree zero in prices and income]} \qquad (8)$$

$$\sum_{i=1}^{n} \alpha_i = 1; \ \sum_{i=1}^{n} \gamma_{ij} = 0; \ \sum_{i=1}^{n} \beta_i = 0; \ \sum_{i=1}^{n} \lambda_i = 0 \qquad \text{[Adding up]} \qquad (9)$$

To solve for expenditure and price elasticities of demand, we first differentiate equation (6) with respect to $\ln x$ and $\ln p_i$:

$$\Psi_i = \frac{\partial w_i}{\partial \ln x} = \beta_i + \frac{2\lambda_i}{b(p)} \left[\ln \left(\frac{x}{a(p)}\right)\right] \qquad (10)$$

$$\Psi_{ij} = \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \Psi_i \left[\alpha_j + \sum_{k=1}^{n} \gamma_{ik} \ln p_k\right] - \frac{2\lambda_i \beta_j}{b(p)} \left[\ln \left(\frac{x}{a(p)}\right)\right]^2 \qquad (11)$$

The Marshallian (uncompensated) price elasticities of demand are:

$$e_{ij} = \frac{\Psi_{ij}}{w_i} - \delta_{ij} \qquad (12)$$

where δ_{ij} is the Kronecker delta, which is equal to 1 when *i=j* and zero otherwise. The expenditure elasticities are given by:

$$e_i = \frac{\Psi_i}{w_i} + 1 \qquad (13)$$

Hicksian (compensated) elasticities are calculated from the Slutsky equation:

$$e_{ij}^c = e_{ij} + e_i w_j \qquad (14)$$

Many households have zero expenditures on recreation equipment in the quarter in which they are surveyed, a common problem in consumer expenditure survey data. This means that equation (6) is a censored model of recreation expenditure shares. Following Shonkwiler and Yen (1999), we estimate a two-stage system of equations to correct for the bias introduced by this problem. The system of demand equations is as follows:

$$w_i^* = f(x_i, \mu_i) + u_i$$

$$d_i^* = z_i'\rho_i + v_i$$

$$d_i = \begin{cases} 1 \; if \; d_i^* > 0 \\ 0 \; if \; d_i^* \leq 0 \end{cases} \tag{15}$$

$$w_i = d_i w_i^*$$

where w_i is the budget share of good i (as specified in equation (6)) and d_i is a binary outcome variable equal to one if the household consumes good i and zero otherwise; w_i^* and d_i^* are the corresponding latent variables; x_i is the household's total expenditures and prices; z_i' are sociodemographic and other variables that explain demand; μ_i and ρ_i are vectors of parameters; and u_i and v_i are random errors.

Assuming the error terms, u_i and v_i are distributed bivariate normal with cov(u_i, v_i)= θ_i, the system of equations in (15) can be rewritten as:

$$w_i^* = \Phi(z_i'\rho_i) f(x_i, \mu_i) + \theta_i \emptyset(z_i'\rho_i) + \epsilon_i \tag{16}$$

where $\Phi(z_i'\rho_i)$ is the cdf and $\emptyset(z_i'\rho_i)$ the pdf.

The Probit model yields estimates of ρ_i and allows us to calculate $\Phi(z_i'\rho_i)$ and $\emptyset(z_i'\rho_i)$. We then use equation (16) in a second stage to obtain estimates of the remaining parameters, including θ_i. We include demographic demand shifters—race, education, age, household size, and whether the household resides in an urban area—as components of the α_i term, as well as dummy variables for each year. The demand shifters are aggregated in α_i in order to preserve the adding up condition.

The expenditure elasticity for the censored good then becomes:

$$e_i^* = \frac{\Phi(z_i'\rho_i)\Psi_i}{w_i} + 1 \qquad (17)$$

and the Marshallian price elasticity for the censored good is:

$$e_{ij}^* = \frac{\Phi(z_i'\rho_i)\Psi_i}{w_i} + \emptyset(z_i'\rho_i)\tau_{ij}\left(1 - \frac{\theta_i}{w_i}\right) - \delta_{ij} \qquad (18)$$

where τ_{ij} is the extensive margin effect of price of good j on purchases of good i obtained from the first stage estimation.

We use a Probit model to estimate the first stage and an Iterative Feasible Generalized Non-linear Least Squares (IFGNLS) procedure to estimate the second stage budget share equation (11). The model includes two goods – outdoor recreation equipment (the censored good) and a composite good comprised of all other expenditures. Only the outdoor recreation good equations are estimated explicitly because estimation of the full demand system would yield a computationally singular result. We impose the restrictions of QUAIDS in equations (7-9) to calculate the parameters for the composite good demand.

III.4. Results

The first stage Probit estimation results are shown in Appendix B, Table B.1., and the second stage results for the budget share equation (12) in Table B.2. The estimated price and expenditure elasticities are reported in Table 3.

The Marshallian (uncompensated) own-price elasticity of demand for outdoor recreation gear is -4.111, indicating that demand is price-elastic – a one percent increase in the price of gear will reduce the quantity demand by approximately 4 percent. According to the estimated cross-price elasticity, a one percent increase in the price of the composite good will reduce the quantity demanded of recreation equipment by 1.2 percent. Thus, if all other goods become more expensive, households tend to reduce purchases of outdoor gear. Changes in the price of gear have very little effect on the demand for other goods, however; the cross-price elasticity of demand for the composite good with respect to the price of recreation equipment is -0.001. The expenditure elasticity of 1.26 suggests that recreation equipment is a luxury good—i.e., a one percent increase in total expenditures leads to a more than one percent increase in the quantity purchased.

To our knowledge, there are no demand elasticities for outdoor recreation equipment in the published literature for comparison with our results. Blow et al. (2015) use CEX data in a linear AIDS model and analyze six categories of spending, including an entertainment category, which includes outdoor recreation equipment and many other sub-categories such as TVs and video games, pets and pet products, toys, recreation equipment rentals and repairs, and admissions fees to movies, concerts, and sporting events. The estimated own-price elasticity of demand for entertainment in Blow et al. (2015) was not statistically significantly different from zero; the estimated income elasticity was 2.30, larger than our estimated expenditure elasticity for recreation equipment.

IV. Tax Revenues and Welfare Effects of a Recreation Equipment Sales Tax

We use the results from the two-stage QUAIDS model to simulate the effects of a 5 percent sales tax on recreation equipment, calculating new levels of spending, average tax payments, CV, and the excess burden per dollar of revenue raised. The 5 percent rate is somewhat arbitrary, but we select it, in part, because current taxes on hunting and fishing equipment are around 10 percent (see Table 1). Also, a relatively low tax rate should be more politically acceptable. The tax payment for an average household would amount to a little over $3 per quarter without any adjustments in demand, based on average quarterly expenditures of $78 (see Table 2).[11]

CV is the amount of income required to bring individuals back to their original utility level after a price change. A first-order Taylor series expansion of the minimum expenditure function, $x = (U, p)$, with respect to price will yield an approximation of this amount of income:

$$\Delta x \approx q \Delta p \tag{19}$$

which we can rewrite in terms of budget shares and relative price changes:

$$\Delta \ln x \approx \sum_{i=1}^{n} w_i \Delta \ln p_i \tag{20}$$

As shown in Friedman and Levinsohn (2002), and used by Renner (2018) and Okonkwo (2021) in two-stage QUAIDS models of carbon taxes, adding a second-order Taylor expansion

of the expenditure function allows for the estimated behavioral responses and substitution effects in response to the price change and a more accurate approximation of CV:

$$CV = \Delta \ln x \approx \sum_{i=1}^{n} w_i \Delta \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} w_i e_{ij}^{c} \Delta \ln p_i \Delta \ln p_j \qquad (21)$$

where e_{ij}^{c} is the compensated (Hicksian) price elasticity of good i with respect to price of good j.

Table 4 shows the average CV and tax expenditures per household and total revenues raised from the 5 percent tax, on a quarterly basis. We also show the excess burden of the tax—i.e., the CV net of tax revenues—per dollar of tax revenue raised (Diamond and McFadden 1974).

The tax causes total household spending on outdoor recreation equipment to drop because of the relatively high own-price elasticity of demand. The average household spends $78 per quarter without the tax and $62 with the tax, with approximately $3 of that spending in the form of tax payments.[12] The average quarterly CV per household is $3.24. For every dollar of tax revenue raised, there is a net welfare loss, or excess burden, of $0.04. In comparison with estimates from the literature of the excess burden of other taxes, the gear tax imposes a relatively small excess burden for each dollar raised, at least at the 5 percent tax rate that we analyze. Studies of U.S. federal income taxes, show marginal excess burdens in the range of approximately 15 to 30 percent of revenues (Browning 1987; Carroll 2009; Saez et al. 2012). Ballard et al. (1985) estimate the marginal excess burden of general sales taxes at 25 to 39 percent, but only 3 to 12 percent for sales taxes applied to a more limited set of products

(excluding gasoline, alcohol, and tobacco). The low expenditure share for recreation equipment, averaging only 0.4 percent across the CEX sample (including the many households with zero expenditures), combined with a tax rate of only 5 percent are the reasons for the low average CV (and excess burden).

In total, the government would collect from U.S. households approximately $389 million per quarter from the 5 percent tax, or about $1.6 billion per year. As pointed out in footnote 2 above, BEA estimates of total outdoor recreation spending are about 2.9 times the CEX estimates of outdoor recreation spending by households. A rough scaling up of our household revenue estimate suggests the tax should bring in about $4.6 billion per year in total tax revenue. As noted above, the federal hunting and fishing excise taxes currently generate about $1 billion in annual revenue. Thus, broadening the base of this federal excise tax, while cutting the tax rate approximately in half (from 10 percent, on most products, to 5 percent), is likely to quadruple annual tax revenues. The $4.6 billion is approximately 1.4 times the National Park Service budget in FY2018, but only about 21 percent of the $12.1 billion spent by all four federal land management agencies combined.

Our analysis assumes a perfectly elastic supply of recreation equipment such that the tax is fully passed on to consumers. If producers of recreation equipment bear some of the burden of the tax, our CV is overstated. Implications for overall welfare effects and total tax revenues are unclear, however. The recreation equipment industry appears to be highly competitive, with few barriers to entry, substitutability across brands and products, and a low degree of market concentration, but future research could investigate these issues and the effect of an excise tax on the industry.

V. Incidence of Recreational Equipment Tax across Income Groups

In this section, we consider the distributional impacts of a tax on outdoor equipment. We sort the CEX households into quintiles based on reported household income and calculate the average tax paid for each quintile, both in dollars per year and as a share of income.

Figure 4 shows average annual tax payments by quintile on the left axis (the bar graph) and average tax payments as a percent of income on the right axis (the line graph). An average household in the highest income quintile would pay $7.64 per quarter in outdoor equipment taxes, which is 12 times as much as an average household in the lowest income quintile. However, this is less than 0.017 percent of average household income in the highest quintile, less than half the average for a household in the bottom quintile, which would pay 0.034 percent of its income in taxes. Interestingly, the second, third, and fourth quintiles pay about as much as a share of income as the top quintile.

We also calculate the Suits Index for our 5 percent gear tax. The Suits Index compares the cumulative proportion of tax revenue paid to the cumulative proportion of income earned by households in the sample and is thus a measure of tax progressivity. It varies from -1 to 1, with negative values indicating regressivity, positive progressivity, and zero a tax that a tax is proportional to income. We calculate a Suits Index of -0.014, thus the gear tax is close to being proportional to income. For comparison, Suits's original 1977 paper finds general sales and excise taxes had indexes of -0.15 in 1970 (Suits 1977).

VI. Discussion: Alternatives to a Gear Tax

In this section, we evaluate alternative options for funding the National Park Service (and other public land agencies) to see how they might compare to the gear tax. A modest 5 percent recreation equipment tax could generate $1.6 billion in revenues per year from households and likely another $3 billion from other consumers. What options might generate equivalent revenues?

One commonly suggested option is an increase in fees for use of public lands, namely entrance fees at national parks. The NPS operates 419 sites, only 109 of which currently charge any kind of entrance fee. In most cases, the fee is on a per-vehicle basis and allows entry to the site for one week; fees average roughly $30 per vehicle.[13] Using these entrance fees and annual visitation data for each park for 2016, we calculate that total NPS fees revenues were roughly $247 million in 2016.[14] Back-of-the-envelope calculations show that to increase fee revenues to $4.6 billion, the estimated revenue from a 5 percent sales tax on outdoor recreation equipment, the NPS could either

- raise fees at the 109 parks that currently have fees to 10 times current levels;
- raise fees at the 109 parks that currently have fees to 5 times current levels and charge international visitors a $150 surcharge; or
- raise fees at parks that currently have fees to 6 times current levels and impose a $50 per person entry fee at the 310 remaining sites.

These are rough calculations and assume no decline in visitation with fee increases. There is limited evidence in the literature on this question, but findings in two studies suggest that entrance fee increases cause only a small reduction in the number of visitors (Stevens et al. 2014; Sage et al. 2017).[15] Raising fees to ten times current levels would probably have a large effect, however, as it would raise the price of admission to a national park to as high as $350 per vehicle

for a one-week visit. Moreover, it would create a large difference in the cost of access across parks, with some continuing to allow admission for free. The second option would raise fees half as much (to a maximum of $210 per vehicle per week) but charge overseas visitors a $150 surcharge to make up the difference. Some observers have suggested that fees should be higher for international visitors (Stevens et al. 2014) and this is consistent with the practice in many other countries (Costa Rica, Kenya, and South Africa, to name a few). In 2016, an estimated 13.3 million overseas tourists visited US national parks (US Travel Association 2016) so a $150 surcharge would generate approximately $2 billion per year. If this surcharge were adopted, it would limit the increase necessary for domestic visitors and get the total to approximately the level of the 5 percent gear tax. The third option would raise fees at the parks that currently charge to six times current levels and add a $50 per person charge at sites that currently allow entry for free.

Entrance fees and a gear tax are probably the options that come closest to the user pays, or benefit principle, approach to funding public lands, but each clearly has drawbacks. The other option for funding public lands that we mentioned in the Introduction is federal energy leasing revenues. The federal government leases offshore and onshore land for oil and gas drilling and other mineral production and collects rents, royalties, and bonus payments from private companies. In FY2019, total revenues amounted to $12 billion, approximately $8.4 billion from production of oil and gas. Prest (2021) finds that increasing onshore oil and gas royalty rates on federal lands from 12.5 percent to 18.75 percent would raise an additional $3 billion per year in the year 2030 and beyond, as would a $50 per ton “carbon adder” (which internalizes the greenhouse gas emissions associated with oil and gas production on federal lands). This is approximately 65 percent of the revenues we estimate would be generated by a 5 percent gear

tax. Notably, federal leasing revenues are already dedicated to a variety of expenditures, namely state governments and the Land and Water Conservation Fund, thus not all of the revenues from an increase in royalty rates or imposition of a carbon adder is likely to go to public lands agencies.

A final point about dedicated revenues is worth reiterating. Virtually every time a dedicated tax is adopted to pay for a public good, general fund revenues fall, sometimes to zero (Auerbach 2010). Dye and McGuire (1992) document this for dedicated state taxes for education, highways, and aid to local governments and Walls (2013) for state parks, which have come to rely heavily on dedicated funds at the expense of general fund revenues. If an outdoor recreation equipment tax were to be the sole source of revenues for national parks and other public lands, it would need to be substantially higher than the 5 percent we modeled here and would likely generate a considerable excess burden per dollar of tax revenue.

VII. Concluding Remarks

In this paper, we assessed the efficiency and distributional impacts of a proposed federal excise tax on outdoor recreation equipment. Using national consumer expenditure data, we estimated a demand function for outdoor recreation equipment and used the model to simulate the effects of a 5 percent sales tax. This comparatively small tax would generate an estimated $4.6 billion in revenue per year, about 45 percent above current annual funding levels for the National Park Service and more than four times the amount generated by existing taxes on hunting and fishing equipment. We estimate that the average consumer would only pay about $12 in taxes each year, and the tax would generate an excess burden of only 4 percent of tax

revenues. Although the Suits Index shows the tax to be approximately proportional to income, across the entire income distribution, we find that households in the lowest income quintile pay significantly more, as a share of income, than households in the other four quintiles.

Despite the tax's drawbacks, we find that other dedicated revenue options also seem to have drawbacks. Entrance fees at national parks would have to increase significantly to match the revenues from a gear tax. In our view, those increases would be unpalatable to the American public. Moreover, they would probably cause substantial drops in visitation, an issue outside our scope here but an interesting topic for future research. In general, a better understanding of recreational use of public lands is needed to assess the efficacy of fee increases as well as a gear tax. In particular, understanding how fee revenues might be used to improve public lands, how those improvements would affect visitation and values, and whether there is a feedback effect on the demand for recreation equipment are important empirical questions (Banzhaf and Smith 2019).

National parks and other public lands in the United States are unique and valuable assets. Evidence suggests the value is growing as more Americans visit and recreate on these lands. But funding woes for the agencies that manage the lands persist and as they do, park conditions are worsening. Despite increased spending on the deferred maintenance backlog in the national park system over the last few years, the backlog has either stayed the same or risen slightly over the same period. Many observers have proposed the federal government move from a nearly total reliance on general fund revenues, allocated through the annual Congressional appropriations process, to a dedicated funding stream. Our analysis suggests that doing this using an outdoor recreation equipment tax would impose a relatively small welfare loss and could generate about $4.6 billion per year, higher than the current budget for the National Park Service. The tax

should be evaluated and compared to a range of possible options for improving public lands financing.

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Table 1. Items Taxed and Tax Rates in Wildlife and Sport Fish Restoration Programs	
Items taxed	**Tax rate**
Handguns	10%
Other firearms (e.g., rifles, shotguns, machine guns)	11%
Ammunition	11%
Archery equipment	11%
Sport fishing equipment (e.g., rod handle, guide, fishing reels)	10%*
Fishing supplies and accessories (e.g., tackle boxes, landing nets)	3%
Electric outboard motors	3%
Additional revenues: Import duties of 1% to 2.7% on various yachts and pleasure craft; import duties of 3.7% to 9.2% on fishing gear. A portion of federal motor fuel tax revenues, estimated annually based on boat registrations, for Sport Fish Restoration program.	
*Taxes on fishing rods and poles taxes are capped at $10. Source: U.S. Fish and Wildlife Service (2018).	

Table 2. Quarterly Household Income and Spending on Outdoor Recreation Equipment			
	Mean	Median	Std. dev.
Recreation expenditures	$78.11	$0.00	$1,391.36
Budget share - recreation	0.0039	0	0.03
Household income	$17,926	$12,776	$17,779
Average quarterly consumer spending on outdoor recreation equipment, total US			$9.7 billion
Total number of households in sample (2005-2016)			319,458
Source: BLS Consumer Expenditure Survey Public Use Micro-data, 2005-2016. Quarterly income obtained by dividing annual income by 4. Expenditures and income are in inflation-adjusted 2016 dollars.			

Table 3. Estimated Price and Expenditure Elasticities of Demand		
	Recreation equipment	Composite Good
Own price, Marshallian	-4.111	-0.991
Own price, Hicksian	-4.105	-0.003
Cross price	-1.221	-0.001
Expenditure	1.262	0.992

Table 4. Quarterly Tax Revenues, Compensating Variation, and Excess Burden of a Five Percent Sales Tax on Outdoor Recreation Equipment			
Average tax payment per household	Average CV	Excess burden per dollar of tax revenue	Total tax revenues
$3.12	$3.24	$0.04	$389 million
Note: average quarterly expenditures on outdoor recreation equipment fall from $78.11 without the tax (in inflation-adjusted 2016 dollars) to an estimated $62.45 with the tax.			

Figure 1. Annual Wildlife and Sport Fish Restoration Program Funding
(in inflation-adjusted 2019 dollars)

Source: U.S. Fish and Wildlife Service. Wildlife and Sport Fish Restoration Programs. Apportionments/Funding Index. Available at https://wsfrprograms.fws.gov/subpages/grantprograms/FundingIndex.htm.

Figure 2. Average Quarterly Household Spending on Outdoor Recreation Equipment

Source: Author calculations from BLS Consumer Expenditure Survey, available at https://www.bls.gov/cex/pumd.htm, and Consumer Price Index, available at https://www.bls.gov/cpi/data.htm.

Figure 3. Consumer Price Index, All Goods and Outdoor Recreation Equipment

Source: BLS Consumer Price Index https://www.bls.gov/cpi/data.htm.

Figure 4. Incidence of Recreation Equipment Tax Across Income Quintiles

End Notes

[1] The CEX data provide estimates of spending by U.S. households, which is far less than total spending on outdoor recreation equipment in the economy. The U.S. Bureau of Economic Analysis, which obtains spending estimates from various Census Bureau surveys of business establishments such as the Economic Census and the Annual Retail Trade Survey for use in the National Income and Product Accounts, provides estimates of outdoor recreation spending that encompasses a larger group of consumers. BEA's estimate of recreation spending in 2016 was $111 billion compared to only $38 billion from the CEX for the same year. BEA numbers are available at https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey.

[2] The special fund created in the new law ends in FY2025.

[3] Fees were raised across the board by $5 instead.

[4] The federal "duck stamp," adopted in 1934, also provides dedicated funds for wildlife conservation. The stamp is required for all migratory waterfowl hunters over age 16 (and is purchased by stamp collectors); the revenues are used for purchase of land to add to the national wildlife refuge system.

[5] Additionally, there are some competitive conservation grant programs funded by the taxes.

[6] The Forsyth-Chafee Fish and Wildlife Conservation Act, often called the "Non-Game Act", passed in 1980. It called for states to include non-game species in their wildlife conservation

programs and authorized the US Fish and Wildlife Service to distribute money to states for nongame species, but no dedicated funding was provided for the program.

[7]Additionally, many saw the "user fee" link between spending on wildlife conservation using revenues generated from a tax on outdoor recreation equipment as tenuous (McIlwaine 1996).

[8] A consumer unit consists of any of the following: (1) all members of a household who are related by blood, marriage, adoption, or other legal arrangements; (2) a person living alone or sharing a household with others or living as a roomer in a private home or lodging house or in permanent living quarters in a hotel or motel, but who is financially independent; or (3) two or more persons living together who use their incomes to make joint expenditure decisions. Financial independence is determined by the three major expense categories: housing, food, and other living expenses. To be considered financially independent, at least two of the three major expenditure categories have to be provided entirely or in part by the respondent. See the CEX glossary at https://www.bls.gov/cex/csxgloss.htm.

[9] Specifically, the CPI used is code SERC, sporting goods in U.S. city average, all urban consumers, seasonally adjusted. The main reason we do not break down demand into sub-categories of spending, even though the data are available in the CEX, is because individual CPIs below the "sporting goods" level of aggregation are not available.

[10] State of residence is sometimes suppressed in the CEX for fear of breaking confidentiality. In these cases, which account for 11.6 percent of the observations in our sample, we use a population-weighted regional average. Five states have no sales tax (Alaska, Delaware, Montana, New Hampshire and Oregon).

[11] We assume the tax is fully passed through to consumers.

[12] Predicted expenditures from our model without the tax are $72 so there is a smaller difference between pre- and post-tax expenditures using estimates from the model.

[13] There are 62 national parks, but the NPS also manages a variety of other types of sites such as national recreation areas, national historic parks, national monuments, and national seashores. Most sites also have a per-person fee option and some charge only on a per-person basis with fees typically $10 or $15. See https://www.nps.gov/aboutus/entrance-fee-prices.htm#CP_JUMP_5864916.

[14] Visitation data for individual parks are available from the NPS Visitor Use Statistics website at https://irma.nps.gov/STATS/. We use the per-vehicle entry fee for each park and assume two people per vehicle and that each visit is 7 days; for parks that have per-person fees and no vehicle fee, we use those fees in our calculations. Our estimate for total fee revenues is very close to the number reported in Department of the Interior (2018), which was $256 million for FY2017.

[15] Economists have looked at fees in other outdoor recreation settings. Ji et al. (2021) evaluate the impacts of a $20 entrance fee (from a base of zero) to lake recreation areas in Iowa using a random utility model (RUM). They find that the fee would decrease the number of trips by an average of 73 percent, or 1.77 trips per year. Lupi et al. (2021) use a RUM to analyze the effects on Michigan residents of entrance fee increases at Great Lakes beaches. A $20 increase reduces the number of trips in that setting by 24 percent. National park trip demand is likely to be quite different from these closer-to-home options, however.