HOLDING SIZE AND BEHAVIOR OF NONINDUSTRIAL PRIVATE LANDOWNERS: A CAUTIOUS SECOND LOOK

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ABSTRACT

Size of the holding has been an important factor in explaining nonindustrial private forest (NIPF) harvesting and management behavior. Large landowners are thought to harvest more readily and manage more actively than their smaller counterparts. These findings from NIPF surveys have resulted partially because of the way activity and size have been measured. Because large ownerships have greater variety in stand conditions and more acres available for treatment, the likelihood of activity in a given time period is naturally higher, regardless of the owners' interests and commitment. Most surveys contribute to this "available acres" artifact by using dichotomous choice scales and short reporting periods and by specifying total ownership size as a sole measure of holding size. An Oregon study of NIPF landowners demonstrated that the minimum involvement necessary to be classified as an active harvester or manager decreased as ownership size and the number of parcels increased, supporting the presence of an available acres artifact. Although the Oregon survey showed the typical direct relationship between size and reported participation, small owners reported management participation relative to rates of harvesting participation as high or higher than larger owners. Smaller owners did use less planning and assistance and were more inclined to partial harvest. Future studies should interpret size effects cautiously. Survey conclusions about holding size effects would be stronger if the available acres artifact were controlled in study design. ADDITIONAL KEYWORDS. Economies of size, harvesting behavior, landowner surveys, landownership.

INTRODUCTION

Much of the survey research on nonindustrial private forestry has shown holding size to be an important determinant of harvesting and management behavior (Alig and others 1990, Binkley 1981, Larsen and Ganser 1972, Thompson and Jones
1981, Webster and Stoltenberg 1959). Most NIPF surveys have shown that larger landowners are more inclined than smaller owners to emphasize timber production objectives, to harvest timber, and to invest after harvest in enhanced timber production.

Three basic explanations have been offered: economies of tract size, diminishing marginal utility, and alternative rates of the return (Straka and others 1984). The size economies explanation posits that activity is discouraged by the high peracre and perunit costs of improving and harvesting small tracts. The utility explanation maintains that small owners prefer nontimber outputs that do not require intensive stand improvements or timber harvest. The rate of return explanation holds that small owners discount future timber revenues heavily because these owners have poorer asset positions from which to draw capital or respond to risk. A common policy recommendation from this research has been to target productivity improvement programs to medium and large owners in an effort to find a more receptive audience, affect more acres for a given level of landowner contact, and reduce costs of program delivery.

Few have challenged the "larger owner/more active" conclusions. Relatively little research has been done to define the limits of these relationships or to quantify how size interacts with stand condition and landowner characteristics. A closer inspection of surveys that have analyzed holding size effects suggests the potential to overstate differences between large and small landowners by failing to account for size as a proxy for variety in forest condition and thus availability for treatment.

Most NIPF surveys ask respondents whether they have participated in an activity during a specified period. Responses are correlated with size of the total ownership. Because large ownerships have a greater number and variety of stands and parcels, they have naturally higher likelihoods of harvesting and silvicultural opportunities in a given time period. The landowner’s behavior is conditional on this physical availability. This "available acres" artifact alone could make large landowners appear to be more active. Using this measurement strategy with 20 landowners holding 20 acres apiece, two could, by involving their entire ownerships, harvest or reforest 40 acres and represent 10 percent participation for that size class. One 400-acre landowner who treated only 10 acres would represent 100 participation.

Studies of NIPF behavior have concluded that holding size affects both harvesting and management in the same way. Although foresters prefer to think of harvesting and management in an integrated management regime, for a given acre of NIPF forest land, harvesting and management decisions are not necessarily made at the same time, under the same biological or economic conditions, or by the same landowner. The relative influence of size on these separate decisions has implications for the supply of timber and amenities. Harvesting is a disinvestment decision and influences short term supply; management is an investment decision and influences long term supply (MacMahon 1964, Alig and others 1990). If holding size discourages management to a greater extent than harvesting, understocked stands can result.
OBJECTIVES

Previous NIPF studies and a recent survey of landowners in western Oregon were evaluated to better understand the "available acres" effect and how ownership size is associated with harvesting and management. Our analysis addressed the following questions:

1. How have study design and variable specifications in previous studies influenced results about holding size? Is an "available acres" artifact present? Have separate studies of harvesting and management behavior differed in approach?

2. How does ownership size correlate with reported participation in the Oregon data? Is there evidence of an available acres effect?

3. How strong are conclusions about holding size? What are some implications for further research and NIPF policies and programs?

METHODS

We reviewed 21 NIPF studies of U.S., Canadian, and Scandinavian landowners for research designs that might contribute to an "available acres" artifact. Special attention was directed to how participation in harvesting or management was defined and to the length of the reporting periods. Dichotomous choice response frames and short reporting periods would be most conducive to an "available acres" effect.

In addition, holding size variables were evaluated for their ability to distinguish unit, parcel, and ownership elements of holding size. Most NIPF surveys have not distinguished among these different elements. The term "tract" is used ambiguously in this literature, referring in different studies to different elements. For our purposes, ownership size is total forest acreage held by a landowner. It includes the effects of holding size at the unit, parcel, and ownership levels and is representative of overall asset position and forest condition variety. Large ownerships are more likely to offer a variety of harvesting and silvicultural opportunities. As a variable for correlating with activity, total ownership size is most vulnerable to available acres effects, because it captures the greatest degree of variety and tells the least about the units that were or were not harvested or managed. Parcels are separate units within an ownership. Parcel size, number, and dispersion influence how efficiently the ownership can be managed. Treatment units are stands that receive separate harvest and silvicultural treatment. Unit size reflects physical and financial influences on per acre costs and harvest returns. The smallest ownerships consist of one unit.

Sampling was also a basis of comparison. Landowner samples for surveys are drawn either proportionally from the landowner population (population-based, e.g., from tax rolls), from acreage represented (area-based, e.g., from Forest Inventory plots), or from participation in some activity such as harvesting or a public program. Acreage-based samples would be most sensitive to available acres effects because they over represent large landowners and usually ask for incidence of activity at the ownership level. By contrast, landowners in activity-based samples are usually asked questions about the treatment unit.
The Oregon survey was conducted by the Department of Forestry and Oregon State University survey research center in 1989. Owners of 5-5,000 acres in 13 western Oregon counties were randomly identified from fire patrol assessment lists. Reminder cards were sent out 10 days, 3 weeks, and 5 weeks after the initial mailing. The final response rate was 59 percent (928 usable responses out of 1,586). The survey was tested for nonresponse bias; responses and nonrespondents were determined not to represent different populations.

Landowners were queried about their ownership goals; demographic and ownership characteristics; past harvesting, reforestation, and timber stand improvement practices; awareness and use of technical assistance, tax credit, and cost share programs; future harvest plans; and approval of various forest management activities. Many of the questions were adapted from a 1989 Washington State survey (Blatner and others 1991).

Separate questions about harvest and management participation were asked in a dichotomous yes/no frame for the period 1979-89. For example, a respondent signifying "yes" to harvest participation could have harvested one or more times during the 10 year period. "Commercial thinning" included types of harvest other than final harvests: improvement cuts, shelterwood or seed tree harvests, salvage cuttings, or partial cuts conducted with little planning or supervision.

Management activities were analyzed in three categories. Planning activities included preparation of a management plan or an inventory of forest volume, growth, and condition. Practices were manipulations of the forest site or stand, including reforestation, herbicide application for brush control, and precommercial thinning. Assistance included public or private technical assistance, cost-sharing, the Federal reforestation tax credit. Respondents who reported "yes" to both harvesting and management questions could have done the activities on the same or separate units. Those who reported management but no harvest could have been reforesting or improving stands that were harvested before 1979. Harvesters who reported no management may have made improvements since the survey or may do so in the future.

Reforestation responses could have included reforestation after harvest, following up on pre-1979 harvests or failed regeneration attempts, rehabilitating stands, or converting crop or Christmas tree land to forest. Reforestation responses were not limited to commercial timber production purposes; some may have planted trees to improve esthetics. Landowners who clearcut but reported no reforestation could have included clearcutting for landclearing purposes. Some respondents may have reforested after the survey was conducted; others may not have been aware of forestry programs or Oregon’s reforestation law.

We chose the survey because it was similar to most previous NIPF surveys in response frame and variable specification. It was unlike most other surveys because it was conducted in a State with strict reforestation requirements. Under the State Forest Practices Act, all harvested land, regardless of ownership size, must be reforested. Therefore, we expected different owner size classes to have similar levels of participation in reforestation, relative to their reported level of harvest participation. Our strategy was to first compare associations between individual activities and size and then to compare size classes for their management participation relative to harvesting. If size effects indicated by the simple associations were not supported by participation relative to harvesting, the available acres could be at least partially responsible.
Because we lacked data on which to measure stand variety within ownerships, we selected the number of parcels per ownership as a crude surrogate. To demonstrate the effect of parcel variety on survey responses, each reported participation in harvesting and reforestation was weighted by the inverse of the parcel number. This adjustment represented the minimum percentage of parcels in an ownership that would be available to produce the reported participation in that activity. This percentage was averaged by size class (Birch and others 1982). Average parcel number and size increased with ownership size, ranging from one for the 5-acre ownership class to 5.4 parcels in the largest ownership size class.

RESULTS AND DISCUSSION

Previous Studies

In general, harvesting and management studies have been conducted using similar designs (table 1). Eight of the studies measured both harvesting and management participation. Most studies used dichotomous choice measures of participation, allowing one response per activity type. One variation was to ask for participation in any of a list of activities. The most common reporting period (10 studies) was 5 years. Other studies used 10 years, 40 years, and respondent tenure. The size variable in all but one study was ownership size — total forest acreage owned. Most studies (18) used population–based sampling.

Most studies found positive correlations between activity and ownership size. The evidence was weaker for the management activity. These results stem partially from the way activity and size were defined and measured. The dichotomous choice response frame is convenient for data analysis and modeling with logit and probit qualitative response models, but this frame gives little information about the acreage impacts of small owner activities and may underrepresent multiple occurrences in multiple activities of large owners. It does not show acres acted on in each ownership size class. Future studies should consider reporting multiple occurrences and acreage of same activity to measure activity on a peracre basis or as a percentage of ownership acres.

Because of the short reporting period, many small ownerships fail to have enough acres that would qualify as feasible harvests or silvicultural opportunities. Even a small owner with intensively managed stands may go for many years without the need to harvest or manage any of them. Her negative reply to a survey question classifies him/her as a nonharvester or nonmanager. A longer reporting period would capture a greater portion of treatment opportunities and more accurately represent activity in the smaller ownership sizes.

Correlations based on ownership size, especially those in population–based samples, combine the microeconomic influences of unit size with the statistical effect of available acres and so present a barrier to detecting or explaining differences in harvesting and management intensity. The few activity–based studies found results that conflicted with the mainstream conclusions about holding size. Royer (1987) found no significant association between reforestation after harvest and ownership size. Hyberg and Holthausen (1989),
<table>
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<th>Variable (2)</th>
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<td>Webster and Stoltenberg 1959</td>
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<td>Anderson 1968</td>
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<td>(nt)</td>
<td></td>
<td></td>
<td>(area)</td>
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<td>Romm and others 1987* (nonsignificant for harvest-related mgt)</td>
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<td>Cleaves and Bennett 1994</td>
<td>Harvest</td>
<td>10 yrs.</td>
<td>Oregon</td>
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1: *Refers to studies in which size was not found to be positively related to participation at statistical significance of p < .05. All other studies found activity to vary directly with size. Studies that did not report statistical testing are designated as nt.

2: Management activities (Mgt.) refer to a variety of types of silvicultural improvements. Harvest refers to any type of final or partial harvest. Unless otherwise noted, surveys contained dichotomous choice questions of the form: "Did you do xx in the period 19xx - 19xx?"

3: *Refers to dependent activity variable. Unless otherwise noted, independent variable was ownership size, the total forest acreage owned by the respondent.

4: Unless otherwise noted, samples were drawn from lists of landowners that represented the owner population. Area-based samples drew respondents by sampling from owners of United States Forest Service Forest Inventory plots, thus were proportional to ownership size. Activity-based samples were drawn from lists of landowners who have participated in some activity, usually harvesting.
using a long reporting period, found correlations between ownership size and activity that were positive but quite weak. Dennis (1989) found no significant association between harvesting behavior and ownership size, and Connaughton and Campbell [In press], found no difference in the harvest probabilities of industrial and NIFF owners.

Most studies have used the owner rather than the parcel, treatment unit, or the activity as sampling units. Information about the physical conditions of units in the ownership have not been integrated with information about landowner characteristics, so it is difficult to make inferential links between attitudes and the intensity of activity or to differentiate between attitudinal, logistical, and economic barriers.

Oregon Survey

Not surprisingly, participation in harvesting increased with ownership size (fig. 1). Larger landowners were more likely to have reported harvest and to have combined thinning and clearcutting. Harvesting participation ranged from 12 percent to more than 70 percent, increasing most dramatically in the first four classes and flattening at larger sizes. Commercial thinning was the most common harvest type for owners with less than 100 acres. Clearcutting and combined harvest types (on separate units within the ownership) were more common for larger owners.

![Figure 1: Participation in harvesting, 1979-88, by western Oregon nonindustrial private forest landowners.](image)

The comparison of reported participation and minimum parcel involvement in harvesting and reforestation (figs. 2a and 2b) showed how larger ownerships can contribute to high reported participation rates with relatively small percentages of their ownerships. For example, the 100-499 acre size class, representing
Figure 2.--Comparison of participation in (a) harvesting and (b) reforestation with the minimum percent of parcels involved per owner. Western Oregon nonindustrial private forest landowners, 1979-89. Size classes adopted from Birch and others (1982).

about 17 percent of the landowner population, reported a 52 percent harvest participation. Landowners in this class would have needed only about 30 percent of their parcels involved in harvesting to achieve that rate. In contrast, the 10-49 acre size class, representing about 55 percent of the landowner population, reported a 25 percent rate that would have involved at least 22 percent of the parcels owned in that class. The effects were similar in harvesting and reforestation, except that the minimum parcel involvement in the small ownership sizes is higher for harvesting. Comparisons of these adjusted figures are less valid in the larger ownership classes, whose data do not reflect multiple treatments.

For comparing participation relative to harvesting, the data were stratified into size classes, which each accounted for 25 percent of the total acreage represented. As in harvesting, reported participation in management (planning, practices, and assistance) increased dramatically by size class. However, management relative to harvesting remained fairly constant across size classes or even decreased (fig. 3). In the practices activities, small landowners were more active than larger owners for reforestation and just as active for precommercial thinning. Relative to harvesting, herbicide use was low for the mid-range owner sizes. Smaller owners tended to both harvest and install practices with relatively less planning and assistance (fig. 3). Compared with the harvest rate, the use of inventions and management plans increased sharply with size (fig. 3). Tax credit and technical assistance received little use by landowners of less than 340 acres. Almost 60 percent of landowners with more than 1,750 acres used the tax credit. Cost share use peaked in the 341-1,750-acre class presumably because of eligibility limitations on large acreage.
Figure 3.--Comparison of participation in (a) silvicultural practices, (b) planning activities, and (c) assistance and harvesting, western Oregon nonindustrial private owners, (NIPF) 1979-88. Each size class represents 25 percent of the NIPF land base.
A closer look at management activities associated with different types of harvesting provides more insight. Harvesters, regardless of type of harvest used, participated in management at two to six times the rate of nonharvesters. Combination harvesters, by definition, had at least two harvested parcels or units and were larger owners, so part of their elevated response could have come from the available acres effect. For all harvest types (including no harvest), landowners participated in practices activities at higher levels than either planning or assistance activities. Smaller landowners participated in practices frequently but did so with relatively less planning, technical, and financial assistance. Most of the planning and assistance participation was on larger ownerships, especially that associated with no harvests or combinations of thinnings and clearcuttings. Thinners had lower participation than either the combined harvest or clearcut-only group. More than two-thirds of those who thinned did so without an inventory; more than half without technical assistance.

CONCLUSIONS

Models of NIPF behavior and the data used to test them should be closely scrutinized before drawing general conclusions about holding size, harvesting, and management activity. The mere likelihood that an activity occurred on an ownership in a given reporting period is not a complete measure of management intensity and is itself conditional on the number of acres available for treatment. Most studies have not correlated acres being harvested or treated with holding size.

Whether activities vary in their susceptibility to available acres effects is a survey measurement question open to further study. Modelers of NIPF behavior should be particularly cautious when incorporating survey results such as these in their projections. Researchers should control for the available acres artifact in study designs.

One improvement would be to simultaneously collect data about characteristics of landowners' characteristics and their woodlands. Recent examples include Dennis (1989) and Bennett (1993). Another approach would be to lengthen the reporting period and ask for activity dates, acres treated, and volumes removed. With the stand or treatment unit as the reporting unit, ownership and unit size could be treated as separate independent variables. Another approach would be to treat groups within spans of ownership size as separate populations. This would allow investigation of other demographic and attitudinal variables within the group. Cleaves and Bennett [In press] showed that ownership size interacted with tenure, form of organization, occupation, and personal income levels in determining whether to harvest. Ownership size, tenure, residence, form of organization, acquisition method, occupation, and income levels were all associated with the choice of clearcutting or thinning. Special studies could show how demographic groups within ownership size classes differ and relate these to measurements of the forest stands.

The Oregon data, typical of NIPF surveys, neither disprove nor strongly support the hypothesis that large owners are generally more active. Participation in physical harvesting and silvicultural practices increase linearly with
ownership size, but there are differences in participation by category activity. The ownership size variation across joint harvest/management responses seems to confound the generally accepted notion that large owners universally harvest and manage more actively. Participation in government tax and incentive programs is solidly dominated by larger owners, but small landowners are more active reforesters, relative to harvesting participation, than large landowners.

The lack of planning assistance employed by small owners in thinning (partial cutting) deserves further study. This result seems relatively immune from artifactual effects of available acres. More specific definitions for types of partial cutting would be helpful, as would a better understanding of the motivation behind partial cutting decisions and the barriers to employing assistance. Perhaps small owners use partial cutting to arbitrage between income needs and the desire to maintain some tree cover. Perhaps they have less access to information about harvesting and improvement options when they cut. In Oregon, another motivation may be to avoid Forest Practices Act requirements by harvesting up to the regulatory definition of clearcutting. Reforestation is not required on residual stands with more than 50 trees per acre, 11 inches average d.b.h., or more than 40 square feet of basal area.

There is a general need to better understand how the ownership, parcel, and treatment unit size interact with forest condition and landowner characteristics to shape harvesting and management decisions. With a clearly defined taxonomy of size variables and an economic engineering methodology, relationships between treatment unit size and management costs and returns could be developed for different stand and site conditions. Available acres notwithstanding, ownership size may be a better measure of asset position and ability to respond to market and biological conditions than of physical constraints traditionally associated with tract size economics (Row 1976). Greater effort is needed to quantify the transaction costs of acquiring assistance, arranging for regulatory permits, and other activities and the effect of recent rises in timber values on the economic feasibility of unit sizes. Without basic economic information about size effects at all three levels, investigations of tradeoffs involved in multiple objective management on smaller parcels and units will be incomplete.

The general conclusion that large landowners are more active is not only open to question, but may be a misleading basis for channelling technical assistance and incentive programs to larger landowners. Targeting to large owners may be justified to minimize delivery costs (Weatherhead 1983), but excessive targeting may ignore high biological and financial potential in small ownerships and underestimate the response in the forest resource that is based on thousands of decisions by smaller owners. Another effect could be to increase the likelihood of substitution of public for private capital.

Perhaps programs should be targeted to resource problems and then to ownership groups. Partial cutting by smaller owners is a ripe area for landowner assistance. A series of poorly conducted partial cuts can create understocked stands. Bennett (1993) showed that in most partial cuts, landowners relied on loggers to decide what trees to remove and how to harvest and market them. There are no cost-shares or tax credits that apply to partial cuttings, and public foresters in Oregon are prohibited from assisting in harvesting of any kind.
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