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

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Abstract

US national parks and other public lands have large deferred maintenance backlogs and a need for more sustainable annual funding streams. Some observers have suggested that dedicated funding sources outside of general revenues would improve the situation. In this study, we analyze the efficiency and equity implications of one option, a federal excise tax on outdoor recreation equipment. Using 12 years of microdata from the US Bureau of Labor Statistics' Consumer Expenditure Survey, we estimate consumer demand for recreation equipment and use the model to simulate the impacts of a 5 percent federal excise tax. We find that the demand for outdoor gear is highly price-elastic, and thus the tax would generate a sizable welfare loss as a percentage of tax revenues raised. The tax would be nearly proportional to income across the income distribution, though households in the lowest income quintile would pay substantially more as a share of income, on average, than households in the four higher income quintiles. The tax would impose only a small financial burden on an average household, however, and generate about \$3 billion annually for public lands. In back-of-the-envelope calculations, we show that raising the same amount of money from national park entrance fees would require very large, and likely unacceptable, increases in those fees.

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1. 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 (NPS 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 congressional appropriations process. Since 1980, appropriations have remained relatively flat in real terms; they have decreased as a share of nondefense discretionary spending and as a share of US GDP (see Appendix A). At the same time, much of the infrastructure in the national parks is aging—some of it dating from the 1930s, as construction projects of the Civilian Conservation Corps—and use of the parks is soaring. Visitation reached an all-time high in 2016, with lodging and campgrounds filled to capacity during peak seasons (Walls et al. 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 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. Employing public use microdata from the annual Consumer Expenditure Survey (CEX), conducted by the US Census Bureau on behalf of the US Bureau of Labor Statistics (BLS), we estimate the demand for outdoor recreation equipment and simulate the effects of a 5 percent excise tax with an Almost Ideal Demand System (AIDS) framework (Deaton and Muellbauer 1980). The AIDS 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 excess burden the tax imposes 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, which 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 consumer spending on these goods over the 2005–16 sample period in our study

was \$94 billion (in inflation-adjusted 2016\$), according to CEX data. Ours is the first empirical study, to our knowledge, that uses household microdata to estimate a model of outdoor recreation equipment demand and thus the first to examine in an empirical setting the efficacy of the “gear tax” for funding public lands.

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, particularly national park entrance fees. Offshore lease revenues have long supported the Land and Water Conservation Fund, which provides funding for land acquisition for new park lands. In July 2020, Congress passed, and the president signed, a law authorizing up to \$9.5 billion of onshore and offshore lease revenues for use on projects in the deferred maintenance backlogs.¹ Some states use oil and gas and other natural resource revenues to fund their park systems and other conservation efforts (Walls 2013). 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, the public backlash led him to ultimately back off from the proposal (Fears 2018)².

The idea of an outdoor recreation equipment tax was first introduced in the mid-1970s (WMI 1975) and has resurfaced from time to time since then. Supporters see it as a broadening of longtime federal 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 appeal of this tax, as with the hunting and fishing taxes, often centers on the “user pays” idea—that is, that the main beneficiaries of the public good are the ones who pay the taxes that support it.

Our results show the gear tax to be an inefficient approach to raising money for public lands. We find the demand for recreation equipment to be highly price-elastic. As a result, an excise tax causes a large reduction in the quantity of gear demanded, and as a result, the CV is sizable. We estimate that a tax rate of 5 percent yields a CV of \$12.19 per household and an excess burden of 118 percent of tax revenue—that is, the tax causes a loss in welfare of \$1.18 for each dollar of tax revenue raised.

¹ The special fund created in the new law, the Great American Outdoors Act (P.L. 116-152), ends in FY2025 and thus does not provide a long-term solution to public land funding shortfalls. The text of the law can be found at <https://www.congress.gov/bill/116th-congress/house-bill/1957/text>.

² Fees were raised across the board by \$5 instead.

Despite the efficiency costs, a 5 percent tax would cause the average household to pay only about \$10 per year in taxes. Thus the tax burden on an average household is relatively small. We estimate the tax would generate revenues of over \$3 billion per year. Additional tax revenues would also be generated by businesses and other entities purchasing outdoor recreation equipment, groups that are not included in our consumer expenditure data, which focus only on spending by US households. We calculate that national park entrance fees would have to be four to seven times current levels to raise as much money as the 5 percent gear tax. With these increases, entrance fees could go as high as \$245 per visit (for a single vehicle for one week). Our entrance fee calculations are back-of-the-envelope but serve as a useful benchmark for comparison.

Most sales taxes are regressive, but we find that an outdoor gear tax is only slightly regressive. We estimate a Suits index of -0.033 , 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 about 2.6 times 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 with other sales taxes, the gear 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. In seminal study, 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—that is, products with the least elastic demands have the highest tax rates. In that spirit, our findings indicate that the gear tax is an inefficient approach. Moreover, using dedicated taxes to fund public goods has some additional drawbacks. Experience suggests that dedicated taxes nearly always crowd out general fund revenues, often leading to no overall increase in funding. In addition, with dedicated taxes, 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 Auerbach (2010) points out, 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, and is an argument often used in favor of a broader outdoor equipment tax (Absolon 2017; Dewitt 2018; Vollman 2019).

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 goods. Banzhaf and Smith (2020) and Chan and Kotchen (2020), in theoretical models, show that if outdoor recreation equipment is a weak complement to public lands, there may be an efficiency argument for using a tax on recreation equipment. Weak complementarity between a private good and a public good means that the public good has no value to individuals unless they also consume the private good. If weak complementarity holds, then there may 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, weak complementarity rules out nonuse values, which may be important 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.

In Section 2, we discuss 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, AIDS model, and framework for evaluating the efficiency and equity of the recreation equipment tax in Section 3. In Section 4, we show the results. Section 5 considers the incidence of a recreational equipment tax across income groups. Section 6 offers some discussion, comparing the gear tax and potential alternative approaches to raising revenues for public lands, and Section 7 provides concluding remarks.

2. Outdoor Recreation-Related Taxes

2.1. 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 Federal Aid in 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, as well as 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.³

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.⁴ Both laws specify that annual federal spending in the programs not be subject to 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. As Lueck and Parker (2019) point out, before 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 1939 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

³ 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 also purchased by stamp collectors); the revenues are used for purchase of land to add to the national wildlife refuge system.

⁴ Additionally, some competitive conservation grant programs are funded by the taxes.

for inflation. In FY2019, taxes in the two programs generated approximately \$1 billion for spending on state wildlife conservation and related programs.

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% ^a
Fishing supplies and accessories (e.g., tackle boxes, landing nets)	3%
Electric outboard motors	3%

Additional revenues:

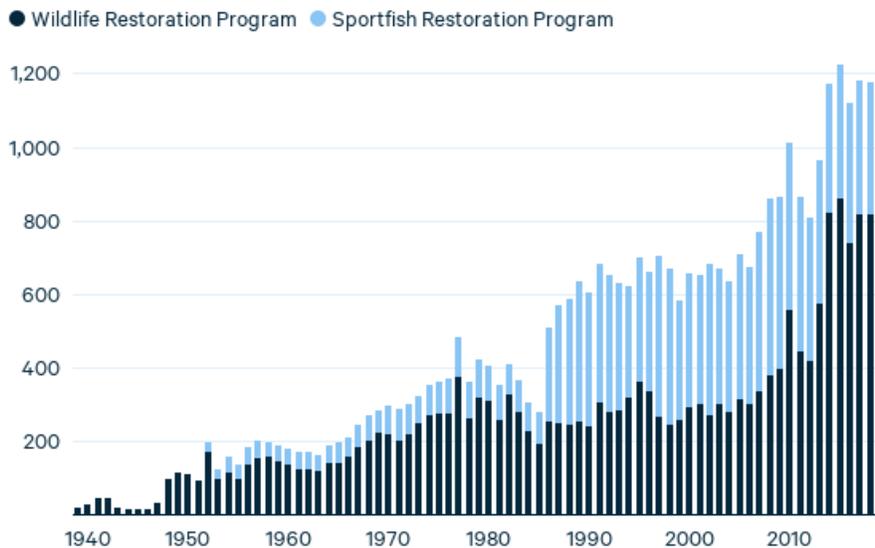
Import duties of 1% to 2.7% on various yachts and pleasure craft; import duties of 3.7% to 9.2% on fishing gear.

A portion of federal motor fuel tax revenues, estimated annually based on boat registrations, for the Sport Fish Restoration Program.

Source: FWS (2018).

^aTaxes on fishing rods and poles are capped at \$10.

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



Fiscal Years. Source: FWS n.d.

2.2. Broadening the Base: Tax Proposals in the 1970s–90s

The Wildlife Management Institute first proposed broadening the base of the federal excise taxes in a 1975 study for the Council on Environmental Quality (WMI 1975). There was a concern that the needs of nongame wildlife species were not being met by the revenues generated from hunting-related taxes, as those revenues in general are targeted toward 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).⁵

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,

⁵ The Forsyth-Chafee Fish and Wildlife Conservation Act, often called the Nongame Act, passed in 1980. It called for states to include nongame 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.

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.⁶ The Teaming with Wildlife concepts were drawn into a larger conservation effort, the Conservation and Reinvestment Act, 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.

2.3. State Recreational Equipment Sales Tax Revenues

Three states have some form of recreational equipment sales taxes. 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 the Texas program uses the money to provide park operating funds. The Georgia program is estimated to generate between \$20 million 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 2 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.⁷

⁶ Additionally, many saw the "user fee" link between spending on wildlife conservation and revenues generated from a tax on outdoor recreation equipment as tenuous (McIlwaine 1996).

⁷ A bill proposing a sales tax of 0.2 percent on outdoor recreational equipment that costs more than \$200 was introduced in the Washington State Legislature in February 2019. It was met with vigorous opposition from the outdoor retail industry, including REI, whose headquarters are in Seattle (Martinell 2019).

3. Estimating the Demand for Outdoor Gear

The efficacy of an excise tax with a broader base—that is, one that encompasses not just hunting and fishing equipment but also 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 microdata to estimate that demand function. 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 AIDS model and show results of the estimation.

3.1. Data: The CEX and Price Indices

The CEX is a survey conducted for the BLS of randomly sampled households (“consumer units,” in BLS parlance⁸) from 91 primary sampling areas across the United States. 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 microdata include 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.⁹ 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 consists of two separate surveys. One is the Interview Survey, in which households are visited every quarter and asked about their purchasing behavior over the quarter, 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 is recorded in the diary, while spending on durable items and goods and services purchased intermittently is covered in the interview. In some cases, spending on

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 The microdata are available at <https://www.bls.gov/cex/pumd.htm>.

individual items is available from both surveys. We rely on the interview data for the recreation equipment categories we use in our analysis and annualize the data. The BLS provides a demographic adjustment factor to scale CEX observations to be representative of the US population. We use these weights in our descriptive statistics and regression.¹⁰

The recreation goods of interest are in the “entertainment” category in the CEX, in the subcategory labeled “other entertainment supplies, equipment, and services.” Within this subcategory, we omit recreation services: vehicle and equipment rentals, boat docking and landing fees, and equipment repairs. This leaves spending on motorized and unmotorized 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 subcategory includes some indoor recreation equipment; thus we are probably overestimating consumer spending on outdoor recreation gear to a certain extent. However, we opt for inclusion in order to capture the athletic gear component of that subcategory.¹¹

Our selection of CEX spending categories is also designed to match the appropriate CPI, which we need in our demand model. The “sporting goods” CPI, which resides within the broader recreation category, includes motorized and unmotorized 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 subcategories we use from the entertainment category do a good job of matching this sporting goods CPI.¹²

The CEX microdata have some strengths and weaknesses for the purpose of understanding the demand for outdoor recreation equipment. In general, the CEX is the best source for national data on consumer spending on a wide array of individual goods and services and is the only source, to our knowledge, of microdata on

¹⁰ Guidance on annualizing and creating weighted estimates from the diary and interview data is available from the BLS at <https://www.bls.gov/cex/pumd-getting-started-guide.htm#section6>.

¹¹ Importantly, apparel is a separate category, so we are not including items such as rain gear, fleeces, and hiking boots that may be used in outdoor recreation activities.

¹² Specifically, the CPI used is code SERC, sporting goods in US city average, all urban consumers, seasonally adjusted. The main reason we do not break down demand into subcategories of spending, even though the data are included in the CEX, is that individual CPIs below the “sporting goods” level of aggregation are not available. CPIs can be found at <https://data.bls.gov/cgi-bin/dsrv?cu>.

spending over multiple years. It provides a consistent national sample of individual household spending on recreation equipment. 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 Weber 1995; Fernández-Villaverde and Krueger 2007). Blow et al. (2015) use an AIDS model to estimate demand for six categories of expenditures, one of which is entertainment spending, which includes recreation equipment. Hawkins (2002), in a study with some similarities to ours, uses the CEX data in an AIDS model of spending across a range of goods and services categories to simulate the effects of sales taxes. A drawback of the CEX for our analysis is that the categories of recreation equipment may not perfectly match the items that would be taxed if such a policy were to be adopted. For example, apparel and footwear are missing. In addition, we are unable to estimate demand for subcategories and measure efficiency and equity of tax rates that vary across the subcategories. In general, as with all surveys, the CEX may not accurately capture all household spending, especially for items such as recreational equipment that are not purchased on a regular basis.

Another drawback of the CEX is that it has expenditures but not individual prices and quantities. This means that, 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 that of Hawkins (2002). Specifically, using 2016 state and local sales tax rates from Drenkard and Kaeding (2016), we create prices for each household based on its state of residence, j , as follows:

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

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 sales tax rate.¹³ There are some drawbacks to this approach, as there may be interstate or local price variation it does not capture. Moreover, households can make purchases across borders, and thus it may not provide an accurate reflection of actual prices paid for every household. Nonetheless, we see it as the best option for creating some variability in prices across households within a given year.

¹³ 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 for τ_j .

3.2. Descriptive Statistics

Table 2 shows summary statistics from the CEX survey. Households spent approximately \$317 per year, on average, on outdoor recreation equipment over the 2005–16 time period, which represents 0.32 percent of their annual expenditures on all goods and services. In total, the CEX data show that US consumers spent approximately \$94 billion per year.¹⁴

Table 2. Annual Household Income and Spending on Outdoor Recreation

	Mean	Median	Std. dev.
Recreation expenditures	\$317.26	\$0	\$5,644.04
Budget share for recreation	0.0032	0	0.026
Average annual consumer spending on outdoor recreation equipment, total US			\$93.9 billion
Total number of households in sample (2005–16)			319,187

Source: BLS Consumer Expenditure Survey Public Use Microdata, 2005–16.

Note: Summary statistics are calculated using BLS population weights to be representative of the US population.

Many households (approximately 85 percent of the sample) report spending nothing on the items in this category, at least at the time they are interviewed by BLS, and thus the median expenditure in the sample is zero. Zero expenditures for some households for some categories of spending in the CEX data are common and have been reported in other studies. Blow et al. (2015), for example, report that 23 percent

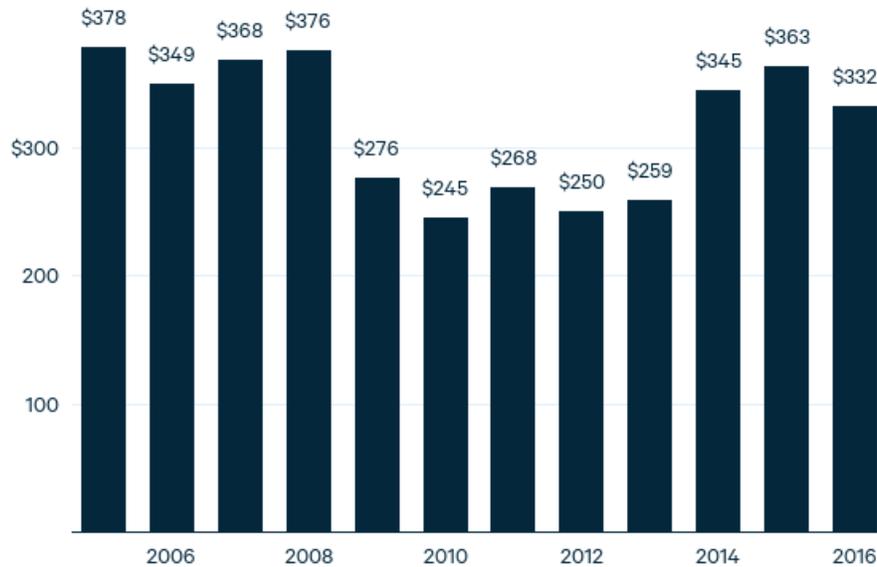
¹⁴ Aggregate consumer spending is also available from the US Bureau of Economic Analysis (BEA), at

<https://apps.bea.gov/iTable/iTable.cfm?reqid=19&step=2#reqid=19&step=2&isuri=1&1921=survey>. BEA obtains its 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. For comparison, the BEA estimate of consumer spending on outdoor recreation equipment in 2016 is \$111 billion, and the CEX estimate for the same year is \$103 billion; thus the estimates from the two different sources are fairly consistent. The Outdoor Industry Association (OIA), a trade group representing the outdoor recreation industry, also produces estimates of consumer spending and total contribution of the industry to the US economy. The OIA estimate of consumer spending in 2017 was \$184.5 million (OIA 2017). Full details about the categories of spending included in the OIA numbers are not available, but the report states that apparel, footwear, and services are included, which could account for the larger magnitude vis-à-vis the government estimates.

of households spent nothing on entertainment, a category that includes recreational equipment but also many other products and services. The CEX is the best source for consumer spending across a range of products, a national sample of consumers, and multiple years, but as with any survey, it is possible that some spending by households is missing in the data.

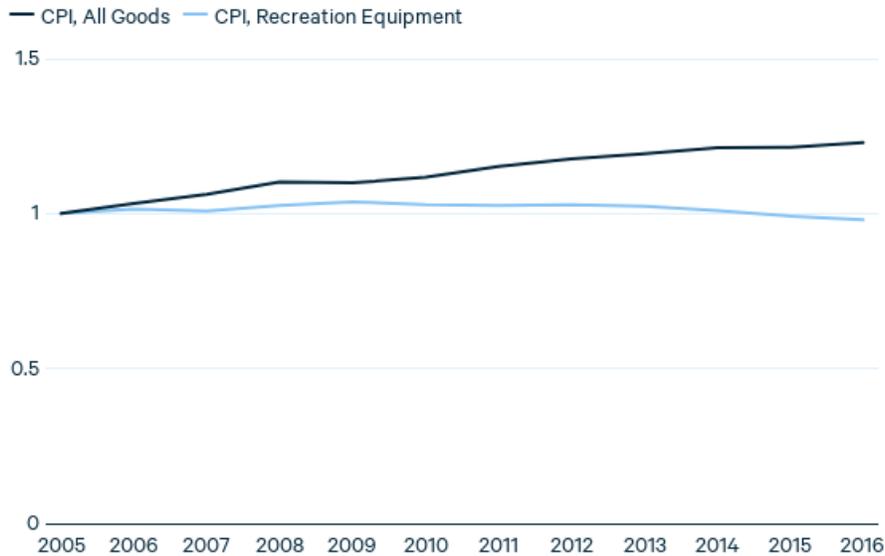
Figure 2 shows average annual household spending on outdoor recreation equipment, in inflation-adjusted 2016\$, for each year of our sample. The effects of the Great Recession show up in outdoor recreation spending, with a 27 percent drop between 2008 and 2009 and recovery not arriving until 2014. Figure 3 compares trends in outdoor recreation equipment prices with 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, while at the same time the general price level rose about 1.9 percent per year, on average.

Figure 2. Average Annual Household Spending on Outdoor Recreation Equipment in inflation-adjusted 2016 dollars



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

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



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

3.3. Empirical Approach: AIDS Model

The linear approximate version of the AIDS model, originally developed by Deaton and Muellbauer (1980), is a popular functional form for demand analysis, as it has several desirable properties. It is an arbitrary approximation to any demand system. It allows for the adding up of individual consumer demands to an aggregate demand with minimal assumptions about Engel curves.¹⁵ 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 exact welfare effects of changes in prices and other variables. This is important for our analysis.

Following Deaton and Muellbauer (1980), we write the consumer’s price-independent generalized-logarithmic expenditure function as

$$\log e(\mathbf{P}, U) = \alpha_0 + \sum_k \alpha_k \log(P_k) + \frac{1}{2} \sum_k \sum_j \gamma_{jk} \log(P_k) \log(P_j) + U \beta_0 \prod_k P_k^{\beta_k} \quad (2)$$

¹⁵ Engel curves are assumed to be linear. Other, more complicated functional forms may be used to relax this assumption, such as the quadratic AID system of Banks et al. (1997) and the Exact Affine Stone Index demand system (Lewbel and Pendakur 2009).

where U is the consumer's utility, \mathbf{P} is a vector of prices, and the α s, β s, and γ s are parameters.

Derivatives of the expenditure function yield the budget share equations. In our model, we have two goods in the demand system, recreational equipment (as defined above), and a composite good comprising all goods and services excluding recreational equipment. The budget share for recreational equipment is written as

$$w_r = \alpha_r + \gamma_{rr} \log(P_r) + \gamma_{rc} \log(P_c) + \beta_r \log\left(\frac{M}{P}\right) \quad (3)$$

where w_r is the household's share of spending on recreation equipment out of total annual household expenditures, P_r is the price of recreation equipment and P_c is the price of the composite good, M is the household's total expenditures on all goods, and P represents a general price index. In the estimation, we also control for household demographics, including the survey respondent education, age, race, family size, and whether the household resides in an urban area. A similar budget share equation exists for the composite good. We solve for $\log(P_c)$ using average expenditure shares for the full sample, as in Zhen et al. (2014), as follows:

$$\log(P) = \bar{w}_r \log(P_r) + \bar{w}_c \log(P_c) \quad (4)$$

We apply standard restrictions to the coefficients on prices and income in equation (3) to calculate the remaining parameters of the model, ensuring consistency with utility theory. Specifically, Slutsky symmetry is satisfied by setting $\gamma_{cr} = \gamma_{rc}$. For the budget shares to exhibit homogeneity of degree zero in prices and income, it is necessary for $\gamma_{rr} + \gamma_{rc} = \gamma_{rr} + \gamma_{cr} = 0$. The adding-up condition is satisfied when $\alpha_c = 1 - \alpha_r$, $\beta_c = -\beta_r$, $\gamma_{cc} = -\gamma_{rr}$, and $\gamma_{cr} = \gamma_{rc}$. With only two goods, it is impossible for all these conditions to hold simultaneously. We use the estimated coefficients on prices and income in equation (3) to guarantee the symmetry assumption holds, while satisfying homogeneity and adding up for the composite good.

We can solve for the recreational equipment own-price (η_{rr}), cross-price (η_{rc}), and income elasticities (η_{rM}) with the following formulas:

$$\eta_{rr} = -1 + \frac{\gamma_{rr}}{w_r} - \frac{\beta_r}{w_r} (\alpha_c + \gamma_{cr} \log(P_c) + \gamma_{rr} \log(P_r)) \quad (5)$$

$$\eta_{rc} = \frac{\gamma_{rc}}{w_r} - \frac{\beta_r}{w_r} (\alpha_c + \gamma_{rc} \log(P_r) + \gamma_{cc} \log(P_c)) \quad (6)$$

$$\eta_{rM} = 1 + \frac{\beta_r}{w_r} \quad (7)$$

3.4. Results

The budget share equation (3), with additional demographic variables, was estimated by ordinary least squares. Results are shown in Table 3. The estimated price and income elasticities are given in Table 4.

Table 3. AIDS Model Estimation Results for Outdoor Recreation Equipment

α_r	0.037*** (0.001)
γ_{rr}	-0.016*** (0.002)
γ_{rc}	-0.002** (0.001)
β_r	0.004*** (0.0001)

Note: Demographic control variables included in regression: education, age, family size, race, and urban location. Full regression results are provided in Appendix B.

No. of observations = 319,187

F-statistic: 448.84***

Standard errors in parentheses.

***p < 0.01, **p < 0.05, *p < 0.10

Table 4. Estimated Price and Income Elasticities of Demand

	Recreation equipment	Composite good
Own price	-5.87	-0.996
Cross price	-1.24	-0.00
Income	2.20	0.996

The own-price elasticity of demand for outdoor recreation gear is -5.87, indicating that demand is highly price-elastic—a 1 percent increase in the price of gear will reduce the quantity demanded by nearly 6 percent. This result is driven by the $\frac{\gamma_{rr}}{w_r}$ term in the own-price elasticity formula. The share of spending on recreation equipment, w_r , is a small number; together with a relatively large (in absolute value) estimated γ_{rr} from the budget share equation, we end up with a highly price-elastic demand for recreation

equipment. This indicates that a tax will have a large effect on aggregate recreational equipment sales.

According to the estimated cross-price elasticity, a 1 percent increase in the price of the composite good will reduce the quantity of recreation equipment demanded by 1.24 percent. Thus, if all other goods become more expensive, consumers tend to reduce purchases of outdoor gear. The income elasticity of 2.20 suggests that recreation equipment is a luxury good—that is, a 1 percent increase in income leads to a more than 2 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 in an AIDS model and analyze six categories of spending: food at home, food away from home, entertainment, apparel, utilities, and motor fuel. Food at home, utilities, and motor fuel can be classified as necessities (the income elasticity estimates of Blow and colleagues indicate as much). In Table 5, we show the estimated own-price and income elasticities for the other three categories in the study by Blow and colleagues: food away from home, entertainment, and apparel. Entertainment includes our outdoor recreation equipment category and many other subcategories, such as televisions and video games, pets and pet products, toys, camera equipment, recreation equipment rentals and repairs, and admissions fees to movies, concerts, and sporting events.

Table 5. Estimated Price and Income Elasticities of Demand in the Extant Literature: Entertainment, Apparel, and Food Away from Home

	Own-price elasticity	Income elasticity
Entertainment	0 ^a	2.30
Apparel	-1.21	1.57
Food away from home	-1.71	1.94

Source: Blow et al. (2015).

^a The estimated own-price elasticity of demand for entertainment had a positive sign but was not statistically significantly different from zero.

Own-price elasticities for food away from home and apparel are elastic at -1.71 and -1.21 , respectively, but much less elastic than our results for outdoor recreation equipment. Blow et al. (2015) estimate a positive own-price elasticity for entertainment, but it is not statistically different from zero. Estimated income elasticities suggest that all three goods are luxury items. In fact, income elasticities are of the same order of magnitude as our estimate for outdoor gear.

4. Tax Revenues and Welfare Effects of a Recreational Equipment Sales Tax

We simulate the effects of a 5 percent tax on outdoor recreation gear using the AIDS model results. 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). A smaller tax on a much larger base should generate at least as much revenue as the current taxes, probably more. Also, a relatively low tax rate should be more politically acceptable. The tax payment for an average household would amount to only about \$16 per year without any adjustments in demand, based on average annual recreation expenditures of \$317 (see Table 2).

We can use the expenditure function that underlies the AIDS model to solve for CV from the tax—that is, the amount of additional income necessary to compensate consumers for the higher price of recreational equipment so that they stay at their original level of utility:

$$CV = e(\mathbf{P}^{Tax}, U^0) - e(\mathbf{P}^0, U^0) \quad (8)$$

The 0 superscript on the terms in equation (8) denote original prices and utility without the tax; \mathbf{P}^{Tax} is the price with the tax. The second term in the CV formula, current expenditures, is available from the CEX data. We solve for the first term, expenditures with the new higher prices, using the demand model results as follows:¹⁶

$$e(\mathbf{P}^{Tax}, U^0) = \exp(\alpha_0 + \alpha_r \log(P_r^{Tax}) + \alpha_c \log(P_c) + \frac{1}{2}\gamma_{rr}(\log P_r^{Tax})^2 + \gamma_{rc} \log(P_r^{Tax}) \log(P_c) + \frac{1}{2}\gamma_{cc} \log(p_c)^2 + U\beta_0(P_r^{Tax})^{\beta_r}(P_c)^{\beta_c}) \quad (9)$$

Table 6 shows the average CV, tax expenditures per household, CV as a percentage of tax revenue raised, and total revenues raised from the 5 percent tax.

¹⁶ We initialize the utility index to its original level, solving for the term $U\beta_0$ in equation (9) using original expenditures and estimated parameters. See Zhen et al. (2014), Shaikh and Larson (2003), and equation (4) in Deaton and Muellbauer (1980). Following the literature, we set the value for α_0 to zero.

Table 6. Tax Revenues and Compensating Variation of a 5 Percent Sales Tax on Outdoor Recreation Equipment

Average tax payment per household	Average CV	CV as percentage of tax revenue	Total tax revenues
\$10.31	\$12.19	118%	\$3.20 billion

Note: Average annual expenditures per household on outdoor recreation equipment fall from \$291.73 without the tax (in inflation-adjusted 2016\$) to \$206.17 with the tax.

Because of the high elasticity of demand, the tax causes total household spending on outdoor recreation equipment to drop. The average household spent \$292 per year without the tax and \$206 with the tax. Approximately \$10 of that spending is in the form of tax payments. The average CV is \$12.19, and the tax causes a loss in welfare of \$1.18 for every \$1 of tax revenue raised. In total, the government would collect approximately \$3.2 billion from the 5 percent tax. Coincidentally, this is equal to the FY2018 appropriations for the National Park Service (NPS). As noted earlier, the current hunting and fishing taxes generate about \$1 billion in annual revenue. Hence, broadening the base while cutting the tax rate approximately in half (from 10 to 5 percent) would more than triple annual tax revenues.

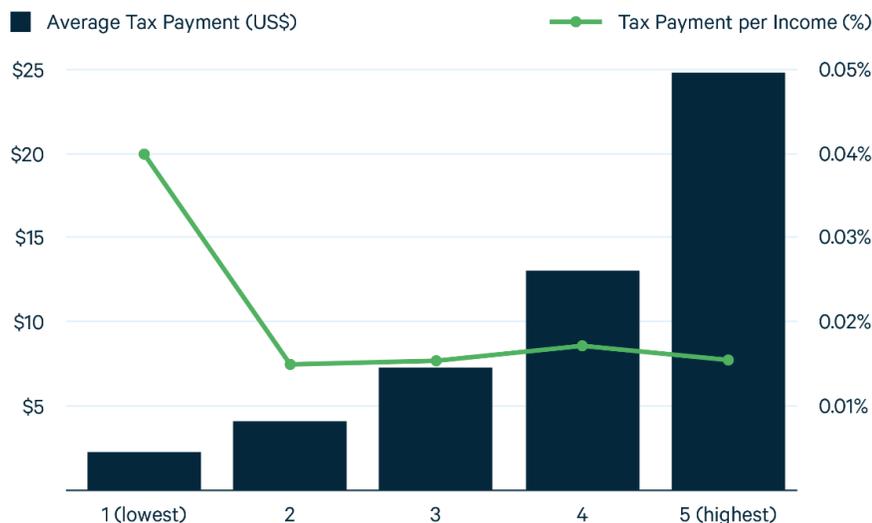
Our analysis assumes a perfectly elastic supply of recreation equipment such that the tax is fully passed on to consumers. If producers of recreation equipment bear some of the burden of the tax, our CV is overstated. Implications for overall welfare effects and total tax revenues are unclear, however. 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. We also note that purchases of recreational equipment by businesses (e.g., by rental equipment providers, outdoor guides, and so forth) are not captured in the CEX and thus not included in our revenue and CV numbers. Total revenues are likely to be somewhat higher than we have calculated here.

5. Incidence of Recreational Equipment Tax across Income Groups

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 and average tax payments as a percentage of income on the right axis. An average household in the highest income quintile spends over \$700 per year on outdoor recreation gear. As a result, it would pay almost 11 times as much in taxes as the average household in the lowest income quintile under a 5 percent outdoor recreation equipment tax. However, as a share of income, the average household in the lowest quintile pays approximately 2.6 times as much in taxes as an average household in the top quintile. Interestingly, though, 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 with 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 values progressivity, and zero a tax that is proportional to income. We calculate a Suits index of -0.033 , and thus the gear tax is slightly regressive but close to being proportional, at least based on spending and income for the CEX households over our 12-year sample period. As a comparison, the original study by Suits (1977) finds general sales and excise taxes had indices of -0.15 in 1970.

Figure 4. Incidence of Tax Across Household Income Quintiles



6. Discussion: Alternatives to a Gear Tax

A tax on outdoor recreation equipment has some drawbacks from an economic efficiency perspective, but a relatively modest 5 percent tax could generate \$3.20 billion in revenues per year for the NPS and other federal land management agencies; applying the tax to a wider group of products, such as hiking boots and some apparel, and accounting for spending by nonhouseholds would likely increase this figure. In this section, we evaluate alternative options to see how they might compare with the gear tax.

One commonly suggested option is an increase in fees for use of public lands, in the form of 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.¹⁷ 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 2016.¹⁸ Back-of-the-envelope calculations show that to increase fee revenues to approximately \$3.2 billion, the revenues we estimate from a 5 percent sales tax on outdoor recreation equipment, the NPS could do one of the following:

- raise fees at the 109 parks that currently have fees to seven times current levels
- raise fees at parks that currently have fees to three times current levels and impose a \$55 per-person entry fee at the 310 remaining sites
- double fees at parks that currently have fees, impose a \$38 per-person entry fee at the remaining sites, and charge overseas visitors an \$80 surcharge

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

¹⁷ There are 62 national parks; the remaining 357 sites managed by the NPS include national recreation areas, national historic parks, national monuments, national seashores, and other designations. Most sites that charge entrance fees 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.

¹⁸ 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 seven 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 by DOI (2018), which was \$256 million for FY2017.

studies suggest that entrance fee increases cause only a small reduction in the number of visitors (Stevens et al. 2014; Sage et al. 2017).¹⁹ Raising fees to seven times current levels would probably have a large effect, however, as it would make the price of admission to a national park as high as \$245. 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 removes some of this disparity across parks by setting a \$55 entrance fee at the sites that currently have no fee, which allows for a smaller increase at the parks that currently have fees.

The third option would increase fees by smaller amounts and make up the difference by charging overseas visitors a surcharge of \$80 per visit. 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 (USTA 2016). If this surcharge were adopted and combined with a \$38 fee at currently unpriced parks and a doubling of fees (to a maximum of \$70 per vehicle) at parks that currently have fees, this would raise approximately the same amount of revenue as the 5 percent gear tax.

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 Section 1 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. In a recent working paper, Prest (2020) finds that increasing onshore and offshore oil and gas royalty rates on federal lands to 25 percent would raise an additional \$3 billion per year, just slightly below our estimates for the 5 percent gear tax. Notably, however, this is a doubling of the current rate on onshore lands (from 12.5 percent) and a 33 percent increase in the rate on offshore lands (from 18.75 percent), increases that are likely to be politically difficult. In addition, because changes in

¹⁹ Economists have looked at fees in other outdoor recreation settings. Ji et al. (2019) 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. (2019) 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.

royalty rates apply to new leases, and there are significant delays between leasing and production, the boost in revenues would not be realized for many years.

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.

7. Conclusions

In this paper, we have assessed the efficiency and distributional impacts of a proposed federal excise tax on outdoor recreation equipment. Using national consumer expenditure data, we have estimated a household 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 \$3.2 billion in revenue per year from US consumers, approximately the same as current annual funding levels for the NPS and three times the amount generated by existing taxes on hunting and fishing equipment. We estimate that the average consumer would pay only about \$10 in taxes each year. But because the demand for outdoor gear is highly price-elastic, the tax generates a sharp reduction in spending and creates a large excess burden per dollar of tax revenue raised. Furthermore, the tax imposes the largest burden as a share of income on households in the lowest income quintile.

Although the gear tax has drawbacks, we find that two other commonly suggested 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, 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 2020).

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 problems 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 increased slightly over the same period. Many observers have suggested 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 will come at a fairly high efficiency cost. The tax should be evaluated and compared with a range of possible options for improving public lands financing.

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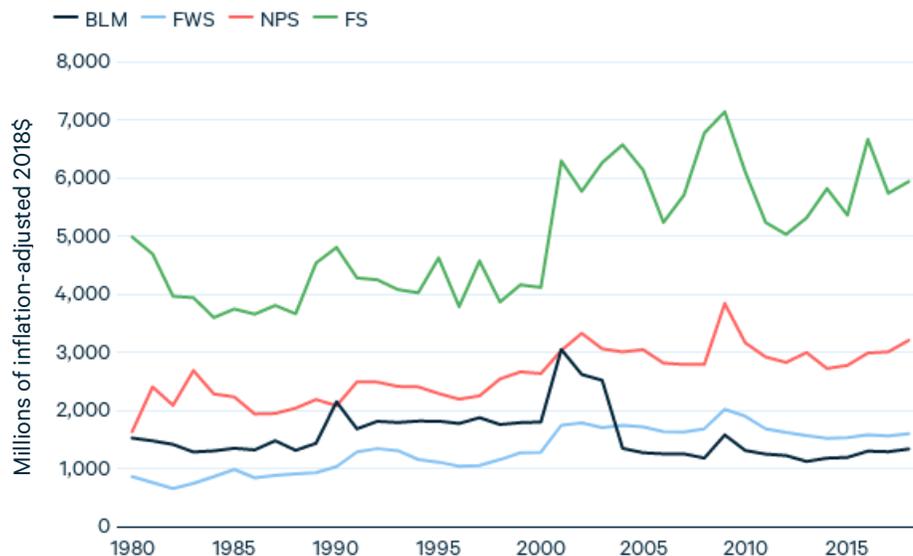
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Appendix A. Appropriations for National Park Service and Other Federal Land Management Agencies

Funding for the federal land management agencies comes, by and large, from annual discretionary appropriations. In inflation-adjusted terms, annual budgets have trended upward slightly for the NPS, remained relatively constant for the Fish and Wildlife Service, and declined for BLM since 1980 (Figure A.1). The Forest Service budget has trended upward slightly, mainly because of a jump in 2000; this is due primarily to an increasing wildfire budget.

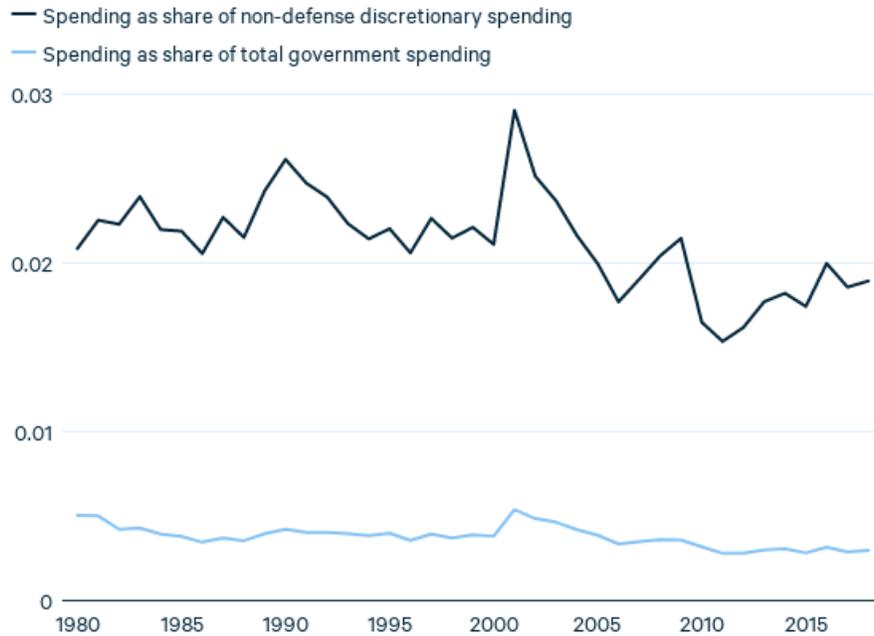
Figure A.1. Total Appropriations for BLM, Fish & Wildlife Service, Park Service, and Forest Service



Source: Annual Congressional Research Service reports, such as Interior, Environment, and Related Agencies: FY2013 Appropriations, at <https://crsreports.congress.gov/product/pdf/R/R42525>, and similar titles.

As a share of total spending by the federal government, appropriations for the four land management agencies amounted to 2.1 percent of all nondefense discretionary spending in 1980 and 1.9 percent in 2018 (Figure A.2). The four agencies accounted for only 0.3 percent of all spending by the federal government, mandatory and discretionary, in 2018, slightly below the 1980 figure of 0.8 percent.

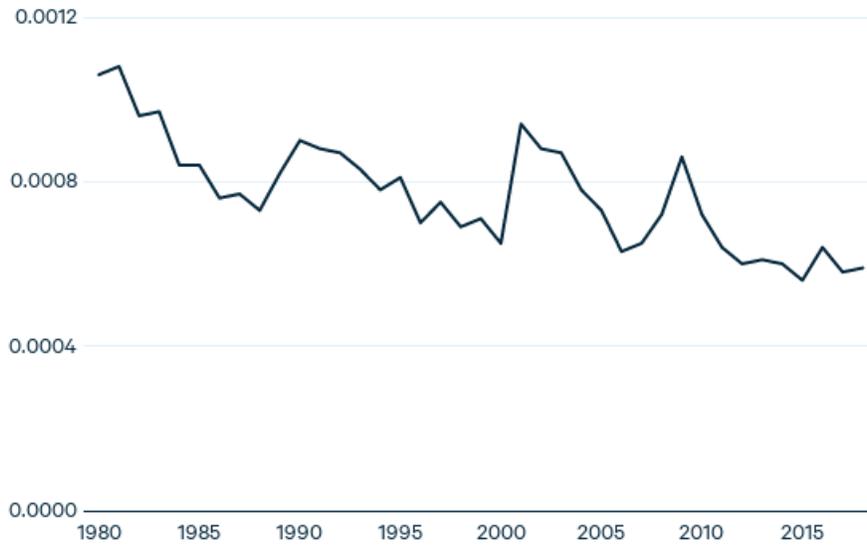
Figure A.2. Total BLM, Fish & Wildlife Service, Park Service, and Forest Service Appropriations as Share of Total and Non-Defense Discretionary Appropriations



Source: Nondefense and total appropriations: Congressional Budget Office and Office of Management and Budget, at <https://www.cbo.gov/publication/55151>. Agency appropriations: See Figure A.1.

As a share of GDP, appropriations for the agencies have fallen over time (Figure A.3). In 1980, federal government spending on the four agencies equaled 0.11 percent of total GDP; by 2018, that figure had fallen almost in half, to 0.06 percent of GDP.

Figure A.3. BLM, Fish & Wildlife Service, Park Service, and Forest Service Appropriations as Share of GDP



Source: GDP: Economic Reports of the President, at <https://www.govinfo.gov/app/collection/ERP>. Agency appropriations: See Figure A.1.

Appendix B: AIDS Model Estimation Results with Coefficient Estimates on Demographic Variables

As described in the text, we include several demographic control variables in the demand regression model. Specifically, we include 0/1 indicator variables for the respondent having a bachelor's degree, a graduate degree above the bachelor's level, living in an urban area, and being white. We also include the age of the respondent and number of family members in the household. All the demographic variables are statistically significant. The full results are provided in Table B.1.

Table B.1. Full AIDS Model Estimation Results for Outdoor Recreation Equipment

α_r	0.037*** (0.001)
γ_{rr}	-0.016*** (0.002)
γ_{rc}	-0.002** (0.001)
β_r	0.004*** (0.0001)
Education (bachelor's)	-0.001*** (0.0001)
Education (graduate)	-0.002*** (0.0002)
Age	-0.00005*** (0.000)
Family size	-0.0005*** (0.00004)
Race (white)	0.002*** (0.0001)
Urban	0.003*** (0.0002)

Demographic control variables included in regression: education, age, family size, race, and urban location. Full regression results are provided in Appendix B.

No. of observations = 319,187

F-statistic: 448.84***

Standard errors in parentheses.

***p < 0.01, **p < 0.05, *p < 0.10