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Projected impacts to the production of outdoor recreation opportunities across US state park systems due to the adoption of a domestic climate change mitigation policy

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ABSTRACT

Numerous empirical and simulation-based studies have documented or estimated variable impacts to the economic growth of nation states due to the adoption of domestic climate change mitigation policies. However, few studies have been able to empirically link projected changes in economic growth to the provision of public goods and services. In this research, we couple projected changes in economic growth to US states brought about by the adoption of a domestic climate change mitigation policy with a longitudinal panel dataset detailing the production of outdoor recreation opportunities on lands managed in the public interest. Joining empirical data and simulation-based estimates allow us to better understand how the adoption of a domestic climate change mitigation policy would affect the provision of public goods in the future. We first employ a technical efficiency model and metrics to provide decision makers with evidence of specific areas where operational efficiencies within the nation's state park systems can be improved. We then augment the empirical analysis with simulation-based changes in gross state product (GSP) to estimate changes to the states' ability to provide outdoor recreation opportunities from 2014 to 2020; the results reveal substantial variability across states. Finally, we explore two potential solutions (increasing GSP or increasing technical efficiency) for addressing the negative impacts on the states' park systems operating budgets brought about by the adoption of a domestic climate change mitigation policy; the analyses suggest increasing technical efficiency would be the most viable solution if/when the US adopts a greenhouse gas reduction policy.

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1. Introduction

The adoption of US policies focused on reducing GHG emissions is likely to alter the provision of public goods and

services. As revenues captured from existing energy markets decrease, public service agencies are likely to see operating budget reductions (Jorgenson et al., 2008; Ross et al., 2008). Impacts to the provision of public services are likely to differ by

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state. For example, in the case of outdoor recreation opportunities provided by state park systems, operating expenditures are generated by a mix of revenues and government appropriations. As a state's economic health wanes, so too will its ability to provide high quality outdoor recreation opportunities in state parks (Siderelis and Smith, 2013). As evidence of this connection, reductions in congressional appropriations in some states have already affected operating hours, reduced employment rates and created a backlog of deferred maintenance. The connection between the provision of outdoor recreation opportunities and the states' economies can subsequently impact public health benefits (Ruhm, 2000). Given GHG reduction policies may alter states' economic growth trajectories, quantifying the projected impacts of climate change mitigation policies on the provision of public goods and services is needed to identify solutions that can maintain those goods and services into the future.

The purpose of this study is to forecast changes in operating expenditures from the year 2014 to 2020 for each of the state park systems within the US under a domestic climate change mitigation policy. Our goal is to demonstrate an empirical linkage between a domestic GHG reduction policy and the provision of public goods and services, specifically outdoor recreation opportunities and its associated benefits. To our knowledge, no previous study had demonstrated a direct linkage between the adoption of a domestic GHG reduction policy and the provision of public services. Through our analyses we produce three specific outcomes highly relevant to environmental policy makers and recreation resource managers: (1) we estimate state-level technical efficiency metrics for the states' park systems, providing decision makers with empirical evidence of specific areas where operational efficiencies can be improved; (2) we estimate state-level changes to operating expenditures under a domestic climate change mitigation policy, highlighting substantial variability across the states' park systems; and (3) we explore two potential solutions (increasing gross state product (GSP) or technical efficiency) for addressing negative impacts on the states' park systems operating budgets brought about by the adoption of a climate change mitigation policy.

2. Study context and related literature

2.1. State park systems in the United States

State park systems in the US facilitate the preservation, regulation and provisioning of natural and cultural ecosystem services. The nation's state park systems are public lands and waters established for their environmental and social value (Caneday et al., 2009). Although the resources, administration type, system size and visitation levels differ among states, services provided by state park systems include both the protection of high quality or unique natural and cultural resources as well as the facilitation of outdoor recreational opportunities.

The economic and social benefits provided by the states' park systems are substantial. In 2013, over 720 million visits were recorded across the 8000 operating units in the US (Leung et al., 2014). Visitors to state parks generate an estimated economic impact of over \$20 billion USD (National Association

of State Park Directors, 2013). In addition to the sizable financial contribution, state park systems also provide physical and mental health benefits. A large volume of research has documented the psychological, social and physiological health benefits of outdoor recreation (Gies, 2006). Maintaining the production of these benefits requires managers understand how to best allocate operating capital among competing uses such as labor and the maintenance of capital improvements. Analyzing the effectiveness with which park system managers make these allocations can be completed through the concept and metric of technical efficiency.

2.2. Technical efficiency

Technical efficiency is a simple concept. Public resource managers are responsible for allocating available financial capital to provide desired goods and services to the public. The provision of those goods and services involves discretionary decisions about how public monies can best be apportioned to specific, controllable output factors of production such as labor and the maintenance of capital improvements. Efficiency is gauged by the ability to produce maximum quantities of the output factors of production at minimal costs. Managers and administrators pursue the least costly means of achieving given ends (Simon, 1976).

Maximizing technical efficiency is a relatively straightforward and logical process when the goals and objectives of a public agency or organization are clear and measurable. Such is the case for the states' park systems, where the primary objective of managers is to provide the public with high quality outdoor recreation opportunities (Siderelis et al., 2012). We assume the states' park system managers are attempting to maximize public enjoyment of the resources they manage while minimizing costs. This assumption forms the basis of our analysis of technical efficiency.

There are several common methods for empirically estimating technical efficiency; the most common being the construction of a linear equation where controllable input factors are regressed on the output factors of production (Greene, 2008); we adopt this method for our analyses. The model we construct using this method is described in Section 3.

2.3. Factors of production in the provision of outdoor recreation opportunities

We gauge managers' technical efficiency by their ability to minimize costs associated with managing their state's park system (input factors = operating expenditures) in an effort to obtain the factors of production involved in producing outdoor recreation opportunities (output factors). The output factors affecting the efficiency of an individual park system are: attendance, capital expenditures, revenue, labor and the total acreage within the system. Each of these output factors affect managers' decisions regarding the magnitude and allocation of operating expenditures:

- *Attendance* refers to the total count of day and overnight visitation to both fee and non-fee areas. Attendance is directly tied to operating expenditures under the logical assumption that it costs more (less) to provide outdoor

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