Journal of Environmental Economics and Management ■ (■■■■) ■■■–■■■

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

The cost of endangered species protection: Evidence from auctions for natural resources ☆

Branko Bošković [a,*], Linda Nøstbakken [b]

[a] Alberta School of Business, University of Alberta, 3-23 Business Building, Edmonton, Alberta, Canada T6G 2R6
[b] Norwegian School of Economics, Department of Economics, Helleveien 30, 5045 Bergen, Norway

ARTICLE INFO

Article history:
Received 6 March 2015

JEL classification:
Q58
D44
Q52
L71

Keywords:
Endangered species regulation
Auctions
Natural resources
Oil

ABSTRACT

This paper examines the effect that endangered species regulation has on natural resource development. Specifically, we use data from competitive auctions to estimate the effect that land-use regulation protecting endangered caribou in the Canadian province of Alberta has on the price producers pay for the right to extract oil. We exploit a regression discontinuity design to evaluate how prices differ along regulation boundaries that constrain resource development. The auction format and the regulation discontinuity allow us to measure the total cost of the regulation. We find that producers pay 24% less on average for oil leases that are regulated and that the total net present value cost of the regulation exceeds $1.15 billion for leases sold between 2003 and 2012, all of which is borne by the government. In spite of these costs, the populations of endangered caribou remain in widespread decline.

Introduction

In this paper, we present a new approach to measure the cost of endangered species protection. In particular, we estimate how lease prices for the right to develop natural resources are affected by endangered species regulations that constrain resource development. We apply this approach to data from the Canadian province of Alberta on auction prices for oil leases and land-use regulations protecting endangered caribou.

Lease prices for natural resources are useful for identifying the cost of endangered species regulation for a number of reasons. First, jurisdictions often sell the right to develop their natural resources through auctions. Auctioned resource rights can be accompanied by restrictions, such as limits on environmental damage from resource development, in certain areas of a given jurisdiction. One can then focus on auctions for resource rights and wildlife regulation that vary within a single jurisdiction, thereby avoiding the empirical challenge of comparing land prices across jurisdictions and how they relate to interjurisdictional differences in wildlife regulation. Second, depending on the format, auctions can reveal the entire cost of

☆ We are grateful to Saulo Castro and Faye Wyatt for excellent research assistance. We thank Roger Bivand, Ujjayant Chakravorty, Jevan Cherniwchan, Calvin Clark, Simon J. Dyer, Elston Dzus, Sacha Kapoor, Andrew Leach, Arvind Magesan, Charles Mason, Margaret Slade, Mara Theine, and seminar participants at the University of Alberta, the University of Calgary, the 2013 AERE Summer Conference, the 2014 AEA/AERE Meetings, the 2014 CEA Meetings, WCERE 2014, and SURED 2014 for helpful comments. This paper was previously circulated as "The Costs of Protecting the Wild: Evidence from Auctions for Natural Resource Development." This research was supported in part by the Western Centre for Economic Research and the Environment Canada Economics and Environmental Policy Research Network.

* Corresponding author.
E-mail addresses: boskovic@ualberta.ca (B. Bošković), linda.nostbakken@nhh.no (L. Nøstbakken).

http://dx.doi.org/10.1016/j.jeem.2016.08.003
0095-0696/

Please cite this article as: Bošković, B., Nøstbakken, L., The cost of endangered species protection: Evidence from auctions for natural resources. Journal of Environmental Economics and Management (2016), http://dx.doi.org/10.1016/j.jeem.2016.08.003

the wildlife regulation. In competitive first-price, sealed-bid auctions, bidders will bid their expected value of the object. In the case of resource rights, this value is the expected net present value of profits from development. Any regulations restricting development, such as wildlife regulation, may require the rights holder to incur compliance costs. Such costs will affect the expected net present value of profits, and knowing this, bidders will decrease their bids. By comparing the auctioned lease price of a regulated land lease to the price of an unregulated but otherwise identical lease, we can identify the effect of wildlife regulation on the value of natural resource development.

Our specific application for studying this issue is the 'oil sands' in Alberta, where firms extract bitumen for production into crude oil. We study this context primarily for two reasons. First, rights for oil development in Alberta are sold through first-price, sealed-bid auctions that are competitive and have been for decades. The oil industry in Alberta, as well as the subindustry that develops oil sands, is well established with a large set of active producers. Oil sands deposits cover a large swath of Alberta, and oil sands reserves are amongst the largest reserves of oil in the world. Although a relatively costly resource that requires unconventional techniques to extract and process, oil sands are highly lucrative once developed.

The second reason is that this application has a clear discontinuity in endangered species regulation that allows us to uncover the causal effect of the regulation on the price producers pay for the right to develop oil sands. In Alberta, oil sands developers are subject to wildlife regulation that varies within the province's boundaries. The regulation aims to protect endangered wildlife – specifically, the caribou – which are endangered in large part because of the immense land disturbances created by the encroaching oil sands development. Like virtually all endangered species regulations in North America, the regulation aims to protect endangered wildlife by restricting development within well-specified geographic zones. Broadly, our approach is to compare auction prices for oil sands leases lying within boundaries of endangered caribou protection zones to auction prices for leases not in the protection zones.

Motivated by the sharp and discontinuous change in endangered species regulation over space, we use a spatial regression discontinuity (RD) approach to identify the effect of the regulation. Following Dell (2010), we employ a multidimensional RD approach, which uses polynomials in latitude and longitude to control for geographic location, while an indicator variable for whether a lease lies in a caribou protection zone describes the discontinuous regulation treatment. In our preferred specification, we control for geographic location, lease-specific controls, and a suite of fixed effects to identify the effect of the regulation protecting endangered caribou on auction prices.

Based on data from more than 3000 oil sands leases auctioned between 2003 and 2012, we find that the regulation reduces auction prices, on a per hectare basis, by about 24% on average. At the mean price per hectare, this effect amounts to a decrease of $192 per hectare in 2012 Canadian dollars. Taking the estimated effect and aggregating across lease sizes and years in our sample, we estimate that the total net present value cost of this regulation for leases sold between 2003 and 2012 is at least $1.15 billion. This total cost estimate is important because, given how the government uses auction revenues and royalties to extract resource rents from producers, this cost is borne entirely by the government in foregone resource revenues.

This paper makes at least two contributions. First, it contributes to the literature on the economics of endangered species protection. Most of this literature focuses on the effects that wildlife protection, in particular the U.S. Endangered Species Act (ESA), has on target wildlife (see, for example, Ferraro et al., 2007; Langpap and Kerkvliet, 2012). In contrast, our paper contributes to a small literature that estimates the costs of wildlife protection. For example, Lueck and Michael (2003) find that private forest landowners prematurely harvest timber to preempt costly land-use restrictions under the ESA should their forests become inhabited by endangered species. Greenstone and Gayer (2009) find that ESA zonal designations for protected species may decrease residential housing values. Zabel and Paterson (2006) find that the number of building permits in municipalities decrease in areas designated as critical habitats. Unlike the existing literature, our focus on auction prices for industrial development allows us to estimate the total cost of endangered species regulation.

Our study is, to the best of our knowledge, the first to use auction data to estimate the cost of environmental regulations or land-use regulations. We believe that this approach is suitable for many different contexts and is not specific to natural resource development or land-use regulations. For any form of regulation on the end-use of an auctioned object, one can estimate the cost of the regulation by comparing the winning auction bids for regulated and non-regulated objects.

Our use of land markets is similar to a literature that uses residential housing markets to estimate the willingness to pay for environmental quality improvements caused by environmental regulation.[1] In contrast, land prices are typically less useful for estimating the cost of regulation to polluting firms. The problem with doing so is because environmental regulation typically only varies across jurisdictions; governments may offer inducements, sometimes unobserved, to mitigate the cost of their regulation in order to lure individual firms to their respective jurisdictions. In comparing land prices across the jurisdictions, these accompanying policies confound estimates of the effect of environmental regulation on polluting firms. Because our approach allows us to focus on one jurisdiction, and a government's objective in auctioning resource rights is to maximize rent extraction, we avoid these identification problems to estimate the cost of the regulation using land prices.

[1] See Chay and Greenstone (2005) for an example of how residential housing prices and changes in environmental regulation can be used to estimate the willingness to pay for improved environmental quality. This literature falls within a larger literature that estimates the benefits of local amenities from housing prices; see Kuminoff et al. (2013) for a recent survey of this literature.

Please cite this article as: Bošković, B., Nøstbakken, L., The cost of endangered species protection: Evidence from auctions for natural resources. Journal of Environmental Economics and Management (2016), http://dx.doi.org/10.1016/j.jeem.2016.08.003