

# Forest Parcelization in the United States

## A Study of Contributing Factors

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### ABSTRACT

Over the past few decades, the number of nonindustrial private forest landowners in the United States has been increasing while the average size of parcels has been decreasing. This trend is often referred to as forest parcelization. This article reviews the causes of parcelization suggested in the existing literature and attempts to provide some empirical evidence concerning their validity. Death, urbanization, income, regulatory uncertainty, and financial assistance for landowners are found to have significant impacts on the change in average parcel size in the United States.

**Keywords:** fragmentation; nonindustrial private forest landowners; parcelization; policy

An estimated 393 million acres of forests in the United States are privately owned. About 59 percent of all private owners are individuals who are known as nonindustrial private forest (NIPF) landowners (Birch 1996). NIPF lands currently supply about half the country's roundwood timber supply, and this number is expected to rise to about 60 percent by the year 2030 (Harrell 1989). Because timber supply from public forests has dropped significantly and demand is rising, NIPF lands are under increasing pressure.

Studies have found that timber supply has a positive relationship with holding size (e.g., Binkley 1981; Greene and Blatner 1986; Romm et al. 1987). However, the average parcel size has been steadily declining and the number of forest landowners has been increasing since the early 1900s (DeCoster 1998). In more recent years, forest ownership has grown 1.6 times faster than the population, and most of this increase has been in the owner-

ship of parcels of less than 100 acres. If present trends continue, by the year 2010 about 95 percent of the nation's private forest ownership will be in parcels of less than 100 acres (DeCoster 1998). This general shift from a few landowners with large holdings to many landowners with smaller holdings is known as parcelization, and it can have a significant impact on timber supplies. Increases in harvesting and transaction costs, and the diversity of landowner objectives and attitudes toward forest management, all contribute to this impact.

This article explores the magnitude and importance of factors influencing forest parcelization in the United States. The terms parcelization and fragmentation often have been used interchangeably. But fragmentation stems from the concept of "island biogeography" first introduced by MacArthur and Wilson in 1967 (Luloff et al. 2000). It refers to forest habitats becoming isolated islands across the landscape. Although differ-

ent, these two concepts are closely related. For example, as the number of landowners increases, landowners' attitude and objectives become more diverse. Some landowners may convert their forestlands to other uses, which leads to forest fragmentation.

### Hypothesized Causes of Parcelization

In the literature, the causes of parcelization (and fragmentation, as the distinction was not made until recently) can be divided into two groups: supply and demand. On the supply side, the drivers are death, taxes, and uncertainty (DeCoster 1998). The effect of death on parcelization is often twofold: (1) When the original owner dies, the land may be divided among the heirs and (2) part or all of the land may be sold to pay estate and inheritance taxes. Forestlands also are subject to property taxes, and if the tax rate exceeds or approaches the appreciation in forest value, the landowner may find it more profitable to put part or all of the land to a higher-valued use (Argow 1996). Increased uncertainty about owning forestland because of environmental regulation is another important factor. Insecurity about property rights has been linked to decreases in productivity (Zhang 1997, 1999) and loss in

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**Right:** By the year 2010, nearly 95 percent of private forest ownership will be in parcels of less than 100 acres.



Todd Fuller

## Calculation of the Dependent Variable

To obtain a measure for parcelization, we calculated the change of average NIPF parcel size between 1978 and 1994. For each state, landowners were aggregated into six parcel size classes: 1–9, 10–49, 50–99, 100–499, 500–999, and more than 1,000 acres. Medians for these classes were 5, 30, 75, 300, 750, and 1,000 acres, respectively. Using these medians and the number of landowners in each size class, the weighted parcel size average was calculated as follows.

$$\text{Weighted size average} = [(5*n_1) + (30*n_2) + (75*n_3) + (300*n_4) + (750*n_5) + (1000*n_6)]/N$$

where  $n_1, n_2, \dots, n_6$  are the number of landowners in each size group, and  $N$  is the total number of NIPF landowners in the state. The dependent variable was then obtained by subtracting the 1994 value from that of 1978. This procedure ensures that most dependent variables are positive (as average parcel size decreased in most of the states) and thus avoids possible confusion in explaining the results.

forestland value (Zhang, in press), but never to parcelization. However, some NIPF owners are weary of current and anticipated land-use regulations (Louisiana SAF Policy and Legislative Committee 1996; Rose and Coate 2000). This increased insecurity may make investment in forestland appear unattractive, thus contributing to fragmentation.

On the demand side are lifestyle and urbanization. To live in or around the woods appears to be a growing lifestyle trend (DeCoster 1998), and this encourages the sale of forests to be used for residential purposes. Barlow et al. (1998) and Befort et al. (1988) have documented the effects of urbanization on land-use patterns, and other studies have also found the impacts of urbanization to be significant (e.g., DeForest et al. 1991; Shands 1991; Harris and DeForest 1993).

Despite its importance, the issue of parcelization has never been explored empirically. Our study is a first attempt to empirically investigate the significance and magnitude of all these causes identified in the literature. However, our efforts were marred with difficulties from the lack of appropriate data. For example, although inheritance and property taxes have been identified as a driving force behind fragmentation and parcelization, state-level inheritance and property tax data for forest

properties are nonexistent. Perhaps the availability of data in the future will facilitate further research. In the meantime, our study used a proxy to represent taxes. In addition, the 1978 data on NIPF landowners are not as strong as those of 1994; for some states, the 1978 survey used a smaller sample size, resulting in relatively weaker data compared to 1994 (Birch 1996).

### Empirical Model

We assumed a linear relationship between the change in average parcel size in each state (except Alaska, which was excluded from our data set) and a group of variables representing the causes of parcelization. The independent variables include the five causes of parcelization and fragmentation documented in the literature: death, taxes, income, uncertainty, and urbanization. In addition, we decided to test the significance of two other factors, timber market and state support of NIPF landowners. These two factors, although not identified in the literature, may have significant impacts on parcelization.

Our data set features 49 observations spanning the years 1978 to 1994. For the dependent variable, the weighted average of parcel size is calculated for each state. Then, the change in average parcel size is calculated by obtaining the difference between the

values for 1978 and 1994. The resulting number for each state serves as our dependent variable (see "Calculation of the Dependent Variable").

Most of the independent variables are measured as changes as well, obtained simply by subtracting the 1978 value from that of 1994. The first independent variable measures the change in death rate per thousand people in each state. Because an increase in death rate raises the likelihood of parcelization, we expect this variable to have a positive relationship with change in average parcel size.

The second variable captures the impact of taxes on parcelization. It is measured as the collection of estate and inheritance taxes per NIPF acre in a state. The data for this variable contains taxes collected on all types of properties and assets, not just forest properties. Because data on estate and inheritance taxes collected from forest properties are not available, we use this variable to capture possible impacts of both estate and inheritance taxes. State-level property tax data on forest parcels are also nonexistent. At the beginning of this study, we considered using the change in property tax rate for farmland, but later decided against it because taxation on farmland is significantly different from that on forestland. Estate taxes also have an obvious connection to death. Although we include a separate variable to capture the impacts of death, the tax variable may capture some of the impacts as well. We expect the tax variable to have a positive sign.

The third variable represents the change in the percent of urban population. This variable is included to capture the impacts of the general trend of urbanization and possible change in lifestyle in the nation. Because urbanization is likely to increase both fragmentation and parcelization (Befort et al. 1988), we expect this variable to be positive.

The income variable represents the change in median family income (in real 1989 dollars) between 1969 and 1989. A higher income makes lifestyle changes affordable, enabling people to purchase bigger houses away from cities. This may eventually contribute

to fragmentation, so we expect the income variable to have a positive sign.

The impact of uncertainty is captured by a variable that represents the change in the environmental voting scores assigned to each state's representatives to the federal legislatures by the League of Conservation Voters (LCV). The scoring is between 0 and 100, with 100 being the most "environment friendly" voting record. Because a legislator's voting behavior represents, at least in part, his or her constituents' interests, the higher the score the more sympathetic the constituents are to environmental causes. Because this may increase the likelihood of stringent environmental regulations in these particular states, landowners in these states may perceive land-use investments as risky. Therefore, as a state's environmental friendliness increases, risk and uncertainty associated with forestry operations may also increase, which in turn may encourage some landowners to sell all or part of their land and invest in other assets. The variable is therefore expected to be positive.

A variable that represents the change in the contribution of forest industries in gross state products is also included in the model. If the forestry sector is not important to a state's economy, the number of forest industries in the state will be small, making the timber market less active. The absence of a well-developed marketing channel may provide an incentive for landowners to use their land for purposes other than forestry. A reduction in the contribution of the forestry sector is expected to reduce average parcel size.

The final variable in the model is a binary dummy (meaning the variable can only take the value of 0 or 1) that represents the presence of a cost-share program in a state. Financial support for landowners could have some positive effect on forest management (Bliss and Martin 1990; Lee et al. 1992; Zhang and Flick, in press) and might prevent delays in reforestation (Bullard and Straka 1988) as it enhances forest landowners' financial returns. An absence of funds may give landowners an incentive to put the land to higher-valued uses such as commercial develop-

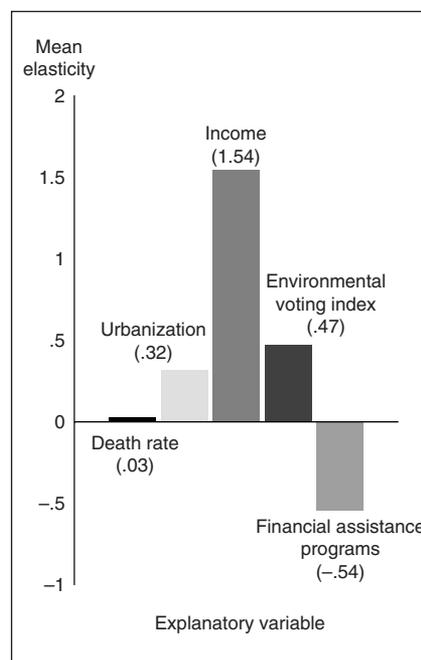
ment, thereby increasing fragmentation. We therefore expect this variable to have a negative sign.

## Results

The model is estimated by the ordinary least square (OLS) method (see "The Regression Model," p. 34). The  $f$ -test on the model is significant at the 1 percent level. The  $r$ -squared value for the model is 0.58, which means that the explanatory variables explain about 58 percent of the variations in the dependent variable. All of the independent variables show the expected relationship with the dependent variable. Urban population, income, environmental voting index, and the cost-share program variables are positive and significant at the 5 percent level. The death rate variable is also positive as expected, and significant at the 10 percent level. The variables representing taxes and the forest industries are not significant.

The significance of the death rate variable is consistent with the literature in that death is one of the major driving forces behind fragmentation and parcelization (DeCoster 1998). Barring large measurement errors, the insignificance of the tax variable implies that estate and inheritance taxes do not have a significant impact on parcelization. However, this result should be considered with caution since we used a proxy that is not specific to forest properties. The significance of the change in the percent of urban population is also consistent with the claims in the literature that urbanization inspires changes in land-use patterns (Befort et al. 1988). Estimates for the income variable, on the other hand, imply that an increase in family income contributes to parcelization. A higher income increases purchasing power, which enables people to afford lifestyle changes. Hence, this variable captures the impacts of changes in lifestyle trends and, to some extent, urbanization.

The environmental voting index variable comes out as significant, implying that landowners in states with environmentally friendly constituents may perceive investment in forestland as more risky because of the likelihood



**Figure 1. Representation of elasticities for significant explanatory variables.**

of stringent land-use regulations. The insignificance of the forest industries variable implies that the hypothesis of a negative relationship between a strong timber market and parcelization cannot be accepted. The dummy variable representing the presence of cost-share programs is also significant, implying that cost-share programs may restrict parcelization or fragmentation or that they at least may slow down the process. This may have important policy implications.

To represent the impacts of the significant explanatory variables, elasticities at the mean of variables are calculated and presented in figure 1. Because elasticities are free from units, the impacts of different variables can be compared to one another effectively. The income variable comes out to be the most elastic, with a value of 1.54. Financial assistance programs are next with an elasticity of  $-0.54$ . The environmental voting index and urbanization have modest elasticities of 0.47 and 0.32, respectively, and the death rate has an elasticity of 0.03. Comparing these values, we can conclude that the income variable has about three times as much impact as do financial assistance programs and uncertainty, and almost five times as much impact as does urbanization.

## The Regression Model

The estimated regression model is as follows.

$$\text{INDEX} = f(\text{DEATH}, \text{ETAX}, \text{URBAN}, \text{INCOME}, \text{LCV}, \text{FORGSP}, \text{CSP})$$

INDEX is our dependent variable measured as the change in average parcel size. DEATH is the change in death rate, ETAX is the proxy for estate and inheritance taxes, URBAN is the change in the percent of urban population, INCOME is the change in median family income, LCV is the change in environmental voting scores, FORGSP is the contribution of the forestry sector in gross state product, and CSP indicates whether or not the state has a cost-share program.

### Conclusions and Discussion

The results of this study show that death, urbanization, income, regulatory uncertainty, and financial assistance for landowners are found to have significant impacts on the change in average parcel size in the United States. These results may have important policy implications. First, not much can be done from a policy standpoint about rising income and increasing urbanization, and only careful planning at the local level may help slow down the parcelization process.

Second, financial assistance programs, such as cost-sharing, also seem to have a significant impact on parcelization; cost-share programs could be used as a policy tool to slow down parcelization. This variable also has the second-largest elasticity. Cost-share programs, although controversial, may have two impacts: (1) They may cause landowners who did not originally intend to actively manage their land to do so, and (2) by increasing the return of forestry investment, these programs may help retain some land for forestry that may otherwise have been lost to other uses.

Finally, regulatory uncertainty associated with owning forestland also has a significant impact. Owning a piece of forest is a substantial investment. Because of restrictions on forest management brought about by regulations, forestry may become a less-attractive investment. This is especially true for landowners who intend to manage their land for wood products. If we are

to meet the nation's wood fiber demands, we must find a way to make forestry-related regulation less onerous and to attract and retain these landowners.

Forest fragmentation and parcelization are important issues in the nation's forest policy. Considering current trends, their importance is likely to intensify (DeCoster 1998). However, in sharp contrast to their importance, studies on these issues are rare. Further research on the process of parcelization—its causes and consequences—will help policymakers understand the process so they can alleviate the problems associated with it.

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