



Shadow pricing diversity in U. S. national forests*

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Abstract

Tobit estimation of the market value of timber sales in national forests of North Carolina demonstrates the important effect of stand diversity on the formulation of bid prices for mixed-species timber tracts. The hedonic model generates a shadow price for diversity according to changes in bid prices, an effective shift in the demand curve for auctioned tracts due to stand diversity attributes. This approach contrasts with traditional shadow price analyses that focus on the supply effects of environmental constraints. Results are corrected for the effects of bidder participation, market conditions, production costs, and other stand attributes. Econometric results demonstrate that stand heterogeneity is a highly significant factor influencing the market value of timber sales from national forests of the Appalachian region. Greater heterogeneity results in lower bid prices for timber sales, indicating a positive shadow price for maintenance of stand diversity.

Key words: tobit model, logging, U. S. national forest, diversity, shadow price.

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Introduction

Logging in U. S. national forests is a topic of important public debate and controversy, in light of often conflicting goals of maintaining the jobs and revenues generated by the timber industry and preserving endangered species, environmental services, and other non-market benefits provided by these forest ecosystems. In response to public demands for ecologically benign use, the USDA Forest Service charted an ecosystem management approach to multiple-use management of the national forests in the 1990s to more effectively incorporate non-timber management goals. The strategy prescribes Forest Service actions that “ensure sustainable ecosystems by restoring and maintaining species diversity and ecological productivity [to] provide recreation, water, timber, minerals, fish, wildlife, wilderness, and aesthetic values for current and future generations (USDA Forest Service 1999).”

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The efficiency of national forestland allocation to timber harvest may be measured in terms of the surplus recovered by the government treasury in public sales. Federal timber sales revenues denote the resource rent captured by the U. S. public from the allocation of federal lands to harvesting. Any decrease in harvest returns to the public treasury resulting from management changes prescribed to maintain ecosystem diversity may serve as a measure of the public opportunity costs or shadow price of ecosystem management.

Shadow prices for environmental goods are commonly estimated as the marginal costs of a *supply* reduction for a market good necessary to meet regulatory constraints for environmental quality. Knowledge of the price and of the required supply reduction for the market output provides a means of determining the imputed value of a linked non-market output. Studies of the marginal costs of pollution abatement (Roan and Martin 1996, Swinton 1998) and of biodiversity conservation (Rubin et al. 1991, Montgomery et al. 1994) follow this shadow pricing approach. In the present study, rather than examining the shift in the timber supply curve imposed by diversity constraints, we consider the shift in *demand* attributable to the reduced 'quality' of timber output from more diverse or heterogeneous stands. We estimate the shadow value of stand diversity as the marginal decrease in the market price for a timber sale associated with increments in stand diversity.

The relationship between timber sale characteristics and the market value of stumpage in national forests provides a means of determining the relative significance of stand diversity in returns to the harvest of public lands. Management for structural and species diversity in national forests is expected to generate opportunity costs to the public treasury, expressed in the decrease in per unit market value of stumpage for more diverse stands. This expectation derives from the premise that higher production and transactions costs for harvesting, sorting, and milling heterogeneous timber stocks depress bid prices. Marginally greater transactions costs for more diverse stands are expected to result from the scale effects of more selective harvesting, sorting, and milling activities; additional presale measurement efforts expended to reduce buyer uncertainties (Munn and Rucker 1998, Leffler et al. 2000); and higher residual stand management and contract enforcement expenditures.

Our premise is examined in an analysis of federal timber auctions from the Pisgah and Nantahala national forests of North Carolina. In a study of the effect of reserve prices on bidding behavior and the market value of timber auctions in these forests, Carter and Newman (1998) found that sales with a higher proportion of hardwood species, and thus greater timber species heterogeneity, attracted fewer bidders. In their analysis of bidding competition in five auction settings, Brannman et al. (1987) found that the high bid increases with the number of bidders. The decrease in the number of bidders for mixed hardwood offerings found by Carter and Newman (1998) prompts our inquiry into the influence of stand heterogeneity on the market value of timber sales.

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