The National Value of Local Outdoor Recreation over the Past 20 Years

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Abstract

I measure the benefits of local outdoor recreation in the United States over 2003-2023 and show how conclusions depend on how travel time is priced. Using the American Time Use Survey to estimate a travel-cost model, I estimate (i) welfare-based willingness to pay, which values travel time at one-third of own wage, and (ii) accounting values that price the realized service (travel) at a replacement wage consistent with household production accounts. Average value per trip is stable at roughly $15-$18 (2023 USD) regardless of pricing technique, with temporary increases around the Great Recession and the COVID-19 pandemic. Scaling by trips and population, national annual value rises by about $100 billion over two decades. In 2022, it totals $216-$241 billion, far exceeding typical municipal park investments. In contrast to average and aggregated value, distributional results depend on the modeling choice of how to price time. While aggregate time trends are similar under both approaches, using a replacement wage compresses the richest-to-poorest quintile ratio in per-trip value from about 10:1 to 1.5:1. The method produces a scalable, repeatable measure of local recreation benefits and connects non-market valuation with accounting-consistent pricing.

1 Introduction

Evaluating progress toward sustainable development requires measuring changes in welfare or real wealth through time, but traditional economic statistics often omit ecosystem services that contribute to welfare and natural capital assets that contribute to wealth (Nordhaus and Tobin, 1973; Arrow et al., 2004; Dasgupta and HM Treasury, 2021). Valuing environmental benefits is necessary when natural resources have competing market and non-market uses and society seeks to achieve sustainable management such that current generations meet their needs without compromising the ability of future generations to do the same (World Commission on Environment and Development, 1987; Solow, 1991). Recreation opportunities are a major ecosystem service provided by nations' land and water bodies. The benefits of outdoor recreation are central to policy appraisals such as benefit cost analyses about the non-market value of natural spaces. In additional to needing to estimate the non-market value of outdoor recreation over time to assess sustainability of management, there is a gap in understanding who benefits from these services (Drupp et al., 2025a). It is important to understand the distribution in benefits across the current generation, as well as across time, in

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order to manage resources in a way that improves well-being. Indeed, Robert Solow (1991) remarked "there is something faintly phony about deep concern for the future combined with callousness about the state of the world today."

This paper estimates the value of local outdoor recreation in the United States, how the value has changed over the last 20 years, and how it varies across the income distribution and racial groups. I evaluate how the estimated values depend on how time is priced in travel cost models. To do so, I first estimate annual willingness to pay (WTP) for local outdoor recreation from 2003 to 2023 using one-third own wage as the opportunity cost of time, and characterize the distribution of benefits across income quintiles and racial groups. I then contrast the WTP estimated (an opportunity-cost-of-time approach) to the value estimated when I use a replacement wage to convert time to a monetary unit (the methodology used in household production accounts).

Beyond estimating willingness to pay, this paper leverages the temporal dimension of my WTP estimates to assess changes in the underlying natural capital stock that enables outdoor recreation. Using the framework developed by Drupp et al. (2024, 2025b), I infer whether recreation-enabling assets are being maintained or depleted over the 20-year study period, which is a crucial sustainability question for natural capital accounting.

I document several stylized facts about local outdoor recreation in the United States. Using the American Time Use Survey, I show that most outdoor time is spent doing everyday activities such as walking, caring for pets or children, and socializing. Most outdoor recreation trips are local, requiring less than 30 minutes of one-way travel. Participation rates are high across income quintiles and racial groups. In my empirical analyses, I find that the WTP per local recreation trip is $18 (2023 USD) when using one-third own wage, and the accounting value of a trip is $15 when using a replacement wage. Following, the welfare provided by local recreation in the United States in 2022 is $241 billion and the accounting value is $216 billion. Both the national welfare estimate and accounting value have increased about $100 billion since 2004.

How time is priced matters primarily for distributional conclusions. Using a replacement wage rather than one-third of own wage has little effect on the aggregate time trend in the value of local recreation, but it substantially compresses income gradients. The richest-to-poorest quintile ratio in value per trip shrinks from about 10 times to about 1.5 times more on average. Conditional on income, the ordering of racial groups' per trip value is unchanged, and the estimates do not vary significantly. Because travel costs for local trips are almost entirely composed of travel time, this comparison isolates how the modeler's choice of time valuation effects estimates of the distribution of benefits across income.

[inset paragraph here with drupp finding]

Using the time people spend traveling to recreate as the travel cost has become a prolific way to estimate the value of non-market environmental benefits. Travel cost models have been used to value improvements in water quality (Keiser, 2019; Griffiths et al., 2012; Egan et al., 2009; Bockstael et al., 1987), the costs of oil spills (English et al., 2018; Hausman et al., 1995), the costs of infectious disease exposure (Day, 2020; Berry et al., 2018), the benefits of agricultural practices (Hansen, 2007; Sullivan et al., 2004; Hansen et al., 1999), the benefits of species conservation (Gürlük and Rehber, 2008; Loomis et al., 2000), and the costs of endangered species protection (Dundas et al., 2018). Given travel cost models' broad application to diverse environmental assets and ecosystem services beyond outdoor recreation, understanding how modeling assumptions affect estimates and developing methods for repeated estimation are crucial for consistent, comparable valuation across contexts.

The first contribution of this paper is demonstrating the ability to repeatedly estimate the value of local recreation at a national scale, filling a current research gap (Fenichel, 2024). Despite more than 50 years of innovation in travel cost methods and their influence on management decisions through benefit cost analyses and litigation (Parsons, 2017), historical data constraints have limited travel cost models to estimates for a site or region and for the average person at a single point in time (Lupi et al., 2020). A repeated national-scale estimate is needed to assess whether local recreation opportunities are being managed sustainably. While the U.S. Bureau of Economic Analysis's Outdoor Recreation Satellite Account tracks spending on recreation's complementary market goods through time (Highfill et al., 2018), such trends may reflect broader consumption rather than environmental management.

The second contribution is describing how the value of local outdoor recreation varies across the income distribution and racial groups, and demonstrating how these distributional patterns depend on how modelers price travel time. Until recently, the intragenerational distribution of environmental benefits received limited attention and is less understood than the distribution of economic resources (*i.e.,* income, wealth) (Cain et al., 2024; Drupp et al., 2025a; Fenichel, 2019). I compare and contrast a traditional opportunity cost of time approach (typical for welfare estimates in a recreation demand setting) to the use of a replacement wage (typical in national accounting), showing that methodological choices have substantial implications for equity conclusions. Because the use of replacement wages may be unfamiliar to some readers, I provide a background in Section 2 on their use in household production accounting.

The third contribution is demonstrating how repeated WTP estimates can reveal changes in recreation-enabling natural capital when direct measurement of the stock is infeasible. Local recreation presents a unique challenge for natural capital accounting because the enabling infrastructure (*e.g.,* parks, greenways, tree-lined streets, schoolyards, and other mixed-use spaces) is too dispersed and heterogeneous for cost-effective direct observation. Using the framework developed by Drupp et al. (2024, 2025b), I combine my estimated WTP trends with established income elasticities to recover the implicit growth rate of the recreation-enabling asset stock. This demonstrates a practical approach for integrating revealed preference estimates into sustainability assessments of how a natural capital asset is being managed when traditional stock inventories are difficult to directly observe.

2 Background: Replacement Wages, Household Production, and Time Valuation

This section discusses the role of replacement wages in valuing household production, and the role they can play in harmonizing recreation demand modeling with existing national accounting methodologies. First, it is useful to understand the difference between two accounting boundaries that are relevant for tracking welfare through time: the System of National Accounts (SNA) boundary and the household production boundary. The SNA captures market transactions and underpins traditional economic statistics such as gross domestic product (GDP) and inflation. The household production boundary captures non-market goods and services that people produce for their own consumption. Measuring the value of household production is an important step towards empirically measuring a national welfare statistic that includes goods and services individuals produce for their own consumption. This welfare measure requires considering an accounting boundary that is the union of the SNA and the household production accounting boundaries (Weitzman, 1976; Sefton and Weale, 2006; Jorgenson and Slesnick, 2014; Fenichel, 2024).

The value of outdoor recreation should, theoretically, be measured under both the SNA and household production accounting boundaries because recreation drives market transactions and also requires people produce the service of recreation for themselves via their own travel time (Office of Science and Technology Policy et al., 2023). Currently, outdoor recreation already generates market transactions (*e.g.,* fuel, lodging, equipment) that are recorded in GDP. The Bureau of Economic Analysis's Outdoor Recreation Satellite Account (ORSA) reclassifies these transactions to measure the "outdoor recreation economy" (Headwaters Economics, 2021; Highfill et al., 2018). To be clear, the ORSA is a reclassification of values already included in GDP, it is not a measurement of a value that is "missing" from GDP.

The BEA also maintains a satellite account that measures household production. National accountants price non-market production that has "near market" analogs. Current near market services included are activities such as cooking, cleaning, or simple repairs. National accountants use replacement wages to value these service, where the replacement wage is the wage a market producer (rather than household) would earn for providing the same service, adjusted for differences in quality between home and specialist production (National Research Council et al., 2005; Landefeld et al., 2009; Bureau of Economic Analysis, 2018b). The BEA's Household Production Satellite Account operationalizes this approach using time inputs from the American Time Use Survey (ATUS) (Landefeld et al., 2009; Bureau of Economic Analysis, 2018a). The value of outdoor recreation, priced via travel time, is not currently included in the U.S. household production accounts despite it being a service that individuals produce for themselves.

Using a replacement wage to value time is conceptually different from using the opportunity cost of time, which is typically used in recreation demand models to estimate WTP measures:

1. **Welfare (WTP) via opportunity cost of time.** In a welfare framework, travel-time costs are converted to willingness to pay using the marginal opportunity cost of time, *i.e.,* the marginal after-tax wage at which an individual can sell an additional unit of time (Nordhaus, 2006). This is a counterfactual valuation that asks what the person could have earned if they had supplied the same time to the market, presumably in their primary job. Historically, limited flexibility in hourly work for large parts of the population (*e.g.,* salaried workers, retirees) led economists to proxy the opportunity cost of time with a fraction of the average wage. The conceptual target is the marginal wage, not the average.

2. **Accounting value via replacement wage.** In household production accounting, time is priced by the market value of the service produced. For near-market services, accountants ask: what would the same service earn on the market if produced by a provider? This is a realized-service valuation that makes non-market production commensurate with market production that focuses on what was produced, rather than what could have been produced with the same amount of time (National Research Council et al., 2005; Landefeld et al., 2009; Bureau of Economic Analysis, 2018b).

These two approaches coincide if and only if the individual's marginal opportunity cost equals the relevant replacement wage. They would not typically be equal because the opportunity cost depends on the person's marginal earning possibilities, whereas the replacement wage depends on the market price of the service produced. Welfare-based WTP and accounting values may diverge even when they use the same underlying time inputs.

Applying this logic to recreation, it is useful to distinguish travel time from on-site leisure time. Travel time is a near market service with close market analogs and can be priced using a replacement wage consistent with household production accounting. Market analogs include professional driving such as taxis, and related transportation services such as driving for Uber. By contrast, on-site leisure is a "personal" good or service that must be produced by the individual. Personal goods and services have no near market equivalent (an individual would not pay someone else to leisure for them). Therefore, personal goods and services are not priced household production accounts (Nordhaus, 2006). Standard travel-cost models therefore yield a lower bound on the benefits of outdoor leisure: individuals would not incur travel costs to produce the trip if the value of the on-site benefits were not at least as large.

Finally, connecting travel-cost valuation to household production accounting aligns empirical practice with the broader objective of building welfare-relevant national statistics that integrate market and non-market production. In the next section, I formalize these ideas by adapting a Becker household production framework to show how outdoor recreation can be considered household production, and how either the opportunity cost of time or replacement wages can be used for valuing travel time.

3 Conceptual Framework: Adapting the Becker Household Production Model

The Becker (1965) Household Production Model considers an individual who maximizes her utility by consuming commodity goods that are comprised of various market and non-market goods or services. Outdoor recreation trips are an example of such a commodity good because they can consist of market goods (e.g., hiking boots, picnic blankets) and non-market goods (e.g., travel time). The Becker Model conceptualizes an individual, or household, as both a consumer and producer because the consumer produces the commodity good for herself. The commodity good is written as

$$Z_i = f_i(\mathbf{x}, \mathbf{T})$$

where $\mathbf{x}$ is a vector of market goods required to produce the commodity good Z_i, $\mathbf{T}$ is a vector of the time inputs, and $f_i(\cdot)$ is the production function for good Z_i.

The consumer's utility function can be written as

$$U(Z_1, \ldots, Z_n) \equiv U(f_1, \ldots, f_n) \equiv U(x_1, \ldots, x_m; T_1, \ldots, T_m).$$

Maximizing utility is constrained by a full resource constraint that considers money spent on required input bundles of market goods $\mathbf{x}$ and time required to make the good or service T_i. This resource constraint is commonly referred to as full income. When assuming that the opportunity cost of time is the average wage rate w, full income is written as the familiar

$$\sum_i \left(\mathbf{p}_i \mathbf{x}_i + w\mathbf{T}_i\right) Z_i = V + w\Psi = S^{\text{hourly wage}} \tag{1}$$

where $\mathbf{p}_i$ is a vector of prices for the vector of market goods $\mathbf{x}_i$ required to produce Z_i, V is income from non-labor sources, Ψ is the full endowment of time, and thus $S^{\text{hourly wage}}$ is full income. In this case, the full price of the commodity good Z_i is

$$\pi_i^{\text{hourly wage}} = \mathbf{p}_i \mathbf{x}_i + w\mathbf{T}_i.$$

Becker (1965) recognized that "marginal, not average, prices are relevant for behavior" (pg. 499). If an individual cannot earn her average wage beyond a set number of hours, as is true for salaried workers or hourly workers with inflexible hours, then Equation 1 will overstate her full income. Therefore, he presents a general case of full income,

$$\sum_i \mathbf{p}_i \mathbf{x}_i Z_i + L(Z_1, \ldots, Z_n) = S^{\text{loss func.}}, \tag{2}$$

where $L(\cdot)$ is a "loss" function that measures the income that an individual forwent by taking the time to produce commodity goods $\mathbf{Z}$ for herself rather than selling that time on the market for the service produced. In this general case, the price of the commodity good Z_i is

$$\pi_i^{\text{loss func.}} = \mathbf{p}_i \mathbf{x}_i + L_i(\mathbf{T}_i). \tag{3}$$

In the empirical sections of this paper, I estimate welfare-based willingness to pay (WTP) using the conventional opportunity-cost-of-time approach, pricing travel time at a fraction of the individual's average wage (αw), with $\alpha = 1/3$ as in standard practice (Cesario, 1976; Lupi et al., 2020). Second, I estimate an accounting value by pricing the service actually undertaken (travel) at a replacement wage $r(k)$ where k is the mode of travel, consistent with household production accounting (Bureau of Economic Analysis, 2018b; Landefeld et al., 2009). The former is a counterfactual, welfare interpretation ("what the person could have earned"); the latter is a realized-service, accounting interpretation ("what the produced service is worth on the market"). The two coincide only if $\alpha w = r(k)$ which does not likely hold in general.

To find the travel cost of a recreation trip using the methodology from household production accounting, I parameterize the income loss function $L_i(\mathbf{T}_i)$ from Equation 3 using a replacement wage. In the case of an outdoor recreation trip, the vector $\mathbf{T}_i$ is composed of the travel time t_i^{near} (the near-market service) and on-site time t_i^{pers} (the personal service). The loss function can then be written as

$$L_i = r(k)\, t_i^{\text{near}} + \lambda\, t_i^{\text{pers}} \tag{4}$$

where $r(k)$ is the replacement wage that could be earned if the individual chose to sell her travel time on the market (the rate depends on the travel mode k: driving, biking, walking, public transport, etc.). The parameter λ is the wage that the individual could earn if she sold her on-site leisure time on the market, which I assume to be zero because leisure is a personal good and thus has no near-market analog in household production accounts. Plugging Equation 4 into Equation 3, the accounting price of an outdoor recreation trip (i.e., the travel cost used for the accounting value) is

$$\pi_i^{\text{acc.}} = \mathbf{p}_i \mathbf{x}_i + r(k)\, t_i^{\text{near}}. \tag{5}$$

For the welfare (measured as WTP) approach commonly used in travel-cost models, I price travel time at a fraction of the individual's average wage as

$$\pi_i^{\text{WTP}} = \mathbf{p}_i \mathbf{x}_i + \alpha\, w\, t_i^{\text{near}}, \tag{6}$$

where w is the average wage rate and α is set to one-third based on revealed- and stated-preference evidence about time valuation, as well as precedent in travel cost models (Cesario, 1976; Lupi et al., 2020). The fraction of the wage rate, αw, is intended to approximate the marginal opportunity cost of time. In my empirical analysis, I report WTP estimates based on π_i^{WTP} and contrast them with accounting values based on $\pi_i^{\text{acc.}}$, comparing both aggregate time trends and distributions across income and racial groups.

Estimating the value of outdoor recreation using both pricing approaches allows me to test the sensitivity of my conclusions along two dimensions. First, I assess temporal sensitivity: whether the observed trends in recreation values from 2003 to 2023 depend on the choice of time valuation method. If aggregate welfare trends are similar under both approaches, this suggests that conclusions about changes in natural capital are robust to pricing methodology. Second, I evaluate intratemporal distributional sensitivity: whether conclusions about how recreation values vary across income quintiles and racial groups depend on time pricing. Because travel costs for local trips are almost entirely composed of time rather than market goods, this comparison isolates how modeling choices affect equity assessments, independent of other methodological decisions.

4 Data and Motivating Facts

My analyses use the American Time Use Survey (Flood et al., 2024), which the U.S. Bureau of Labor Statistics conducts. It is the most comprehensive survey of its kind in the United States and has been used by economists to understand patterns and behaviors in daily life (Burda et al., 2013; Aguiar et al., 2013; Bayham et al., 2015; Berry et al., 2018; Cubas et al., 2021; Bayham et al., 2021; Chan and Wichman, 2022).

Individuals are asked to report their time spent on all activities in a 24-hour period. Respondents report their primary activities, location, duration, and whether the activity was done with others. There are 17 major activity categories and over 400 six-digit coded activities (U.S. Bureau of Labor Statistics, 2024). The ATUS is a stratified survey, and weekends are over sampled to capture a greater variety of behavior. All statistics I present account for the respondents' sample weight. Respondents are linked to the Current Population Survey (CPS) to observe key demographic information including county of residence, income, and other demographic characteristics.

I identify outdoor leisure activities using two filters. First, I identify activities that occurred "Outdoors - not at home" using the location codes provided in the ATUS. Leisure activities outside at home (i.e., in an individual's yard) are not included in my definition of local outdoor leisure. Second, I filter to 99 six-digit leisure activities that occur outdoors, all of which are presented in Appendix Section A.1, Table 4. These 99 leisure activities are deemed as outdoor leisure if they are activities someone may participate in with their free time outside of work.

In Table 1, I group the 99 six-digit activities into categories and calculate the average total hours Americans spend doing each. The most common outdoor leisure activity is walking, followed by Pet Care and Leisure, Socializing and Relaxing, and then Child Care and Leisure. These activities are not stereotypical outdoor recreation activities, like Fishing and Hunting (sixth and seventh most common), Hiking (eleventh), Snow Sports (nineteenth), or Climbing (twenty-sixth).

I identify indoor leisure activities that may be substitutes for outdoor leisure using two filters. First, I filter to activities that occurred at one of the following places: bar or restaurant, other store/mall, school, library, gym/health club, or other places (not at home). Second, I identify 90 six-digit activities that are indoor leisure activities, all of which are listed in Appendix Section A.1, Table 5. Again, leisure activities are those that people participate in using time outside their work hours. I group similar activities into six different substitute activity categories, which are listed in Table 2, along with the average annual time Americans spend participating in each.

I calculate the travel time for any activity using individuals' daily diaries. Once an indoor or outdoor activity is identified, I sum the travel time that occurs within two activities before and after the outdoor activity to get the round-trip travel time.

I classify an outdoor leisure activity as local if the activity's total travel time is less than one hour.

Table 1: Summary of outdoor activity categories, sorted by average total annual hours. This table provides an overview of the most time-consuming outdoor activities.

	Activity Category	Avg. Annual Hours (Million)
1	Walking	2748.65
2	Pet Care and Leisure	2406.80
3	Socializing and Relaxing	1795.08
4	Child Care and Leisure	1090.81
5	Running	699.18
6	Fishing	664.77
7	Hunting	496.69
8	Water sports	488.14
9	Biking	435.45
10	Golfing	376.42
11	Hiking	264.75
12	General Sports	263.36
13	Soccer	177.50
14	Baseball	172.06
15	Basketball	166.58
16	Football	116.21
17	Softball	94.44
18	Racquet Sports	93.35
19	Snow Sports	92.12
20	Religious Activity	91.09
21	Rollerblading	54.90
22	Adult Care and Leisure	47.87
23	Equestrian Sports	47.67
24	Volleyball	47.05
25	Vehicle Touring/Racing	33.30
26	Climbing	20.71
27	Rugby	8.34
28	Rodeo Competitions	6.85
29	Hockey	6.07
30	Extracurricular club activities	3.80

Seventy-eight percent of outdoor leisure activities require one hour or less of travel time. I chose this as the cut-off for a local trip because the average one-way commute time in metropolitan areas was 26 minutes from 2012 through 2016 (U.S. Census Bureau, 2017), which is the middle of my study period. Additionally, 62 percent of outdoor leisure activities require 50 minutes of travel versus 78 percent requiring one hour. Using a one-hour cut-off, rather than the approximately 50-minute round-trip travel time for the average work commute, allows me to include the 16 percent of recreational trips that require between 50 and 60 minutes of travel in my analyses. This helps provide needed statistical power when subsetting the data by time periods or demographic groups.

The median round-trip travel time for outdoor leisure is 30 minutes. Most outdoor leisure activities require an hour or less of travel time, regardless of income quintile or racial group (Appendix Section A.2, Figure 5). Indoor leisure activities require just over 30 minutes of travel. There were no significant changes in average travel time for outdoor leisure activities across income or racial groups between 2003 and 2023 (Appendix Section A.2, Figure 6).

The average number of annual local trips per person has been weakly increasing for all income quintiles

Table 2: Summary of indoor substitute activity categories, sorted by average total annual hours. This table provides an overview of the most time-consuming indoor activities.

	Substitute Activity Category	Avg. Annual Hours (Billion)
1	Eating or Drinking	23.89
2	Shopping	18.89
3	Socializing	10.23
4	Entertainment	9.50
5	Playing Sports or Games	8.56
6	Hobby or Relaxing	3.51

(Figure 4a). The increase in trips is most prominent for the richest quintiles. Notably, the poorest quintile saw a significant increase in the average number of annual trips taken during the 2008 financial crisis. The richest quintile experienced a similar but larger increase during the 2020 COVID-19 pandemic. In both cases, the increased number of annual trips persists through time. The number of outdoor recreation trips has also increased for all racial groups (Figure 4b).

5 Methods

5.1 Discrete Choice Travel Cost Model

The two prices for an outdoor recreation trip defined in Section 3 can be used in a travel cost model to find the WTP of a local recreation trip (when using the price defined in Equation 6) or the accounting value of a trip (price from Equation 5). I estimate my model for multiple time periods, allowing me to observe trends in both values through time. I follow McFadden's binary choice random utility model (McFadden, 1974a,b). I model individuals making a discrete choice to take an outdoor recreation trip or choose a "no deviation" option where they participate in all daily activities other than the outdoor recreation trip. The utility for an individual i choosing to take her utility-maximizing number of trips (denoted as j and equal to either one or zero) is

$$U_i^j = V_i^j + \varepsilon_i$$

where V is the deterministic utility that is a function of observables and ε is the error term that I assume follows a Type 1 Extreme Value distribution. This distribution assumption allows me to use logistic choice probabilities to model choice-taking behavior.

I condition on three-year time periods and estimate the value of a local outdoor recreation trip for seven periods between 2003 and 2023, enabling the observation of trends in the value provided by outdoor recreation through time.

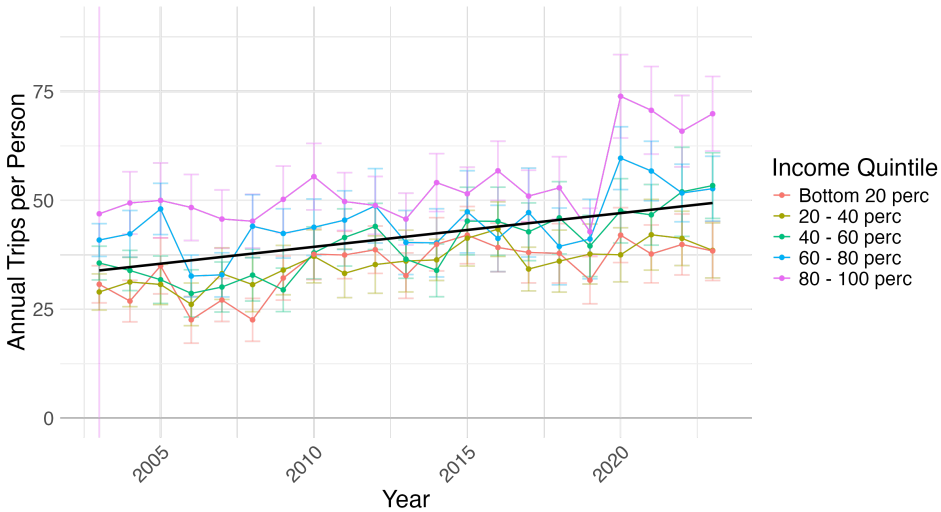
I model the conditional indirect utility of taking a trip ($j = 1$) in time period t as

$$V_i^1 \mid t = \beta_0 + \beta_1 \pi_i + \beta_2 D_i + \beta_3 y_i + \beta_{\mathbf{4}} \mathbf{M_i} + \beta_{\mathbf{5}} \mathbf{L_i} \tag{7}$$

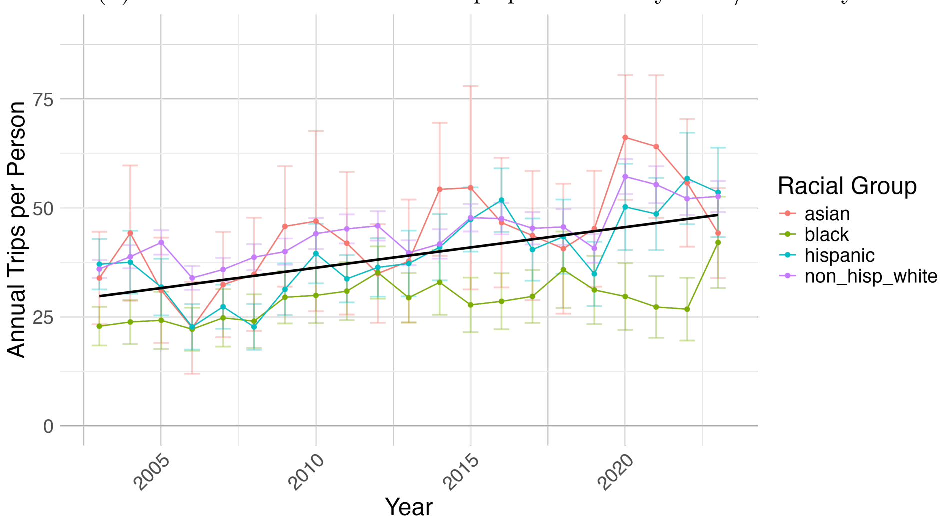
where β_0 is the baseline utility of taking a trip, π is the travel cost of a trip (π^{WTP} or $\pi^{\text{acc.}}$), D is the quality of the trip measured as the activity participated in, y is income measured in 2023 USD, $\mathbf{M}$ is a vector of demographic characteristics, and $\mathbf{L}$ is a vector of trip costs for substitute leisure activities that are not outdoor recreation. I normalize the conditional indirect utility of not taking a trip to zero, $V^0 = 0$.

Figure 1: Annual number of trips taken for outdoor and indoor activities by income quintile and race.

(a) Annual Local Recreation Trips per Person by Income Quintile



(b) Annual Local Recreation Trips per Person by Race/Ethnicity



Choosing to normalize to zero over any arbitrary constant has no effect on estimating the value for a local recreation trip other than easing the estimation of parameters, as it is eventually differenced out.

I convert travel time to travel cost, π, in the two previously discussed ways: using one-third the wage rate or a replacement wage. Therefore, I estimate Equation 7 separately for each method. For both, I assume the marginal expenditure on market goods for local trips is minimal, and set $p_i x_i = 0$. To calculate the travel cost in a welfare setting where the value per trip is the WTP per trip, I use one-third of an individual's wage rate, such that Equation 6 can be rewritten as

$$\pi_i^{\mathrm{WTP}} = \frac{1}{3} w \, t_i^{\mathrm{near}}.$$

Second, when calculating the accounting value of a trip, I convert travel time to a monetary cost using a replacement wage valued at \$15 per hour, the typical wage of a taxi driver (O*NET Online, 2024). Therefore, Equation 5 becomes

$$\pi_i^{\text{acc.}} = 15 \times t_i^{\text{near}}.$$

The choice probability of taking a trip is modeled as

$$\Pr(j=1) = \frac{\exp(V^1)}{\exp(V^0) + \exp(V^1)} = \frac{\exp(V^1)}{1 + \exp(V^1)}$$

and parameters are estimated by maximizing the log of the likelihood of taking a trip versus not deviating.

I calculate an individual's value for a daily trip to a local recreation site by finding the difference between the expected utility of taking a trip $\mathbb{E}[U^1]$ and the expected utility of never taking a trip $\mathbb{E}[U^0]$, where the expected utilities can be calculated using the logged sum of indirect utilities. The change in expected utility is converted to monetary units by using the marginal utility of money parameter, β_1. The average value of a single trip is

$$v_t = -\frac{1}{\beta_1}\left(\mathbb{E}[U^1] - \mathbb{E}[U^0]\right)$$

which can be rewritten using the log-sum formulas as

$$v_t = -\frac{1}{\beta_1}\big(\ln \sum_j e^{V_i^j} - \ln e^{V^0}\big) = -\frac{1}{\beta_1} \ln \sum_j e^{V_i^j}$$

and expanding the summation term yields

$$v_t = -\frac{1}{\beta_1} \ln\left(e^{V_i^1} + e^{V^0}\right) = -\frac{1}{\beta_1} \ln\left(e^{V_i^1} + 1\right). \tag{8}$$

After estimating the parameters in Equation 7, I use predicted indirect utility levels V_i and the β_1 to calculate the average value of a trip for all individuals using both travel cost prices, π^{WTP} and $\pi^{\text{acc.}}$.

5.2 Aggregation

The ATUS sampling strategy is designed to produce national, annual statistics. The sampling strategy is not designed to be subset to geographic units below the national level or time periods shorter than one year, although it can be subset to demographic groups of interest. I use the sample weights to calculate the national value for annual access to local recreation. To do so, I multiply each individual's value of a trip, v_t, by their ATUS sampling weight. The national value for annual access to local recreation is

$$\Upsilon_t^{\text{national}} = \sum_i \omega_i v_t \tag{9}$$

where ω is the sampling weight. I bootstrap the standard errors for Υ_t. The time period t is the period the data is conditioned on to parameterize Equation 7.

In addition to finding the average value per trip (v_t) and the national value per year ($\Upsilon_t^{\text{national}}$), I calculate the annual value of access to local outdoor recreation per person ($\Upsilon_t^{\text{personal}}$). To do so, I follow the American Time Use Survey's methodology for calculating the expected number of trips to be taken by an individual annually $\mathbb{E}[x]$ (U.S. Department of Labor and Bureau of Labor Statistics, 2022). I find the average annual number of trips for three-year time periods. I multiply the expected number of trips by the expected value per trip for the relevant three-year period,

$$\Upsilon_t^{\text{personal}} = \mathbb{E}[x_i \mid t]\,\mathbb{E}[v_t \mid t] \tag{10}$$

Calculating the annual value per capital and nationally using this aggregation method assumes that local outdoor leisure is a homogenous good after controlling for quality and the availability of substitutes (Addicott and Fenichel, 2019). If my measure of quality at sites and travel time to substitute leisure activities properly control for quality and availability of substitutes, my estimate of the expected national WTP will equal the aggregated changes in value for heterogeneous local outdoor leisure trips.

I estimate $\Upsilon_t^{\text{national}}$, $\Upsilon_t^{\text{personal}}$ and v_t using a three-year period t to track changes in welfare through time. The t subscript is the middle year of the three-year period. This allows for the supply of outdoor leisure opportunities and alternative leisure substitutes to change over time, despite not directly observing the land and water that enable outdoor recreation. Demand will quickly adapt to supply changes, so conditioning on a three-year period allows me to estimate the number of trips demanded based on that period's recreation opportunities and alternatives. Conditioning on year leads to sample sizes too small to gain informative statistical insight.

I condition on income quintiles and race to test how my estimates change across populations of interest. Using multiple individuals to estimate the parameters requires assuming individuals have Gorman preferences. Gorman preferences are homothetic, quasi-linear, impose linear shifts in demand for changes in price or income, are homogeneous of degree 0 for prices and income, and have constant income elasticity. This means an individual will consume the same ratio of goods after an increase in income. Conditioning on income and comparing estimates across income quintiles will reveal if this is an appropriate assumption or whether poor and rich people have different preferences. If preferences differ significantly, this variation would not be observed when aggregating individuals at the national level.

5.3 Matching and Identification

I use the heterogeneity in individuals' locations and the local outdoor sites they visit to identify my parameters. This provides more variation in the travel time, and thus travel cost, than is typically observed when estimating demand (Burt and Brewer, 1971). I directly observe the travel time for individuals who take a trip to a local recreation site (recreators).

Using nearest-neighbor matching, I construct expected travel time for individuals who do not take a trip (non-recreators). For each non-recreator, I match them to n recreators where $n \in \{2, 3, 5\}$. Non-recreators are only matched with recreators that are in their same geographic state and time period. To find matches, I calculate propensity scores using the following three equations

$$P_i = \alpha_1 H_i^S + \alpha_3 H_i^W + \alpha_3 H_i^E + \varepsilon_i \tag{11}$$

$$P_i = \alpha_1 H_i^S + \alpha_3 H_i^W + \alpha_3 H_i^E + \alpha_4 B_i + \varepsilon_i \tag{12}$$

$$P_i = \alpha_1 H_i^S + \alpha_3 H_i^W + \alpha_3 H_i^E + \alpha_4 B_i + \alpha_5 R_i + \varepsilon_i \tag{13}$$

where H^S is the time an individual spent sleeping the day they were interviewed for the ATUS, H^W is the time spent working, H^E is time spent eating or socializing, B is an indicator variable for if an individual is interviewed on a weekend or holiday and R is an indicator variable for if an individual lives in a rural area. Using Euclidean distance, I match non-recreators to their n nearest neighbors using the difference between the non-recreators' propensity score P_i and the recreators'. This is done using the `MatchIt` package in R (Greifer, 2025). I use the average travel time of a non-recreator nearest neighbors to impute travel time for non-recreators.

I measure recreators' quality of local outdoor leisure trips with the outdoor activity they most likely participate in, assuming the quality of trips closely follows an individual's activity. For recreators, I directly observe the activity. For non-recreators, I impute their expected activity using their n nearest neighbors' activities. I use this expected activity as the approximation for the expected quality of a trip to non-recreators.

I use the lower bound of income bins reported in the ATUS to measure all individuals' income. Income is binned, so $\hat{\beta}_y$ is set identified (Manski and Tamer, 2002). I use this same income when I use one-third of an individual's wage rates to price the opportunity cost of travel time.

I observe the reported racial group of all individuals in the ATUS. I group reported race and ethnicity into the following categories: non-Hispanic White, Black, Hispanic, Asian, or other.[1]

To control for the availability of substitute alternative leisure activities, I include a vector of the expected travel times for the six alternative leisure activities presented in Table 2. I calculate the expected travel time for an individual i by finding the average travel time for each leisure activity in that individual's county that year.

5.4 Inferring Natural Capital Stock Changes

It is important to note that these estimates reflect observed WTP at the time of each survey, capturing both income effects and changes in ecosystem service provision that occurred during the 2003–2023 period. Recent theoretical work on the valuation of ecosystem services suggests that WTP estimates should be adjusted over time to account for relative price changes (RPCs) that arise from the limited substitutability between environmental amenities and market goods (Drupp et al., 2025b). The income elasticity framework implies that as national income grows, the real value of environmental amenities should increase at a rate given by $\text{RPC}_t = \eta(g_C - g_E)$, where η is the income elasticity of WTP, g_C is the growth rate of consumption measured by GDP growth, and g_E is the growth rate of ecosystem services.

I leverage this framework to conduct a back-of-the-envelope calculation that infers changes in the stock of recreation-enabling assets over the 20-year study period. Rearranging the RPC formula yields

$$g_E = g_C - (\text{RPC}_t/\eta).$$

I calculate RPC_t as the proportional change in estimated values over time:

$$\text{RPC}_t = \frac{v_t - v_{t-1}}{v_{t-1}}$$

where v_t is the average value per trip in period t. Because all values are expressed in real 2023 USD, this captures the real relative price change. I take η from published estimates in Drupp et al. (2025b) and use observed U.S. GDP growth as g_C. With these three components observed or estimated, I solve for g_E:

[1] While individuals certainly identify with more specific racial or ethnic groups than these categories, there are not enough observations to subset the variable further without losing the ability to make useful statistical inferences.

Table 3: Average annual value for outdoor recreation for the three outcomes of interest.

Travel Cost Method	Value per Trip (2023 USD)	Value per Person (2023 USD)	Value Nationally (Billion 2023 USD)
replacement_wage	14.80	624.27	162.80
third_wage	18.47	780.86	203.45

the implied growth rate of the recreation-enabling asset stock. This approach allows me to infer whether the dispersed infrastructure that enables local outdoor recreation (i.e., parks, greenways, tree-lined streets, mixed-use spaces) has been maintained, expanded, or depleted during 2003–2023, addressing a key challenge in natural capital accounting when observing changes in dispersed natural assets is difficult.

6 Results

Figure 6 shows the trend in the value for local recreation in three different ways: a) the average U.S. resident's value per local recreation trip (v_t) defined in Equation 8, b) the average annual value per capita ($\Upsilon_t^{\text{personal}}$), which accounts for changes in the average number of trips taken per year, defined in Equation 10 and c) the national value for local recreation ($\Upsilon_t^{\text{national}}$) which accounts for changes in the average number of trips and population growth, defined in Equation 9. Results are shown for my preferred model, which matches non-recreators to their five nearest neighbors and uses Equation 13 to calculate propensity scores. Regression results for my preferred model are in Appendix Section A.3. The results are robust to different imputation methods, including the number of matches and the matching equation (Appendix Section A.4, Figures 8 and 9).

Figure 6 shows that when aggregating to the national level rather than to a sub-national demographic group, the use of a replacement wage versus one-third of the average wage rate does not have major implications. The average value per trip has remained around \$15 real 2023 USD (hereafter, \$) if using a replacement wage and \$18 if using one-third of the wage rate (Table 3). The two notable exceptions are the 2009-2011 and 2018-2020 periods. In each, the average value sharply increases. However, this increase also comes with significant variation, and neither increase significantly differs from the average value per time over the entire study period. The change in value in these periods is more notable when using one-third of the wage rate than when using a replacement wage.

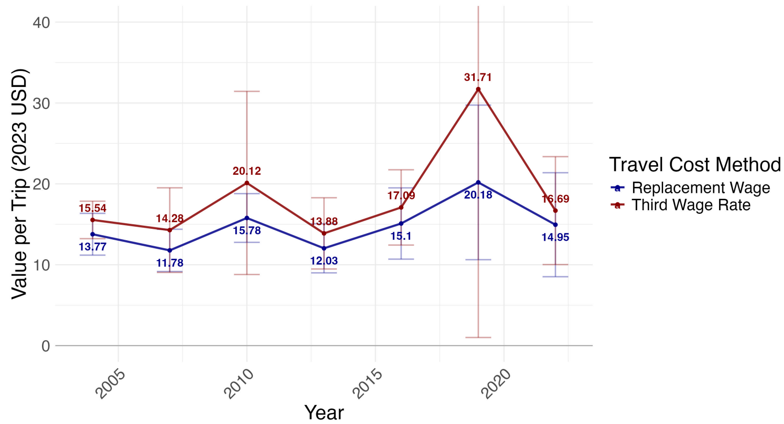
The average value over the entire study period for annual access to local recreation per person is \$624 when using a replacement wage and \$781 when using one-third of the wage rate. With exceptions in the two previously mentioned periods, the annual value per person has not significantly grown or decreased over the past 20 years, regardless of pricing method. Over the study period, the national value for annual access to local parks is \$163 billion when using a replacement wage and \$203 when using one-third of the replacement wage. The national value for annual access has increased by \$96 (\$105) billion from the first period of 2003 – 2005 to the last period of 2021 – 2023 when using one-third of the wage rate (a replacement wage). Both increases are significant at the $\alpha = 0.1$ level, but not at $\alpha = 0.05$.

The use of a replacement wage versus one-third of the average wage rate has major implications when estimating the average value for a recreation trip across different economic classes (Figure 6). Regardless of the method, the richest quintile has a significantly higher value per trip than the poorest income quintile. However, using a replacement wage reduces the difference in the richest quintile's value from 10 times larger than the poorest to 1.5 times larger.

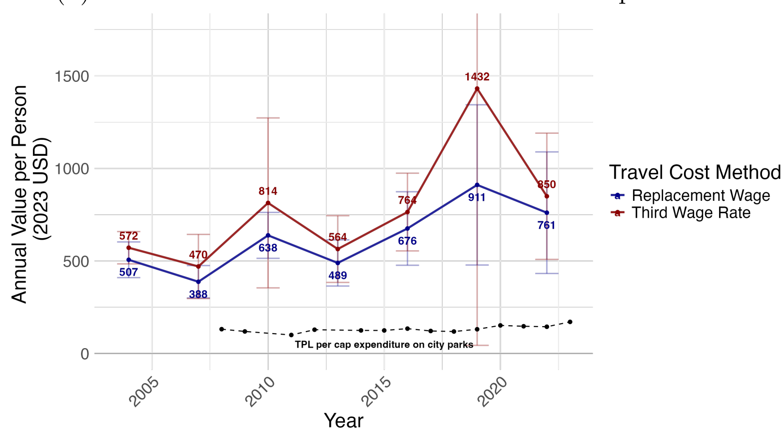
After controlling for income, there are significant differences in different racial and ethnic groups' value

Figure 2: **The 20-Year Trend in Annual Value.** Panel A shows the trend in average value per trip, Panel B shows the annual value for local recreation per average US resident, and Panel C shows annual value for national access to local recreation (i.e., allowing for population growth). Note that time periods are groups of 3 years. For example 2003-2005 is the average of 2003, 2004, and 2005 and its results are plotted in in 2004.

(a) Value of a Local Recreation Trip



(b) Annual Value of Access to Local Recreation per Person



(c) Annual Value for Access to Local Recreation, Nationally

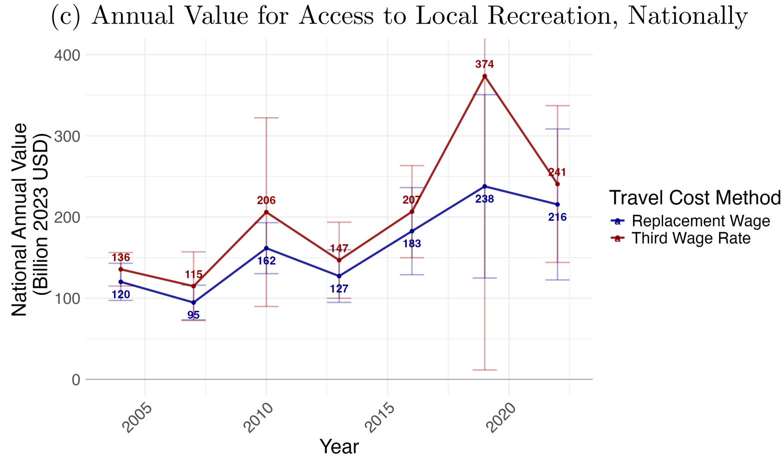
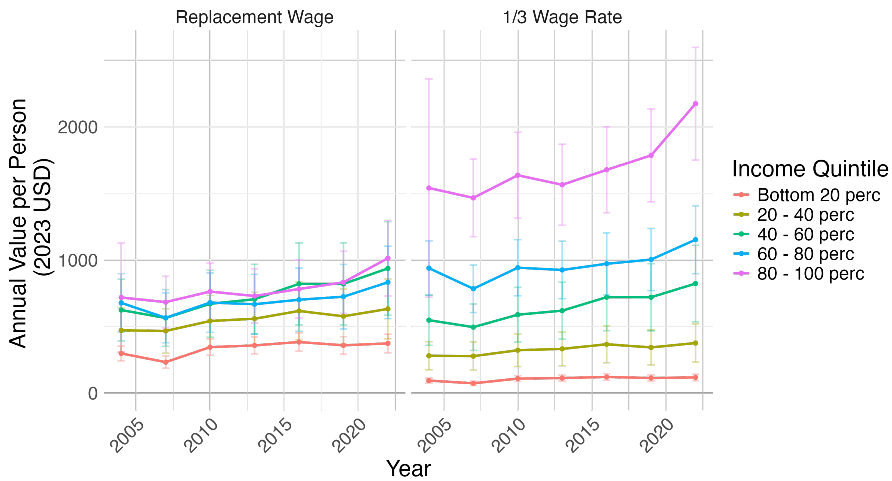


Figure 3: **Annual Value for Local Recreation by Income Quintile.** The figures show national trends in average annual value per person and the average value per trip (which is average across all time periods). This figure differs from above, in that is uses time varying trips, but a constant value per trip to calculate national annual value for access to local recreation.

(a) Trend in National Value of Access to Local Recreation



(b) Avg Value per Trip

for a local recreation trip (Appendix Section A.2, Figure 7). Regardless of how I price travel time, Hispanic people's value per trip is double any other racial group. However, because of variation in the value across Hispanic people, this higher value is not statistically different from any other racial group. All other racial groups' values are more precisely estimated and not significantly different from each other.

7 Back-of-the-Envelope: Changes in Recreation-Enabling Natural Capital

Beyond documenting trends in recreation values, I use the framework developed by Drupp et al. (2024, 2025b) to infer whether the stock of recreation-enabling assets has been maintained, expanded, or depleted over the 20-year study period. As described in Section 5, I calculate the implied growth rate of recreation-enabling assets (g_E) using the formula $g_E = g_C - (\text{RPC}_t/\eta)$, where g_C is U.S. GDP growth, RPC_t is the relative price change in recreation values, and η is the income elasticity of WTP. I use three elasticity values for sensitivity: $\eta = 0.6$ (general ecosystem services), $\eta = 0.66$ (forest ecosystem services), and $\eta = 1.0$ (unity) (Drupp et al., 2025b).

Figure 4 shows the estimated growth rates of recreation-enabling assets over time, separately for the two time pricing methods. Several patterns emerge. First, the estimated asset growth rates are sensitive to the elasticity assumption, with lower elasticities producing more volatile estimates due to the amplification effect when dividing by $\eta < 1$. Second, g_E exhibits substantial variation across periods, ranging from strong expansion (positive g_E) to significant contraction (negative g_E).

The most notable periods are the 2006–2008 and 2018–2020 intervals. During 2006–2008 (the period leading into the Great Recession), WTP for recreation declined by 4–12%, while economic growth remained strong ($g_C = 7.9\%$), resulting in positive implied asset growth (g_E ranging from +12% to +28% depending on specification). This period of asset expansion may reflect a combination of factors: economic prosperity enabling increased public investment in parks and recreation infrastructure, coupled with relatively stable or declining real demand as households had more disposable income for alternative leisure activities.

The subsequent 2009–2011 period shows WTP increasing by 15–21% despite near-zero economic growth ($g_C = 0.4\%$), resulting in negative implied asset growth (g_E ranging from -15% to -34%), suggesting the asset stock contracted as demand surged but budgets were constrained during the recession.

In stark contrast, the 2018–2020 period (encompassing COVID-19) shows WTP increasing dramatically by 52–116%, leading to large negative g_E estimates (-80% to -188%). This signals scarcity: demand for outdoor recreation surged while supply remained fixed or was even constrained by park closures and capacity restrictions. High WTP growth indicates people were willing to pay substantially more for scarce recreation access. The Drupp framework interprets rising WTP not as good news about recreation provision, but as evidence that the asset stock is not keeping up with demand.

These results highlight a key insight from the natural capital accounting framework: rising willingness to pay for an ecosystem service can signal either increased environmental quality or increased scarcity relative to demand. The WTP trends alone do not reveal whether recreation opportunities improved—they must be combined with income growth to infer asset stock changes. The substantial period-to-period volatility in g_E also suggests that managing recreation-enabling infrastructure to maintain steady supply relative to demand remains a challenge, with major economic shocks revealing both periods of relative abundance (recession) and severe scarcity (pandemic).

8 Discussion

This paper provides repeated, national-scale estimates of the value of local outdoor recreation in the United States over two decades using the ATUS. The average value per trip is stable at roughly \$15–\$18 (2023 USD), with upticks in value around the 2008 financial crisis and the 2020 COVID-19 pandemic. The increase in

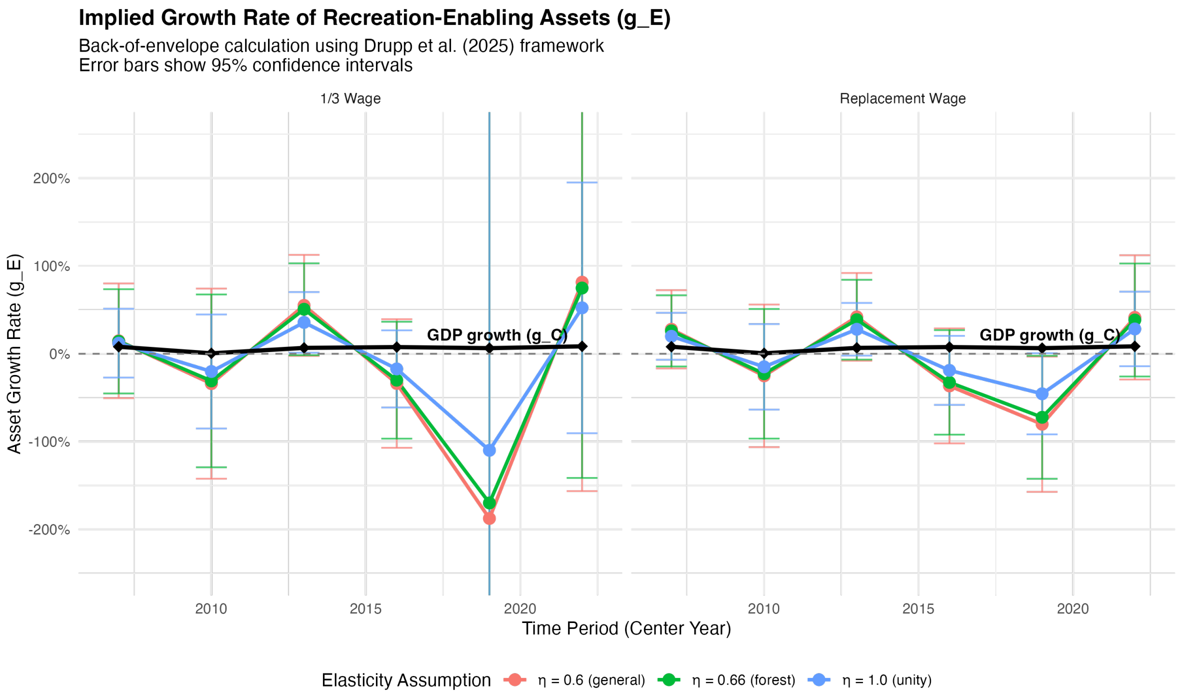


Figure 4: **Implied Growth Rate of Recreation-Enabling Assets.** The figure shows the estimated growth rate of the natural capital stock that enables local outdoor recreation (g_E) for each three-year period from 2007–2023. Estimates are calculated using the formula $g_E = g_C - (\mathrm{RPC}_t/\eta)$ where g_C is GDP growth (shown as black diamonds), RPC_t is the relative price change in recreation values, and η is the income elasticity. Three elasticity values are shown: 0.6 (general ecosystem services), 0.66 (forest services), and 1.0 (unity). Error bars represent 95% confidence intervals. Positive g_E indicates asset expansion; negative g_E indicates contraction. The two panels show results separately for replacement wage (left) and one-third wage (right) time pricing methods.

value per trip was temporary and not statistically significant, however the number of trips taken by the poorest quintile permanently increased after the 2008 financial crisis, and similar result may be true for the richest quintile following the COVID-19 pandemic (Figure 4a). After scaling by trips and population, the national annual value of local recreation is \$216–\$240 billion and has increased of roughly \$100 billion since the early 2000s.

This paper also describes who benefits. Participation and trip taking are widespread across income and racial groups. The national value trend is similar regardless of how time is priced. However, when analyzing who benefits (rather than the national aggregate), the modeling choice of how to price travel time has consequence. This modeling choice substantially changes the difference in the value per trip of the richest income quintile compared to the poorest from 10 times larger to only 1.5 times. This result highlights that the modeler's choice of pricing travel time has major implications for interpreting who prefers outdoor recreation. Using the tradition methodology (one-third of the average wage rate) may lead to concluding that recreation trips are a luxury good, where the demand rises quickly with income. However, when using the replacement wage approach common in household production accounting, the difference in the value of a trip between the richest and poorest quintile is less than the difference in their income. After controlling for income, the choice of how to price travel time does not alter the qualitative ordering across racial groups conditional on income.

The results have implications for policy and environmental-economic statistics. First, because the ATUS supports annual repetition, the value of a local recreation trip can be easily and repeatedly estimated through time. The stability in value per trip but growth in national value (via trips and population) highlights the importance of tracking both intensive and extensive margins.

Second, for distribution-sensitive BCAs and related guidance, the choice of time-pricing matters. Using a replacement wage produces distributional summaries that depend less on labor-market earnings disparities and more on the realized service produced by an individual (in this case, driving to a recreation site for yourself rather than driving someone else for a wage). This may be attractive when summarizing who benefits from public investments (e.g., neighborhood parks, trails) without embedding wage-based income disparities into benefit estimation (Ando et al., 2024).

Finally, pricing travel time at a replacement wage aligns recreation-with-travel squarely within household production accounts. Incorporating the methods from this paper into national satellite accounts could complement the Outdoor Recreation Satellite Account's market reclassifications and expand the Household Production Satellite Account. In turn, this provides a bridge from recreation demand to non-market accounting practices, advancing the integration of environmental benefits from recreation into new national environmental-economic statistics.

In sum, the paper demonstrates a scalable way to measure non-market recreation benefits over time, shows how distributional conclusions hinge on the valuation of time, and offers an accounting-consistent path to embedding recreation benefits in national statistics and policy appraisal.

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A Appendix

A.1 Detailed Activity Frequencies

Table 4: Total time spent over study period on outdoor activities.

	Activity	Avg. Annual Hours (Million)	Activity Description	Actvity Category
1	130131.00	2748.65	Walking	Walking
2	20603.00	1924.90	Walking, exercising, playing with animals (2008+)	Pet Care and Leisure
3	120101.00	814.43	Socializing and communicating with others	Socializing and Relaxing
4	130124.00	690.85	Running	Running
5	130112.00	656.55	Fishing	Fishing
6	130118.00	496.69	Hunting	Hunting
7	130104.00	429.85	Biking	Biking
8	120301.00	373.45	Relaxing, thinking	Socializing and Relaxing
9	130114.00	372.63	Golfing	Golfing
10	20601.00	358.74	Care for animals and pets (not veterinary care)	Pet Care and Leisure
11	110101.00	338.97	Eating and drinking	Socializing and Relaxing
12	130132.00	319.84	Participating in water sports	Water sports
13	30103.00	283.06	Playing with hh children, not sports	Child Care and Leisure
14	130116.00	264.75	Hiking	Hiking
15	30110.00	263.37	Attending hh children's events	Child Care and Leisure
16	120201.00	206.03	Attending or hosting parties/receptions/ceremonies	Socializing and Relaxing
17	30109.00	193.75	Looking after hh children (as a primary activity)	Child Care and Leisure
18	130106.00	153.40	Boating	Water sports
19	130103.00	153.39	Playing basketball	Basketball
20	130199.00	143.36	Playing sports n.e.c.	Sports
21	130202.00	117.58	Watching baseball	Baseball
22	130126.00	110.09	Playing soccer	Soccer
23	20602.00	96.76	Care for animals and pets (not veterinary care) (2008+)	Pet Care and Leisure
24	130125.00	90.99	Skiing, ice skating, snowboarding	Snow Sports
25	130120.00	87.22	Playing racquet sports	Racquet Sports
26	30105.00	82.99	Playing sports with hh children	Child Care and Leisure
27	130213.00	81.42	Watching football	Football
28	30111.00	69.37	Waiting for/with hh children	Child Care and Leisure
29	130224.00	67.41	Watching soccer	Soccer
30	130127.00	62.31	Playing softball	Softball
31	40110.00	61.95	Attending nonhh children's events	Child Care and Leisure
32	140101.00	57.90	Attending religious services	Religious Activity
33	120307.00	56.24	Playing games	Sports
34	130122.00	54.84	Rollerblading	Rollerblading
35	130102.00	54.47	Playing baseball	Baseball
36	30112.00	46.52	Picking up/dropping off hh children	Child Care and Leisure
37	130110.00	41.01	Participating in equestrian sports	Equestrian Sports
38	130130.00	35.61	Playing volleyball	Volleyball
39	130113.00	34.78	Playing football	Football
40	130226.00	33.30	Watching vehicle touring/racing	Vehicle Touring/Racing
41	130299.00	33.26	Attending sporting events, n.e.c.	Sports
42	40109.00	32.40	Looking after nonhh children (as primary activity)	Child Care and Leisure
43	130225.00	32.13	Watching softball	Softball
44	120202.00	32.10	Attending meetings for personal interest (not volunteering)	Socializing and Relaxing
45	140102.00	27.15	Participation in religious practices	Religious Activity
46	130134.00	26.94	Working out, unspecified	Sports
47	40503.00	22.78	Animal and pet care assistance for nonhh adults	Pet Care and Leisure
48	130108.00	20.71	Climbing, spelunking, caving	Climbing
49	120399.00	19.63	Relaxing and leisure, n.e.c.	Socializing and Relaxing
50	40599.00	18.31	Helping nonhh adults, n.e.c.	Adult Care and Leisure
51	30504.00	15.45	Waiting associated with helping hh adults	Adult Care and Leisure
52	130203.00	13.19	Watching basketball	Basketball
53	40105.00	13.11	Playing sports with nonhh children	Child Care and Leisure
54	130227.00	11.44	Watching volleyball	Volleyball
55	130229.00	10.24	Watching water sports	Water sports
56	30101.00	10.23	Physical care for hh children	Child Care and Leisure
57	30501.00	8.34	Helping hh adults	Adult Care and Leisure
58	130222.00	8.33	Watching running	Running
59	130212.00	8.22	Watching fishing	Fishing
60	40199.00	7.81	Caring for and helping nonhh children, n.e.c.	Child Care and Leisure
61	40111.00	7.80	Waiting for/with nonhh children	Child Care and Leisure
62	130123.00	7.50	Playing rugby	Rugby
63	40112.00	7.22	Dropping off/picking up nonhh children	Child Care and Leisure
64	130210.00	6.66	Watching equestrian sports	Equestrian Sports
65	130219.00	6.15	Watching rodeo competitions	Rodeo Competitions
66	130218.00	6.13	Watching racquet sports	Racquet Sports
67	130204.00	5.60	Watching biking	Biking
68	40101.00	5.31	Physical care for nonhh children	Child Care and Leisure
69	140105.00	5.19	Religious education activities (2007+)	Religious Activity
70	130206.00	4.67	Watching boating	Water sports
71	120299.00	4.26	Attending/hosting social events, n.e.c.	Socializing and Relaxing
72	130117.00	4.01	Playing hockey	Hockey
73	60201.00	3.80	Extracurricular club activities	Extracurricular club activities
74	130214.00	3.79	Watching golfing	Golfing
75	30199.00	3.74	Caring for and helping hh children, n.e.c.	Child Care and Leisure
76	20699.00	3.63	Pet and animal care, n.e.c.	Pet Care and Leisure
77	129999.00	3.23	Socializing, relaxing, and leisure, n.e.c.	Socializing and Relaxing
78	50201.00	2.98	Socializing, relaxing, and leisure as part of job	Socializing and Relaxing
79	130216.00	2.07	Watching hockey	Hockey
80	50203.00	1.96	Sports and exercise as part of job	Sports
81	30599.00	1.80	Helping household adults, n.e.c.	Adult Care and Leisure
82	30402.00	1.68	Looking after hh adult (as a primary activity)	Adult Care and Leisure
83	139999.00	1.60	Sports, exercise, and recreation, n.e.c.	Sports
84	40106.00	1.36	Talking with/listening to nonhh children	Child Care and Leisure
85	130223.00	1.13	Watching skiing, ice skating, snowboarding	Snow Sports
86	40401.00	1.04	Physical care for nonhh adults	Adult Care and Leisure
87	60299.00	0.87	Education-related extracurricular activities, n.e.c.	
88	130221.00	0.84	Watching rugby	Rugby
89	40399.00	0.84	Activities related to nonhh child's health, n.e.c.	Child Care and Leisure
90	130121.00	0.69	Participating in rodeo competitions	Rodeo Competitions
91	49999.00	0.49	Caring for and helping nonhh members, n.e.c.	Adult Care and Leisure
92	30499.00	0.48	Caring for household adults, n.e.c.	Adult Care and Leisure
93	149999.00	0.46	Religious and spiritual activities, n.e.c.	Religious Activity
94	140103.00	0.40	Waiting assoc w/religious and spiritual activities	Religious Activity
95	30401.00	0.13	Physical care for hh adults	Adult Care and Leisure
96	40402.00	0.12	Looking after nonhh adult (as a primary activity)	Adult Care and Leisure
97	130220.00	0.06	Watching rollerblading	Rollerblading
98	39999.00	0.03	Caring for and helping hh members, n.e.c.	Adult Care and Leisure

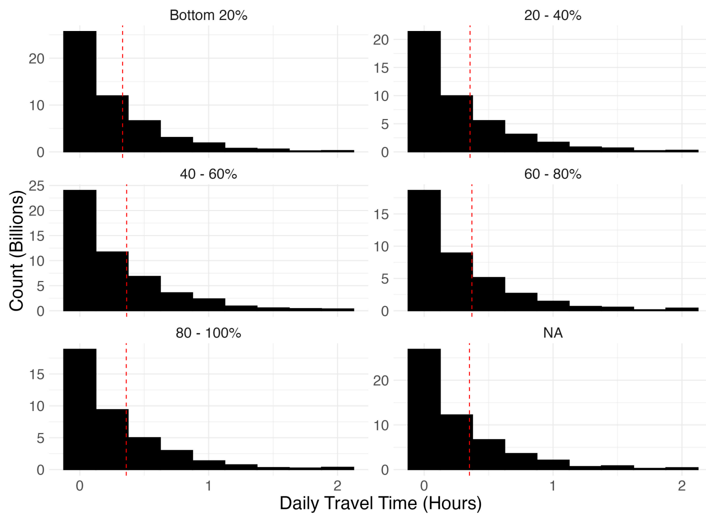
Table 5: Total time spent over study period on indoor activities, and their substitute category.

	Activity Code	Avg. Annual Hours (Billion)	Activity Description	Substitute Category
1	110101.00	442.77	Eating and drinking	Eating or Drinking
2	70104.00	396.29	Shopping, except groceries, food and gas	Shopping
3	120101.00	175.49	Socializing and communicating with others	Socializing
4	120303.00	46.30	Television and movies (not religious)	Entertainment
5	120403.00	45.47	Attending movies/film	Entertainment
6	70103.00	38.23	Purchasing food (not groceries)	Eating or Drinking
7	120201.00	36.54	Attending or hosting parties/receptions/ceremonies	Socializing
8	130134.00	36.53	Working out, unspecified	Playing Sports or Games
9	120499.00	31.01	Arts and entertainment, n.e.c.	Entertainment
10	130133.00	28.79	Weightlifting/strength training	Playing Sports or Games
11	120301.00	24.90	Relaxing, thinking	Hobby or Relaxing
12	120307.00	23.63	Playing games	Playing Sports or Games
13	120401.00	23.55	Attending performing arts	Entertainment
14	120312.00	22.60	Reading for personal interest	Hobby or Relaxing
15	130103.00	14.49	Playing basketball	Playing Sports or Games
16	120202.00	12.67	Attending meetings for personal interest (not volunteering)	Hobby or Relaxing
17	70101.00	11.95	Grocery shopping	Eating or Drinking
18	130107.00	10.63	Bowling	Playing Sports or Games
19	130199.00	10.60	Playing sports n.e.c.	Playing Sports or Games
20	130128.00	10.22	Using cardiovascular equipment	Playing Sports or Games
21	120402.00	9.75	Attending museums	Entertainment
22	130203.00	8.15	Watching basketball	Entertainment
23	130213.00	7.95	Watching football	Entertainment
24	130202.00	7.61	Watching baseball	Entertainment
25	130109.00	7.54	Dancing	Playing Sports or Games
26	120308.00	7.03	Computer use for leisure (exc. Games)	Playing Sports or Games
27	120306.00	6.70	Listening to/playing music (not radio)	Hobby or Relaxing
28	130120.00	6.52	Playing racquet sports	Playing Sports or Games
29	130105.00	6.27	Playing billiards	Playing Sports or Games
30	110201.00	5.50	Waiting associated w/eating and drinking	Eating or Drinking
31	130136.00	4.35	Doing yoga	Playing Sports or Games
32	130101.00	3.71	Doing aerobics	Playing Sports or Games
33	130130.00	3.43	Playing volleyball	Playing Sports or Games
34	50202.00	3.24	Eating and drinking as part of job	Eating or Drinking
35	120309.00	3.21	Arts and crafts as a hobby	Hobby or Relaxing
36	130299.00	2.79	Attending sporting events, n.e.c.	Entertainment
37	130224.00	2.72	Watching soccer	Entertainment
38	130216.00	2.37	Watching hockey	Entertainment
39	120305.00	2.26	Listening to the radio	Hobby or Relaxing
40	130226.00	1.99	Watching vehicle touring/racing	Entertainment
41	130122.00	1.88	Rollerblading	Playing Sports or Games
42	130225.00	1.73	Watching softball	Entertainment
43	50201.00	1.65	Socializing, relaxing, and leisure as part of job	Socializing
44	130119.00	1.60	Participating in martial arts	Playing Sports or Games
45	120504.00	1.19	Waiting associated with arts and entertainment	Entertainment
46	130117.00	1.17	Playing hockey	Playing Sports or Games
47	130227.00	1.15	Watching volleyball	Entertainment
48	130218.00	0.93	Watching racquet sports	Entertainment
49	130232.00	0.89	Watching wrestling	Entertainment
50	130210.00	0.64	Watching equestrian sports	Entertainment
51	130207.00	0.61	Watching bowling	Entertainment
52	130229.00	0.50	Watching water sports	Entertainment
53	120311.00	0.49	Hobbies, except arts and crafts and collecting	Hobby or Relaxing
54	130214.00	0.49	Watching golfing	Entertainment
55	120399.00	0.49	Relaxing and leisure, n.e.c.	Hobby or Relaxing
56	130135.00	0.44	Wrestling	Playing Sports or Games
57	120299.00	0.43	Attending/hosting social events, n.e.c.	Socializing
58	130222.00	0.42	Watching running	Entertainment
59	50203.00	0.39	Sports and exercise as part of job	Playing Sports or Games
60	120501.00	0.37	Waiting assoc. w/socializing and communicating	Socializing
61	139999.00	0.28	Sports, exercise, and recreation, n.e.c.	Playing Sports or Games
62	130115.00	0.28	Doing gymnastics	Playing Sports or Games
63	70201.00	0.28	Comparison shopping	Shopping
64	130219.00	0.26	Watching rodeo competitions	Entertainment
65	130209.00	0.26	Watching dancing	Entertainment
66	120313.00	0.26	Writing for personal interest	Hobby or Relaxing
67	120502.00	0.23	Waiting assoc. w/attending/hosting social events	Socializing
68	130205.00	0.23	Watching billiards	Entertainment
69	120310.00	0.10	Collecting as a hobby	Hobby or Relaxing
70	129999.00	0.10	Socializing, relaxing, and leisure, n.e.c.	Socializing
71	130215.00	0.09	Watching gymnastics	Entertainment
72	120503.00	0.08	Waiting associated with relaxing/leisure	Hobby or Relaxing
73	130206.00	0.08	Watching boating	Entertainment
74	110299.00	0.07	Waiting associated with eating and drinking, n.e.c.	Eating or Drinking
75	130217.00	0.07	Watching martial arts	Entertainment
76	130220.00	0.06	Watching rollerblading	Entertainment
77	130211.00	0.05	Watching fencing	Entertainment
78	130223.00	0.04	Watching skiing, ice skating, snowboarding	Entertainment
79	130111.00	0.04	Fencing	Playing Sports or Games
80	70199.00	0.03	Shopping, n.e.c.	Shopping
81	130231.00	0.03	Watching people working out, unspecified	Entertainment
82	79999.00	0.03	Consumer purchases, n.e.c.	Shopping
83	130230.00	0.03	Watching weightlifting/strength training	Entertainment
84	130221.00	0.02	Watching rugby	Entertainment
85	70299.00	0.01	Researching purchases, n.e.c.	Shopping
86	120199.00	0.01	Socializing and communicating, n.e.c.	Socializing
87	130201.00	0.01	Watching aerobics	Entertainment
88	120599.00	0.01	Waiting associated with socializing, n.e.c.	Socializing
89	130204.00	0.01	Watching biking	Entertainment
90	119999.00	0.00	Eating and drinking, n.e.c.	Eating or Drinking

A.2 Supplementary Figures

Figure 5: Distribution of average travel time for outdoor and indoor activities by income quintile and race. Outdoor activities have an average travel time below 30 minutes, while indoor activities have an average travel time just over 30 minutes.

(a) Outdoor Avg. Travel Time by Income



(b) Outdoor Avg. Travel Time by Race

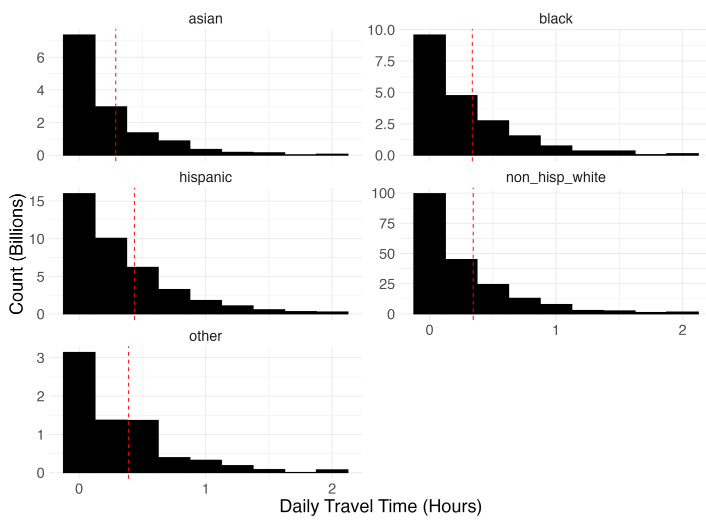
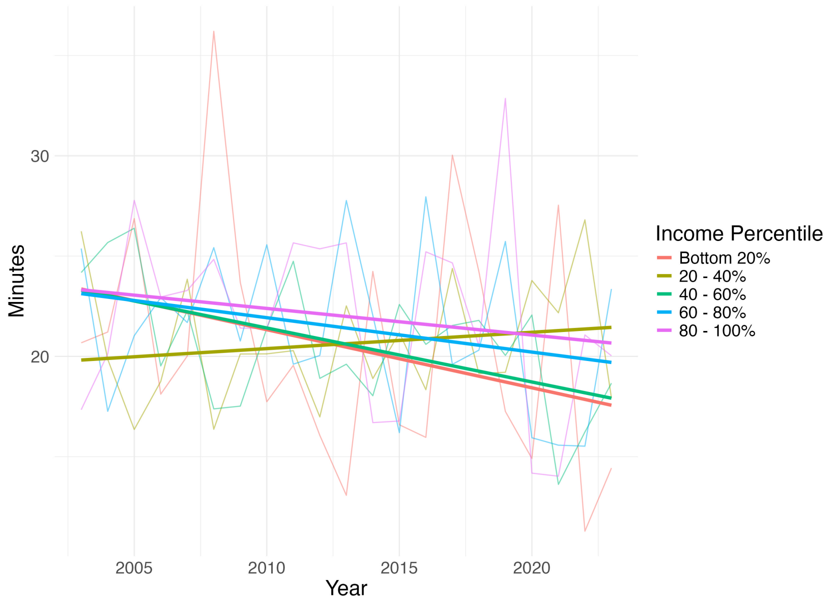


Figure 6: Average travel time for outdoor activities by income quintile and race.

(a) Outdoor Avg. Travel Time by Income



(b) Outdoor Avg. Travel Time by Race

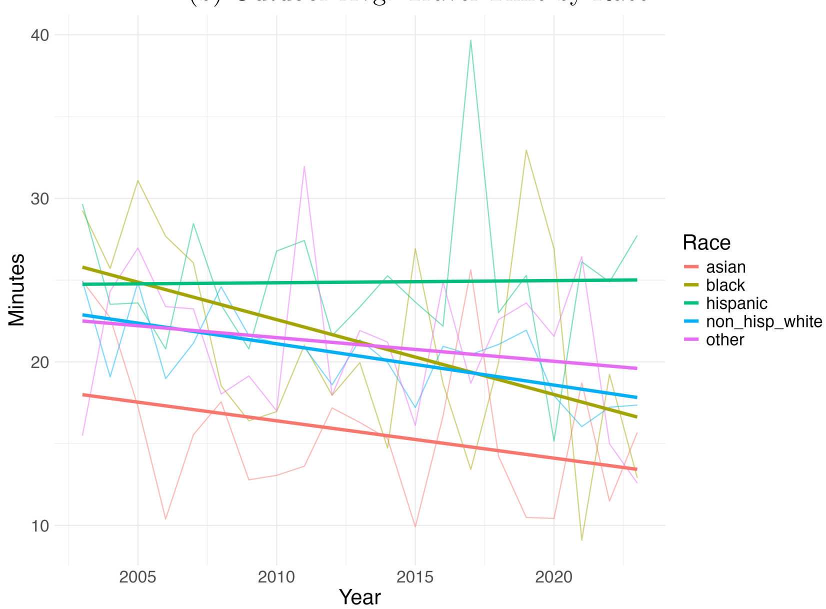
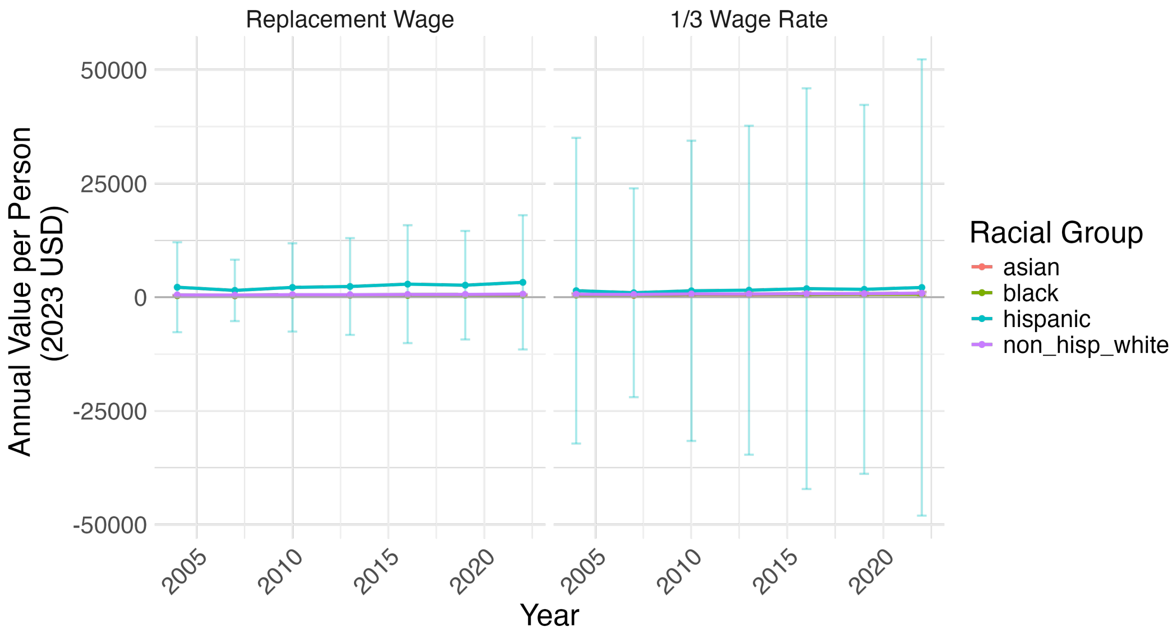
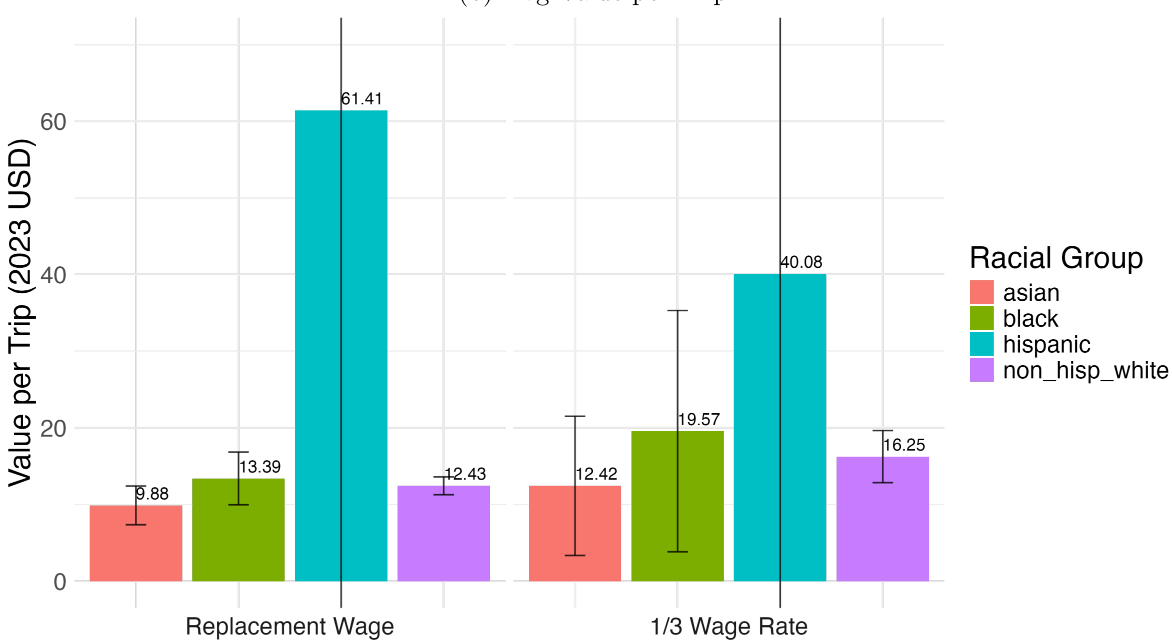


Figure 7: **Annual Value for Local Recreation by Race/Ethnicity.** After controlling for income, the use of a replacement wage or 1/3 wage rate does not significantly change the estimated value for local recreation for different racial groups. This contrasts with the results for income quintile, where the use of a replacement wage or 1/3 wage rate significantly changes the estimated value for local recreation.

(a) Trend in National value of Access to Local Recreation



(b) Avg Value per Trip



A.3 Regression Results for Preferred Model

A.3.1 One-third Wage Rate

Table 6: Three-year period regression results for my preferred model (5 neighbor matches, matched using Eqn. 13)

		2003	2006	2009	2012	2015	2018	2021
1	Dependent Var.:	trip	trip	trip	trip	trip	trip	trip
2								
3	Constant	-1.147*** (0.1899)	-0.9261*** (0.1976)	-0.5510** (0.1876)	-0.4487* (0.1931)	-0.7005*** (0.1753)	-0.6829** (0.2205)	-0.6100** (0.2090)
4	travel_cost_third_mid	-0.0645*** (0.0050)	-0.0724*** (0.0069)	-0.0463*** (0.0063)	-0.0713*** (0.0071)	-0.0477*** (0.0069)	-0.0237** (0.0079)	-0.0728*** (0.0099)
5	prob_eat_drink	-1.823*** (0.0998)	-1.592*** (0.1223)	-1.368*** (0.1018)	-1.862*** (0.1213)	-1.668*** (0.1220)	-1.617*** (0.1332)	-1.980*** (0.1746)
6	prob_pet_care	-1.594*** (0.0543)	-1.522*** (0.0647)	-1.635*** (0.0560)	-1.626*** (0.0554)	-1.487*** (0.0553)	-1.438*** (0.0635)	-1.402*** (0.0671)
7	prob_child_care	-1.276*** (0.0656)	-1.233*** (0.0825)	-1.416*** (0.0716)	-1.707*** (0.0952)	-1.180*** (0.0841)	-1.005*** (0.1125)	-1.151*** (0.1311)
8	prob_social_relax_leisure	-1.481*** (0.0715)	-1.183*** (0.0946)	-1.846*** (0.0873)	-1.573*** (0.0968)	-1.882*** (0.1029)	-1.435*** (0.1098)	-1.557*** (0.1482)
9	prob_religous_spiritual	-1.051*** (0.2219)	-2.041*** (0.3602)	-1.716*** (0.2624)	-1.177*** (0.2594)	-1.114*** (0.2981)	-1.266** (0.4124)	-1.239** (0.4317)
10	prob_adult_care	-1.637*** (0.2605)	-0.8659* (0.4160)	-1.193*** (0.3584)	-1.613*** (0.2911)	-0.9021*** (0.2730)	-0.7874* (0.3069)	-0.7933* (0.3718)
11	fam_inc_mid_2023	6.59e-6*** (4e-7)	7.25e-6*** (4.87e-7)	5.12e-6*** (4.66e-7)	5.68e-6*** (5.18e-7)	4.3e-6*** (5.26e-7)	3.1e-6*** (6.19e-7)	6.59e-6*** (7.35e-7)
12	my_raceasian	-0.1784 (0.1118)	-0.2894* (0.1396)	-0.3772** (0.1176)	-0.0651 (0.1061)	-0.1597 (0.1124)	-0.1528 (0.1232)	-0.0750 (0.1255)
13	my_raceblack	-0.6216*** (0.0717)	-0.6219*** (0.0801)	-0.5168*** (0.0646)	-0.5035*** (0.0681)	-0.5325*** (0.0685)	-0.5973*** (0.0858)	-0.6078*** (0.1009)
14	my_racehispanic	-0.0434 (0.0584)	-0.3177*** (0.0700)	-0.1492** (0.0575)	-0.1378* (0.0633)	0.1691** (0.0571)	-0.0992 (0.0713)	-0.0259 (0.0765)
15	my_raceother	0.1067 (0.1153)	0.3714** (0.1183)	-0.2368. (0.1344)	-0.0903 (0.1356)	-0.1561 (0.1475)	0.1408 (0.1512)	-0.0005 (0.1620)
16	category_entertainment	0.0071*** (0.0019)	-0.0009 (0.0022)	-0.0007 (0.0020)	-0.0040. (0.0022)	0.0041. (0.0022)	-0.0063** (0.0024)	0.0057** (0.0021)
17	category_shopping	-0.0029 (0.0059)	0.0043 (0.0061)	0.0066 (0.0054)	-0.0125* (0.0052)	-0.0089* (0.0045)	0.0008 (0.0056)	0.0004 (0.0059)
18	category_socializing	0.0008 (0.0028)	-0.0029 (0.0031)	-0.0027 (0.0029)	0.0073* (0.0032)	0.0032 (0.0028)	0.0012 (0.0031)	0.0017 (0.0027)
19	category_eating_or_drinking	0.0047 (0.0063)	-0.0054 (0.0068)	-0.0043 (0.0058)	0.0062 (0.0060)	0.0082 (0.0057)	0.0042 (0.0061)	-0.0114. (0.0063)
20	category_playing_sports_or_games	0.0002 (0.0022)	0.0029 (0.0025)	-0.0033 (0.0024)	-0.0055. (0.0029)	0.0008 (0.0024)	-0.0011 (0.0032)	-0.0015 (0.0035)
21	category_hobby_or_relaxing	0.0016 (0.0018)	-0.0030 (0.0021)	0.0034 (0.0021)	0.0051** (0.0019)	-0.0004 (0.0021)	0.0026 (0.0021)	0.0025 (0.0020)
22	--------------------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------
23	S.E. type	IID	IID	IID	IID	IID	IID	IID
24	Observations	29,615	20,143	22,851	20,442	18,980	14,036	10,930
25	Squared Cor.	0.09573	0.08357	0.09390	0.10655	0.09277	0.07453	0.09678
26	Pseudo R2	0.08956	0.08795	0.09302	0.10316	0.08842	0.07360	0.08593
27	BIC	22,416.4	14,698.9	17,994.2	15,724.2	15,650.4	11,686.6	9,440.6

A.3.2 Replacement Wage

Table 7: Three-year period regression results for my preferred model (5 neighbor matches, matched using Eqn. 13)

		2003	2006	2009	2012	2015	2018	2021
1	Dependent Var.:	trip	trip	trip	trip	trip	trip	trip
2								
3	Constant	-0.8518*** (0.1905)	-0.6430** (0.1984)	-0.3471. (0.1889)	-0.1743 (0.1935)	-0.5129** (0.1759)	-0.5632* (0.2211)	-0.3800. (0.2106)
4	travel_cost_15	-0.0737*** (0.0054)	-0.0889*** (0.0075)	-0.0576*** (0.0064)	-0.0791*** (0.0068)	-0.0513*** (0.0065)	-0.0416*** (0.0075)	-0.0750*** (0.0088)
5	prob_eat_drink	-1.794*** (0.0998)	-1.516*** (0.1224)	-1.327*** (0.1020)	-1.788*** (0.1217)	-1.619*** (0.1226)	-1.553*** (0.1334)	-1.901*** (0.1751)
6	prob_pet_care	-1.598*** (0.0542)	-1.533*** (0.0646)	-1.640*** (0.0560)	-1.625*** (0.0554)	-1.489*** (0.0553)	-1.442*** (0.0635)	-1.410*** (0.0672)
7	prob_child_care	-1.257*** (0.0656)	-1.211*** (0.0825)	-1.391*** (0.0718)	-1.675*** (0.0953)	-1.149*** (0.0844)	-0.9480*** (0.1129)	-1.088*** (0.1317)
8	prob_social_relax_leisure	-1.460*** (0.0716)	-1.138*** (0.0948)	-1.796*** (0.0876)	-1.505*** (0.0971)	-1.826*** (0.1038)	-1.380*** (0.1100)	-1.486*** (0.1489)
9	prob_religous_spiritual	-0.9689*** (0.2217)	-1.941*** (0.3598)	-1.589*** (0.2630)	-1.047*** (0.2594)	-1.061*** (0.2988)	-1.234** (0.4128)	-1.130** (0.4319)
10	prob_adult_care	-1.626*** (0.2605)	-0.8450* (0.4139)	-1.150** (0.3592)	-1.597*** (0.2908)	-0.8673** (0.2729)	-0.7464* (0.3071)	-0.7412* (0.3725)
11	fam_inc_mid_2023	3.71e-6*** (3.43e-7)	4.29e-6*** (4.08e-7)	3.17e-6*** (3.85e-7)	2.79e-6*** (4.34e-7)	2.31e-6*** (4.41e-7)	2.19e-6*** (5.38e-7)	4.07e-6*** (6.61e-7)
12	my_raceasian	-0.1734 (0.1117)	-0.2918* (0.1395)	-0.3750** (0.1176)	-0.0573 (0.1060)	-0.1539 (0.1123)	-0.1479 (0.1233)	-0.0853 (0.1257)
13	my_raceblack	-0.6155*** (0.0718)	-0.6256*** (0.0803)	-0.5266*** (0.0648)	-0.5106*** (0.0684)	-0.5344*** (0.0686)	-0.5998*** (0.0859)	-0.6156*** (0.1011)
14	my_racehispanic	-0.0465 (0.0585)	-0.3225*** (0.0701)	-0.1504** (0.0576)	-0.1178. (0.0634)	0.1766** (0.0571)	-0.0994 (0.0714)	-0.0246 (0.0766)
15	my_raceother	0.1035 (0.1155)	0.3738** (0.1186)	-0.2377. (0.1343)	-0.0783 (0.1358)	-0.1550 (0.1476)	0.1442 (0.1515)	-0.0052 (0.1622)
16	category_entertainment	0.0071*** (0.0019)	-0.0009 (0.0022)	-0.0008 (0.0020)	-0.0040. (0.0022)	0.0042. (0.0022)	-0.0061** (0.0024)	0.0059** (0.0021)
17	category_shopping	-0.0023 (0.0059)	0.0055 (0.0061)	0.0063 (0.0054)	-0.0118* (0.0052)	-0.0088. (0.0045)	0.0011 (0.0057)	0.0002 (0.0059)
18	category_socializing	0.0009 (0.0029)	-0.0028 (0.0031)	-0.0025 (0.0029)	0.0071* (0.0032)	0.0035 (0.0028)	0.0012 (0.0031)	0.0016 (0.0027)
19	category_eating_or_drinking	0.0044 (0.0063)	-0.0047 (0.0068)	-0.0039 (0.0058)	0.0063 (0.0060)	0.0076 (0.0057)	0.0043 (0.0061)	-0.0112. (0.0063)
20	category_playing_sports_or_games	0.0003 (0.0022)	0.0031 (0.0025)	-0.0030 (0.0024)	-0.0054. (0.0029)	0.0008 (0.0024)	-0.0011 (0.0032)	-0.0014 (0.0035)
21	category_hobby_or_relaxing	0.0013 (0.0018)	-0.0031 (0.0021)	0.0032 (0.0021)	0.0047* (0.0019)	-0.0005 (0.0021)	0.0027 (0.0021)	0.0025 (0.0020)
22	--------------------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------	-------------------
23	S.E. type	IID	IID	IID	IID	IID	IID	IID
24	Observations	29,615	20,143	22,851	20,442	18,980	14,036	10,930
25	Squared Cor.	0.09618	0.08561	0.09601	0.10968	0.09381	0.07579	0.09919
26	Pseudo R2	0.09037	0.08989	0.09449	0.10538	0.08928	0.07543	0.08786
27	BIC	22,396.7	14,668.1	17,965.1	15,685.8	15,635.8	11,663.8	9,421.0

A.4 Robustness Checks for Matching

Figure 8: **Robustness Check for Value per Trip Estimates: differing matching equations.** To estimate the value of local recreation, I used nearest neighbor matching to impute the travel time for non-recreators (for whom it is impossible to observe travel time). Here, I show how neither the number of ”neighbors” used to impute unobservable travel time nor the matching equation used significantly change the estimated value per trip.

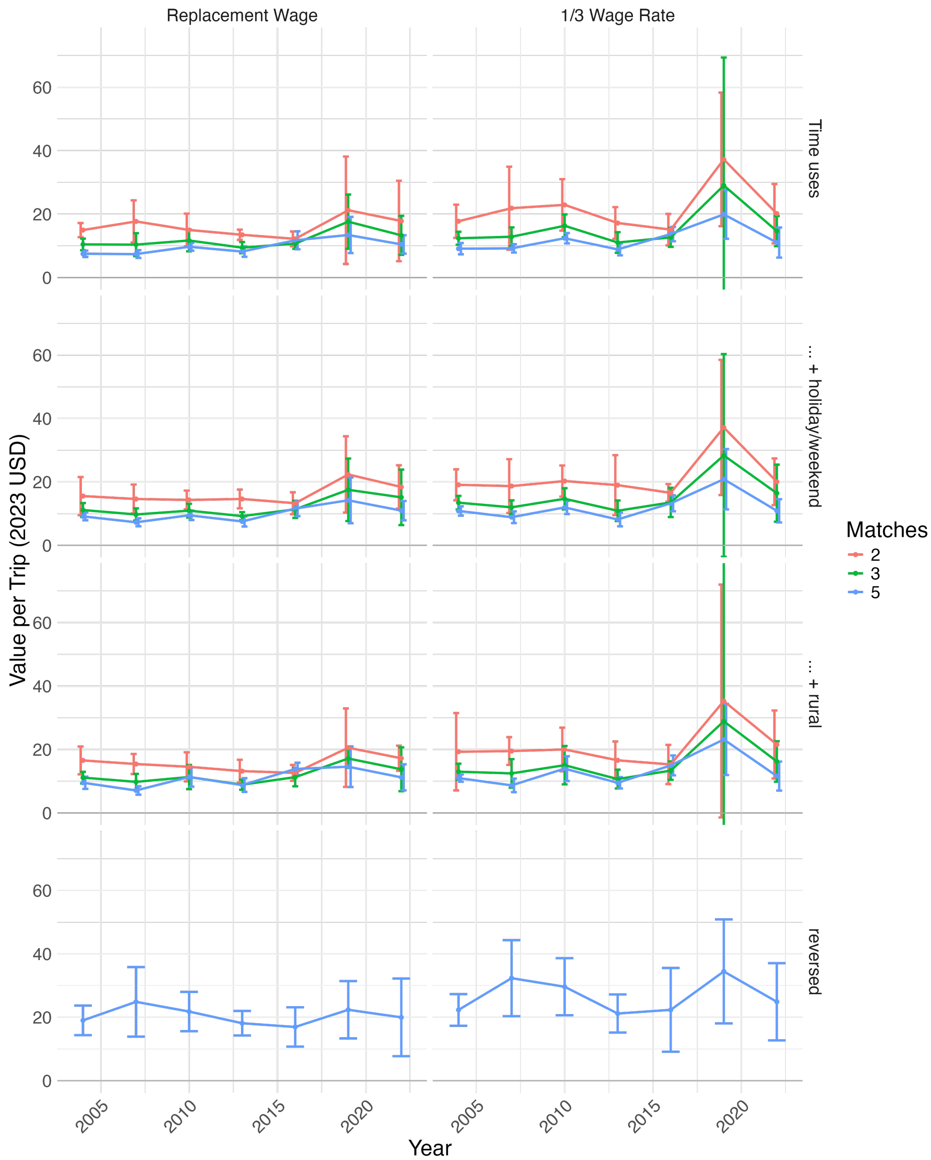


Figure 9: **Robustness Check for Value per Trip, using restricted caliper.**