

Chapter 3

Private Forests

Management and Policy in a Market Economy

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This chapter discusses privately owned forests and timber management in a market economy, including private property rights and tenure, landowner objectives and characteristics, markets, and government policies. Private forest land ownership and management—whether it be industrial or nonindustrial—is often assumed to represent the classic model of atomistic competition in a free market, private enterprise system. Private stumpage markets for timber are perhaps the best example of how this kind of market competition allocates scarce inputs such as land, capital, and labor for efficient production of wood fiber outputs, for example, pulpwood and sawtimber. Where strong private markets for timber exist, there are usually many private forest landowners (producers) and a moderate number of timber buyers (consumers).

Property rights, landowner characteristics and objectives, commodity and land markets, and political processes determine how forests are managed, protected, or reserved. These factors and their effects on forest management and allocation are discussed in this chapter. Most studies have employed various types of econometric techniques to assess the effect of various independent variables (e.g., landowner objectives, income, timber prices, subsidies) on dependent variables (e.g., tree planting, timber harvesting).

Landowner characteristics and objectives influence all types of forest management, including timber harvesting, reforestation, and participation in public programs. Specific factors tested for influence on timber harvesting include timber prices, reforestation costs, and nontimber values.

Reforestation is hypothesized to be affected by timber prices, reforestation costs, interest rates, nontimber values, and public programs.

1. PROPERTY RIGHTS AND TENURE

Various individuals, firms, communities, and units of government may own forests and timber. Different types of forest land ownership and forest landowner objectives affect how forest land will be managed. The spectrum of forest land and timber ownership could range from absolute fee simple ownership, where the land and timber belong entirely to a private individual or firm, to complete government control and production. Within each of these different types of ownership, landowners may have different degrees of rights of control and exclusion in different countries or in different regions of the same country.

Forest land may be bought and sold in most countries where private ownership dominates. However, transactions costs may restrict entry and exit into forest land markets. Fee simple ownership implies that individual forest landowners have exclusive rights to use and dispose of their property and its produce. These rights are still not absolute, but rather are conditioned by the overall interests of the state in protecting health, safety, public welfare, and, more recently, the environment. Nonindustrial private forest (NIPF) landowners (farmers and, increasingly, urban residents) and industrial private forest landowners in most countries hold some type of fee simple ownership.

Government ownership and management of forests, usually with private market production of goods, is at the other end of the spectrum. Governments also may own or co-own processing facilities, such as sawmills or plywood mills, but this is becoming less common. More often, governments that do own forests will provide services for recreation, wilderness, or amenities, or will contract with private vendors to provide those services.

NIPF landowners may also hold title to land, but enter into conservation easements to protect the land from development. This transfers some of the rights of disposition from landowners to the state or other public or quasi-public entity. For example, a transfer of development rights allows private owners to maintain use of their land, but may require public access to that land in exchange for direct payments or indirect tax benefits.

Industrial forest landowners are creating new forest and timber ownership vehicles, separating the various components of land and timber into bundles of rights. Traditionally, the forest industry purchased forests or bare land outright, and then managed the existing forests or planted new

forests for timber production. Even in the most traditional forest products firms, this single-purpose landownership model is waning. Firms that have land near expanding urban areas often have real estate development divisions. Several large firms have separated forest land ownership from wood processing, purchasing all their wood on the open market or from long-term lease arrangements. Even companies that have large land bases—often amassed during corporate mergers and buyouts—conduct active land sales programs to consolidate their holding near strategic centers or to generate revenue to pay off debt. Three large forestry firms in the United States have separated stock for their forest land holdings and manufacturing facilities since the 1980s, and several now have no company forest lands.

As discussed in greater detail in chapter 6, nontraditional corporate or other private entities also are becoming owners and managers of forest land for timber production. Timber investment management organizations (TIMOs) have become popular in the United States and now own in excess of three million hectares of forest land, mostly in the South. These TIMOs obtain funds from pension funds or from other large investors and then purchase and manage forest land. Thus, there is a trend toward more separation of timber rights from forest land rights, although most private forest land ownership still is in traditional NIPF or industry ownership and management.

2. LANDOWNER OBJECTIVES

Two basic economic theories, utility maximization and profit maximization, have been used to test hypotheses about private forest management. Utility is assumed to include both monetary and nonmonetary benefits associated with owning forest land. NIPF owners are often assumed to choose among the various benefits that forests produce in order to achieve the greatest utility for themselves. The profit-maximizing approach represents the landowner as a commercial entity that uses forest as a means of production, usually of timber products (see chapters 4 through 9). Utility maximization may be more relevant for owners of small forest tracts (see chapters 14 through 16) and profit maximization more germane for large tracts, forest industry, and TIMOs. Application of utility-maximization theory is challenging because of difficulties in assessing nonmarket values. The profit-maximization approach is narrower in its perspective but offers considerable power in examining nonmarket values through shadow prices from profit functions (Newman and Wear 1993, Prestemon and Wear 2000, Wear and Newman 1991).

Private industrial firms are generally presumed to be economically rational decision makers that seek to maximize the timber profits from their forest lands, within the constraints of society and politics. This may not always be the case, especially in the short run, since many large firms own timberlands as a hedge against large price swings for wood fiber in the open market or to prevent an expensive paper mill (establishment costs exceeding \$1 billion) from running out of wood. Large firms also may have capital constraints that limit their timber investments, even if they can meet their nominal cost of capital or hurdle rates.

NIPF owners may have multiple reasons for owning forest land, including timber production, carbon storage (chapter 13), amenities (chapters 4 and 14), and personal identity (Bliss and Martin 1989). Young and Reichenbach (1987) found that the intent to harvest timber is a function of attitudes and beliefs, and traditional assistance programs will not influence landowner behavior. Timber production is often one objective, but not the dominant one in many cases. Thus these landowners may manage forests less intensively, often for longer rotations and for more diverse benefits than industry owners.

The new land-owning organizations, such as TIMOs and pension funds, as well as wealthy private investors, generally own forest land to earn a reasonable rate of return on their capital. They seek profits as one of their key objectives, and their timber investments compete with other potential investment vehicles. Timber offers some security and less volatility than other investments such as stocks or commercial real estate, but it must earn good investment returns to be viable (chapter 6).

These landowners manage their forest lands within the context of implicit social norms and explicit laws, regulations, and incentives in their countries, states, or localities. Most countries now have explicit regulations to ensure continuous forest production and adequate environmental protection and biodiversity. For example, Indonesia requires that the annual harvest from public lands by timber concessionaires cannot exceed the net annual growth of their forests (about 1 cubic meter per hectare per year).

Social norms, as reflected by pressure from environmental groups and perhaps from individual consumers, are also being reflected in worldwide retail market demands for sustainable forest management. This adds another dimension to successful profit maximization, even for narrowly focused firms. For example, some firms are seeking certification for their forests in order to guarantee that they can sell their products in the green European markets and in U.S. retail home improvement stores.

The objectives and motivations of NIPF landowners throughout the world have been examined in a plethora of studies. Table 3.1 presents the results of a national survey of NIPF landowners in the United States.

Conclusions from this survey depend on whether statistics are summarized by the number of owners or by forest area. Private landowners holding land with timber production as the main objective comprised only 3% of the total private forest landowners but controlled 29% of the private forest area in the United States (Birch 1996a and b).

Table 3.1. Nonindustrial private forest landowner objectives, United States and the U.S. South (Birch 1996a and b)

Objective	United States		U.S. South	
	% of acres	% of owners	% of acres	% of owners
Timber	29	3	35	4
Other economic	19	17	20	20
Recreation and aesthetic	27	23	13	15
Part of farm or residence	17	39	17	37
Other	16	15	14	18
No answer	2	4	1	5

This table also summarizes survey results from the U.S. South, which is 90% privately owned and is a productive timber-growing region. More than 60% of the acres in the South have timber production as their main or secondary objective, and various commodity interests are important for over 75% of the southern land base. Bliss and McNabb (1992) concluded that the most prevalent reason for owning property was to keep it in the family, while NIPF landowners in Illinois wanted to (1) provide wildlife habitat, (2) preserve natural beauty, and (3) provide a heritage to pass on to future generations (Young et al. 1984).

3. LANDOWNER CHARACTERISTICS

Examination of the influence of landowner characteristics has focused exclusively on NIPF landowners. In addition, because this type of information is available only with micro data (for individual landowners), characteristics are tested only when landowner survey data are used. One exception to this can be found in chapter 14, where aggregate income and education data were incorporated into a model of amenity demand and harvest probability.

Several of the studies considered in this chapter used a survey conducted by Fecso et al. (1982) of reforestation by NIPF landowners in the South (Hardie and Parks 1991, Royer 1987). A more recent survey (Birch 1996a and b) provided information on NIPF owners by region, but has not been

used in empirical hypothesis tests. In addition, many of the studies have relied on smaller, focused surveys, often addressing only one region or state.

Following the application of utility theory to forest management (Binkley 1981), empirical tests of NIPF management began to include such characteristics as landowner income, occupation (primarily focusing on farmer/nonfarmer), residency status (absentee or resident), education, and age. Perhaps the most important characteristic is income, because increasing income is hypothesized to reduce landowner incentives to harvest timber. Alig et al. (1990) found that owner characteristics had a greater effect on the probability of timber harvesting by NIPF owners than on the probability of tree planting. This probably means that immediate market feedback (timber income) induces a more direct response than the delayed response required for tree planting. Below we discuss the general conclusions from the literature, with key citations.

Table 3.2. Influence of landowner characteristics on NIPF forest management

Characteristic	General conclusion		Selected citations
	Planting	Harvesting	
Income	Usually positive, not unanimous	Negative, limited studies	Hyberg and Holthausen (1989) Dennis (1989) Alig (1986) Chapter 14 Hardie and Parks (1991) Zhang and Flick (2001) Romm et al. (1987) Greene and Blatner (1986) Royer (1987) deSteiguer (1984)
Occupation as farmer	No effect	Weak positive	Hyberg and Holthausen (1989) Binkley (1981) Boyd (1984) Dennis (1989) Romm et al. (1987)
Age	No effect	No studies	Romm et al. (1987) Zhang and Flick (2001)
Education	No studies	Mixed	Greene and Blatner (1986) Chapter 14 Dennis (1989) Binkley (1981) Boyd (1984)

As noted in table 3.2, income is the landowner characteristic that has been addressed most frequently and provides the most consistent results. In the utility model of NIPF behavior (Binkley 1981, Dennis 1989), income is hypothesized to have an ambiguous effect on harvesting and planting. The empirical studies, while not unanimous, indicate that higher income

landowners are more likely to reforest, but that the substitution effect of harvesting dominates the income effect, resulting in higher incomes leading to lower harvest probabilities.

Occupation as a farmer is not a distinct variable in the utility model, but farmers are often hypothesized to behave more as profit than utility maximizers, and thus to have a higher probability of harvesting. This was weakly confirmed by the studies we examined. The hypothesized effect on planting is ambiguous, and our survey found no empirical support for any differences between nonfarmers and farmers. Hardie and Parks (1991) used a theoretically elegant study to examine the effect of owner, market, and policy variables on the probability of reforestation. They found that household income, income as a farmer, and income as a forest resident were significant determinants of the probability of reforestation, lending very limited support the influence of farm occupation on management. Full- or part-time residence on the forest versus absentee landownership is often hypothesized to influence forest management. Romm et al. (1987) found that full-time residents had a higher probability of planting, and part-time residents had a lower probability.

Age has been included in only a few studies. Romm et al. (1987) found that older age reduced the probability of investment, but Zhang and Flick (2001) found that age had no influence on planting. Education has been shown to have a significant negative influence on harvesting. Hardie and Parks (1991) also found that having inherited a forest had a significant negative impact on reforestation probability.

One significant complication with the empirical results of the characteristics examined above is that there should be multicollinearity between education, age, occupation, and income. All of these characteristics, as well as residency status and estate circumstances, contribute to landowner wealth, and wealth may be a better indicator of forest management plans, but data are generally unobtainable. More complex treatments of landowner wealth may be necessary to address the influences on management behavior.

4. MARKETS

Markets for timber and other forest products are complex and often assumed to be imperfect. Timber sales generally entail high transactions costs for professional consulting fees, landowners' time, government agency administration, and timber buyer cruising and bidding. These costs range from as low as a few percentage points of the total value of the product sold to more than 20% of the total sale value. For local timber products such as fuelwood and poles, the transactions costs may largely involve time

collecting wood from state or community lands and perhaps paying a small fee for doing so. These markets for household use of forest products are less well defined than for industrial forest products (see chapter 15 for additional discussion of nontimber forest products).

The United States has fairly active markets for sawtimber products, but forest landowners may have few markets for their small-diameter pulpwood trees. With low timber values, transport costs may restrict sales to a local area. In many areas, only one or two timber buyers for any product operate within this range, while there may be many forest landowners. This oligopsonistic market structure may lead to some loss of efficiency in timber markets and thus lower prices and less production than would be the case if perfect competition existed.

Statistical tests of the influence of market factors on private forest management are numerous, although the findings are weak. Landowners, both industrial and NIPF, are hypothesized to increase both planting and harvesting in response to higher product prices. The joint nature of forest production, both the production of timber and amenities from the forest and the production of sawtimber and pulpwood from the timber, complicates this response. Investigators have devised numerous techniques to isolate the effects of prices on management, including application of principal components to develop a price index (chapter 14) and using a site-specific growing stock weighted price (chapter 4; Lee 1997, Prestemon and Wear 2000). Table 3.3 provides our general conclusions on the influence of market factors on private forest management and lists some key citations.

Landowners are hypothesized to increase both harvesting and planting when output prices (timber prices) increase. Other market factors addressed by various studies include reforestation cost, tract size, and the discount rate. Reforestation costs and the discount rate are considered the cost of inputs to the production of timber, and thus the higher these costs are, the lower the probability of planting and harvesting. Fixed costs associated with initiating harvests (see chapter 5) make costs per unit of output lower on larger tracts, and thus tract size is hypothesized to proxy for harvesting costs or possibly for amenities (Amacher et al. 1998, Newman and Wear 1993).

One potential concern is that most studies isolate the harvesting and planting decision, addressing only one of these clearly related decisions. An analysis by Newman and Wear (1993) jointly addressed these two forest management decisions and responses to output prices and input costs.

Overall, there is some support for increasing sawtimber prices leading to increased harvest. Pulpwood prices and the effect of sawtimber prices on planting are generally not significant (no effect). Some studies have found that industrial landowners are more price responsive, and one study (Newman and Wear 1993) found more responsiveness in the long run,

although statistical significance tests could not be conducted on these estimates. Newman and Wear also found that pulpwood and sawtimber appear to be substitutes in short-run production but complements in long-run production.

Table 3.3. Influence of market factors on private forest management

Market factor	General conclusion		Selected citations
	Planting	Harvesting	
Timber price	Limited price responsiveness for NIPF and industrial owners, not unanimous	More price responsiveness than planting	Alig (1986) Brooks (1985) Lee et al. (1992) Hyberg and Holthausen (1989) Dennis (1989) Newman and Wear (1993) Royer (1987) Lee (1997) Chapter 4 Chapter 14 Boyd (1984) Binkley (1981)
Reforestation cost	Negative, less conclusive for industrial owners	Mixed results	Hyberg and Holthausen (1989) Newman and Wear (1993) Royer (1987)
Discount rate	No effect, but not unanimous	Inadequate number of studies	Lee et al. (1992) deSteiguer (1984) Hyberg and Holthausen (1989)
Tract size	No effect	Generally no effect, not unanimous	Royer (1987) Hyberg and Holthausen (1989) Greene and Blatner (1986) Dennis (1989) Romm et al. (1987)
Amenity values	No studies	Negative	Chapter 14, Lee (1997), Chapter 4

Evidence suggests that increased reforestation costs lead to reduced reforestation. Results of the influence of input costs on harvesting are mixed. The discount rate is hypothesized to negatively influence planting. Empirical evidence is weak and contradictory. Prestemon and Wear (2000) estimated the probability of harvesting as a function of price change and calculated an

implied discount rate for both landowner groups, concluding that NIPF landowners have higher rates than industrial landowners.

Tract size was not found significant in empirical tests on the influence on planting or harvesting, although two studies provide limited support for the hypothesis that larger tracts are more likely to be harvested. Moulton and Birch (1995) found that an emphasis on commodity production was directly related to tract size.

5. POLICY IMPACTS

While markets are imperfect, they are the principal mechanism that allocates forest management and timber harvests throughout the world. Markets for other private goods produced from forests have more limitations than timber markets but remain the principal means of resource allocation. Markets will allocate forest land and timber and are usually considered reasonably efficient. However, perceived market imperfections such as imperfect competition (oligopsony), long waits for investment returns, and external costs (e.g., water pollution) or benefits (e.g., carbon storage) have led to government interventions in private timber production. Almost every country has some form of government education, research, subsidy, protection, or regulation for public and private forest lands (Cubbage and Haynes 1988).

Public policies can augment market incentives, but they do not supplant or negate market prices and mechanisms except in the rare instances of total government control and production of forest goods and services. Cooperation among landowners or forest producers, government subsidies or regulation, redefinition of property rights, controls on monopoly power or other market or government methods may be able to promote efficient and equitable outcomes for both buyers and sellers, as well as prevent negative externalities from adversely affecting other owners or the public.

Economists generally believe that forest regulations have an adverse effect on forestry investments, although landowner opposition to regulation is not universal, and little empirical work has substantiated investment effects (Johnson et al. 1997). Boyd and Hyde (1989) found no significant differences between reforestation levels in Virginia (with a regulatory seed tree law) and North Carolina (with no regulations but the largest state-funded cost-share program in the United States). This led them to conclude that regulation was not effective and has high administrative costs as well.

It has generally been presumed that forest industry manages its forest land for timber production in an economically rational manner and achieves reasonably good levels of productivity based on economic efficiency criteria.

Nonindustrial private forests, however, have been widely viewed as underproductive and subject to some criticism for not achieving their potential timber production capacity, thus prompting calls for public policy interventions. The means of influencing private landowners depends on the severity of the perceived difference between private market outcomes and public goals, the influence of interest groups seeking public policies to alter market outcomes, and the ability of governments to pay for public programs. Most studies have examined NIPF timber production policies, but more recently, forest stewardship and multiple use policies have been examined. Program participation has also been studied to attempt to determine if the programs are reaching the intended audience (table 3.4).

Table 3.4. Influence of forestry programs on private forest management

Forestry program	General conclusion		Selected citations
	Planting	Harvesting	
Knowledge of cost-share programs	Positive	Generally positive, not conclusive	Hyberg and Holthausen (1989) Royer (1987) Zhang and Flick (2001) Megalos (2000) Hardie and Parks (1991)
Knowledge of public technical assistance	Positive	Positive	Hyberg and Holthausen (1989) Royer (1987) Zhang and Flick (2001) Hardie and Parks (1991)
Regulation	Negative	No studies	Zhang and Flick (2001), Boyd and Hyde (1989)

Cost-share assistance directly influences planting but not harvesting. In contrast, most technical assistance is aimed at harvesting practices. Because of the simultaneity problem with receiving cost-share assistance and, to a smaller degree, technical assistance, many surveys ask if landowners had prior knowledge of these programs. The empirical results indicate that landowners with knowledge of these programs were more likely to plant and harvest than landowners who were unaware of these programs. One study (Lee et al. 1992) addressed only the non-cost-shared planting done by both landowner groups. Of the four programs evaluated (Soil Bank, Forestry Incentives, Conservation Reserve [CRP], and Agricultural Conservation), three had no influence on non-cost-shared acres, implying that (1) the

influence of the programs did not extend beyond the participants, and (2) the use of federal funding did not substitute for private funding for reforestation. The fourth program, CRP, had a positive influence on both NIPF and industrial planting, implying that there may be a positive externality beyond program participants.

The econometric models by Hardie and Parks (1991) indicated that the parameter for technical assistance by public foresters had the greatest positive magnitude by far and the highest level of statistical significance in predicting area reforested by private landowners. They also examined the interaction of technical assistance programs and state and federal cost-share programs. They concluded that cost-share programs and rates had a strong impact on reforestation performed in consultation with public forestry assistance, with 85% of the predicted acres regenerated being due to these programs. Changing the amount of publicly owned technical assistance was effective but did not produce the same magnitude of increase as the cost-share instruments.

Cabbage (2003) reviewed field surveys of harvested tracts to evaluate the effects of forestry assistance conducted in the 1980s. Cabbage reports that the studies consistently found that public forestry or consulting assistance increased net revenues from timber sales to forest landowners. In addition, prospective returns from future management were higher when technical assistance was used in the current harvest. Forestry assistance resulted in positive impacts on both revenues and residual stand quality (Cabbage 2003).

Several studies have examined program participation, primarily for the cost-share programs. English et al. (1997) found that higher income and lower costs led to increased participation. Nagubadi et al. (1996) found that higher age, larger size, and forest association membership led to increased participation. In contrast, Stevens et al. (1999) found that age reduced participation, but that income increased participation. Megalos (2000) and Lorenzo and Beard (1996) also found that owners of larger tracts and nonfarm owners were more likely to participate.

Esseks and Moulton (2000) performed a survey of NIPF owners, assessing their use of the Forest Stewardship Program (FSP) and Stewardship Incentives Program (SIP). These programs were initiated in the late 1990s and continue as part of the Forest Land Enhancement Program enacted as part of the 2002 Farm Bill. They provided cost-share assistance for a broad range of forest practices, including reforestation/afforestation, forest improvement, wildlife, forest stewardship plans, agroforestry, recreation, soil and water quality, riparian areas and wetlands, and fisheries. This broader subsidy program attracted many new persons to nontimber

forest practices. More than half of the active FSP landowners in the South (58%) had not previously received professional forestry advice.

More than 80% of all landowners had begun to carry out at least one management activity; 69% of the southern forest landowners had begun at least two management activities; and 44% had begun three or more activities. Nationwide, 25% of SIP participants performed reforestation; 44% performed forest improvement; 11% established wildlife practices; 3% had agroforestry practices; 6% had recreation practices; and 10% had soil and water practices. Less than 1% of the area involved riparian or fisheries practices. These statistics indicate that subsidies can be effective at inducing a wide range of multiple-use forest practices. Landowners in the South remain more utilitarian than the rest of the United States but are still quite amenable to enrolling in nontimber forest management practices.

6. CONCLUSIONS

Timber production by private forest landowners is the classic forestry case of supply and demand in private markets. Owners of private forests in most developed countries own both the land and the timber that grows on that land. Privately owned timber is generally sold in markets, either as stumpage for individual stands, prices for individual logs, concessions for large forest areas, or as transfer prices between divisions of vertically integrated firms.

Economic studies of NIPF forest management (reforestation) and timber harvesting provide excellent examples of the power of economics and econometric analyses. Timber harvesting decisions are not always influenced by the same factors as reforestation. Owner income had a positive influence on reforestation probability but a negative effect on harvesting probability. Farming as an occupation, level of education, and tract size usually were found not to influence tree planting but positively influenced timber harvesting. Timber prices were only moderately effective at influencing tree planting but almost always influenced timber harvesting. Public policy interventions—subsidies and technical assistance—were usually the largest factors influencing reforestation, and technical assistance was important in timber harvesting decisions.

In two explicit studies that have been performed in the United States, regulations have been found to discourage timber investments by NIPFs. Those studies were narrowly construed, but the results are not surprising. Regulation is almost by definition meant to alter free market outcomes in order to protect nonmarket values, so some efficiency loss should be expected. Economic analyses can assess and compare the efficiency losses to

the environmental benefits. Nontimber forest values are becoming more important to NIPFs and demonstrably reduce timber production. Subsidies encourage NIPF landowners to enroll in a broader set of multiple use forestry practices.

These research findings can help analysts, planners, and policy makers decide when markets will achieve desired forest management outcomes, when policy interventions will be required to achieve outcomes different than those prompted by markets, and the magnitude of the public investment required to achieve new program goals.

In a market system, private forest landowners will produce timber to maximize profits or will maximize the utility of the bundle of all goods and services on their forests. Subsequent chapters in this book expand the set of economics tools for analyzing both timber and nontimber forest products and nonmarket forest goods and services. Theoretically sound and technically accurate analyses of the values of all these goods and services from forests can help us better allocate scarce resources.

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