

PRIVATE FOREST OWNERS IN ALABAMA: PROFILES AND HOLDING
SIZE DISTRIBUTION

Except where the reference is made to the work of others, the work described in this thesis is my own or was done in collaboration with my advisory committee.
This thesis does not include proprietary or classified information.

Yi Pan

Certificate of Approval:

Larry Teeter
Professor
School of Forestry and Wildlife Sciences

Yaoqi Zhang, Chair
Assistant Professor
School of Forestry and Wildlife Sciences

Daowei Zhang
Professor
School of Forestry and Wildlife Sciences

Stephen L. McFarland
Dean
Graduate School

PRIVATE FOREST OWNERS IN ALABAMA: PROFILES AND HOLDING
SIZE DISTRIBUTION

Yi Pan

A Thesis

Submitted to

the Graduate Faculty of

Auburn University

in Partial Fulfillment of the

Requirements for the

Degree of

Master of Science

Auburn, Alabama
May 11, 2006

PRIVATE FOREST OWNERS IN ALABAMA: PROFILES AND HOLDING
SIZE DISTRIBUTION

Yi Pan

Permission is granted to Auburn University to make copies of this thesis at its discretion,
upon the request of individuals or institutions and at their expense.
The author reserves all publication rights.

Signature of Author

Date of Graduation

VITA

Yi Pan, daughter of Zhaonian Pan and Ying Zhang, was born on March 6, 1982, in Nanjing, Jiangsu Province, the People's Republic of China. She graduated from Nanjing University in 2004 with a Bachelor of Arts degree in Economics. She entered the Graduate School, Auburn University in August 2004, specializing in Forest Economics. She married Feng Chen, son of Shouju Chen and Shuxia Liu, on November 23, 2004 at Auburn.

THESIS ABSTRACT

PRIVATE FOREST OWNERS IN ALABAMA: PROFILES AND HOLDING
SIZE DISTRIBUTION

Yi Pan

Master of Science, May 11, 2006
(B.S., Nanjing University, 2004)

81 typed pages

Directed by Yaoqi Zhang

A large portion of forestland in Alabama is privately owned. Thus private forest owners in Alabama play an important role in producing timber, providing forest recreation, protecting biodiversity, etc. Two studies regarding private forest ownership in Alabama are included in this thesis.

The first study is about family forest owners which are a critical component of Alabama private forest owners. We used data of family forest owners in 1993 and 2002-2004 from the National Woodland Owner Surveys (NWOS) conducted by the USDA Forest Service's Forest Inventory and Analysis program (Birch 1996; Butler et al. 2005) to investigate changes in family forest ownership within the last decade. The results suggest that, compared to a decade ago, in general the owners are more educated and many family forest owners with smaller landholdings are younger even though owners with larger holdings are getting older. Their objectives for owning forestland are

diversified and dynamic, but the importance of amenity values, legacy, recreation and the land as an investment are increasing. Examining the management activities of family forest owners, 85% of the family forestland is owned by people who have harvested trees, 28% of the family forestland is owned by people who have a written forest management plan, and 50% of the family forestland is owned by people who have sought forest management advice.

The second study is a detailed analysis which focuses on private timberland ownership distribution in 55 counties (data of other 12 counties are not available) in Alabama. Four different measures were employed to measure forestland distribution and the correspondingly estimated regression result suggests that the percentage of old population and rural population play an important role in forestland ownership distribution. Meanwhile, greater per capita income, higher percent of population below poverty and higher percent of forest cover tend to result in land consolidation while higher educational attainment denotes a tendency to resist forestland consolidation. Furthermore, population density, share of African-American population and average land quality index are not statistically significant in any of the four models.

ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my advisor, Dr. Yaoqi Zhang, for his patient, friendly, and unfailing support over the past two years. He provided constant guidance and timely help that enabled me to complete my program of study.

I would also like to thank my committee members, Dr. Daowei Zhang and Dr. Larry Teeter, for their critical suggestions. Appreciation is also due to Dr. Brett Butler for his help in the first part of my thesis. I also thank Mr. Paul Holm for revising the language for my whole thesis. I would like to appreciate Dr. Yanshu Li for sharing her precious research experience with me, which means a lot to me. Appreciation is also extended to Dr. Glenn Glover and Dr. Venkatarao Nagubadi who gave me great help in data collection. I also would appreciate the financial support from Center for Sustainable Forestry and Forest Policy Center at Auburn University; McIntire-Stennis Program of USDA and AU Competitiveness Research Grants.

Finally, I am indebted to my parents for encouraging me to pursue this degree, and supporting me every step along the way. I also sincerely appreciate the unconditional support from my parents in law. My husband, Feng Chen, a man of great patience and kindness, deserves my deepest thanks. The encouragement and support he gives me make this thesis as much his as it is mine.

Style manual or journal used: Journal of Forestry

Computer software used: Word and Excel for Windows XP Version XP, SAS 8.2,

Limdep 8.0.

TABLE OF CONTENTS

LIST OF FIGURES.....	xi
LIST OF TABLES.....	xiii
I. INTRODUCTION.....	1
II. ARE ALABAMA’S FAMILY FOREST OWNERS CHANGING.....	3
INTRODUCTION.....	3
DATA AND METHODS.....	8
RESULTS.....	10
HOLDING AND TRACKING SIZE.....	10
DEMOGRAPHIC CHARACTERISTICS.....	12
OBJECTIVES FOR OWNING FORESTLAND	14
FUTURE INTENTIONS.....	15
FOREST MANAGEMENT DECISIONS	16
CONCLUSION AND DISCUSSIONS.....	18
III. PRIVATE FORESTLAND OWNERSHIP DISTRIBUTION IN ALABAMA:	
PARCELIZATION OR CONSOLIDATION.....	21
INTRODUCTION.....	21
LITERATURE REVIEW	24
METHODS.....	30
DATA.....	30

DISTRIBUTION OF FORESTLAND HOLDING SIZE.....	34
MODEL SPECIFICATION.....	37
RESULTS.....	39
CONCLUSIONS.....	42
IV. SUMMARY.....	44
V. REFERENCES.....	46
VI. FIGURES AND TABLES.....	53

LIST OF FIGURES

Figure 2.1 a). The age of family forest owner in Alabama based on ownership.....	54
Figure 2.1 b). The age of family forest owner in Alabama based on area.....	54
Figure 2.2. Education level of the family forestland owners	55
Figure 2.3 a). Ownership objectives of the family forestland owners in Alabama by ownership	56
Figure 2.3 b). Ownership objectives of the family forestland owners in Alabama by area.....	56
Figure 2.4. Future Intention of the family forestland in 2004.....	57
Figure 2.5a). Timber harvesting rate reported, 1994 and 2004.....	58
Figure 2.5b). Percentage of written management plan, 1994, 2004.....	58
Figure 2.5c). Percentage of management advices received, 1994, 2004... ..	58
Figure 2.6. Mean of holding size and the year of land acquisition in Alabama	59
Figure 3.1. Frequency of owners by holding size in Escambia and Etowah	60

Figure 3.2 Percentage of total acres by holding size in Escambia
and Etowah County..... 61

Figure 3.3 Lorenz curve for forestland distribution.....62

Figure 3.4 Gini coefficient of forestland distribution in 55 counties in Alabama.....63

LIST OF TABLES

Table 2.1. Forestland area in Alabama by ownership, 2004.	64
Table 2.2. Area and number of family owned forests by size of landholdings, 1978, 1994,2004.....	65
Table 2.3.Holding sizes with age, income, land tenure and harvests (ANOVA).....	66
Table 3.1.Summary Statistics and Description of Dependent and Independent Variables.....	67
Table 3.2. Regression results on factors that influence forestland holding and distribution.....	68

I. INTRODUCTION

Forests are a valuable resource. The entire forest ecosystem provides the basis for biological diversity, natural communities, wildlife habitats, scenic landscapes and recreational opportunities. There are an estimated 620 million acres of forestland in the coterminous United States (Smith et al., 2004). Over 63 percent of the total forestland in the coterminous United States is privately owned. This number jumps up to 94 percent in Alabama.

Privately owned forest land contributes significantly to the state and local economy and to tourism and outdoor recreation. Private owners include forest industry companies, other businesses or corporations, partnerships, tribes, families, and individuals (Butler and Leatherberry 2004). Primarily private ownership defines the unique character of Alabama's forestland ownership profiles. There are diversified studies focusing on private ownership within Alabama. Some previous studies concerned the demographic characteristics, motivations of owning forestland, and the management behaviors of Non-industrial private forest owners in Alabama. Other researchers were more interested in the private ownership distribution and possible ownership fragmentation and concentration in Alabama (Bliss et al., 1998; Sisock 1998).

Our study can be divided into two parts. In the first part, we are interested in family forest ownership which is a smaller but core subset of non-industrial private forest

ownership. There are an estimated 432,000 family forest owners in Alabama who now control 67% of the State's forestland. The composition and characteristics of these family forest owners have changed substantially over the past decade and will continue to change. The data used in this analysis were collected in 1993 and 2002-2004 as part of the National Woodland Owner Surveys (NWOS) conducted by the USDA Forest Service's Forest Inventory and Analysis program (Birch 1996; Butler et al. 2005). Two objectives are expected to be achieved: (1) the investigation of how the Alabama family forest owners have changed in the past decade (2) obtainment of information about their diversity in terms of demographic characteristics and management planning among the different holding sizes.

In the second study, we are more interested in the holding size distribution of private forest ownership. America's private forest lands are held by almost 10 million owners, the vast majority of whom hold less than 5 acres (Sampson 2000). Studies and surveys conclude that forest ownership parcelization is occurring at national wide as indicated by a dramatic increase in the number of ownerships and decrease in the average holding size. Most studies neglect the important issue of structural changes and regional differences, since analyzing the average holding size is not sufficient to help us understand the structural change and the driving forces of the change in distribution of forestland holding size. We are using the data of private forestland ownership in 55 counties of Alabama and four different measures to describe the ownership distribution numerically and graphically. Furthermore, a simple regression will be conducted to find the possible associated factors affecting such distribution.

II. ARE ALABAMA'S FAMILY FOREST OWNERS CHANGING?

Introduction

“Family forest” is a term introduced by forest owner associations in Europe in the mid 1990s. It is a substitute for terms such as “private woodlots’ and “non-industrial private forests”. There are three qualities to distinguish family forest ownership from other types of forest ownership: (1) Ownership is private, not public; (2) Forest area is relatively small and forest management techniques are often “small-scale”; (3) The forestry-related business is normally a stand-alone operation and is not associated with a timber processing facility (Demarsh et al. 2004). Based on these characteristics, family forest owners have diverse backgrounds and experiences. They also have various reasons for owning the forestland as well as a wide range of management objectives. To fully understand the forests and the forces that affect them, we need to know the families and individuals who own them. Knowing current status and historical change of family forest owners provides valuable information for policy makers, foresters, and all individuals and groups interested in understanding and interacting with family forest owners.

Family forest owners are changing dynamically. The number of family forest owners in the contiguous United States increased from 9.3 million in 1993 to 10.3 million in 2003, and these owners now control 42% of the nation's forestland (Butler and

Leatherberry 2004). Nationally, family forest owners were found to be well educated, older people who owned less than 50 acres of forestland with enjoyment of the forest's beauty/scenery a primary ownership objective. Nationwide the holding size tends to be smaller in the North than in the South and West. The proportion of owners with second homes is greater in the West and the North than in the South. Regarding the motivation of owning the land, aesthetic enjoyment is cited more frequently in the North and West than in the South, while 41% of the family forestland in the South is owned by people who indicate that timber production is an important reason, compared to 22% and 18% in the North and West, respectively (Butler and Leatherberry 2004). Although Butler and Leatherberry provided a good summary of the nation wide family forest owners, some states may differ from the national trend, like the differences among the three regions in the United States. Hence, it is important to examine state level forest ownership patterns.

We focused our study on Alabama. It is the fifth most forested state in the United States (Smith et al. 2004) and may represent the general situation in the southern United States. Alabama's forests contain biologically diverse natural communities, provide ecosystem services such as watershed and air quality protection, and have significant cultural, recreational, economic, and spiritual values. There are 23 million acres of forestland in Alabama, accounting for 71% of the total land area of the State (Hartsell and Brown 2002). The vast majority (94% or 22 million acres) of the State's forestland is privately owned and family forest owners control 67% of the State's forestland (Table 2.1). Northern Alabama supports a large number of owners with small average holding sizes and southern Alabama supports a smaller number of owners with larger average holdings.

Somberg (1971) is among the earliest investigators to characterize the private non-industrial forest owners in Alabama. In his study, the private non-industrial forest (NIPF) owner was defined as a landowner who had at least 20 acres of forestland regardless of how much non-forested land he or she may have owned. All industrial, State, Federal, and municipal ownerships were excluded. He summarized that the “average” forestland owner in Alabama with 20 acres or more of forestland was a white male who owned, on average, 717 acres of land, of which 437 acres were forested. The typical or average owner was 58 years of age and was a farmer with a high school education. He was raised on a farm and lived on his property. He purchased most of his property and has held it for an average of 24 years.

In 1992, an Alabama Agricultural Experiment Station survey of more than 700 forest owners in the State revealed that income from timber sales, keeping land in the family, and appreciation of the forest’s aesthetics were the three primary benefits gained from owning timberland (Bliss 1992). This study found that for NIPF owners in Alabama, approximately 40% were 65 years or older, while only about 2% were less than 35 years old and 40% of NIPF owners had completed at least 16 years of formal education. About 25% of the respondents cited income from timber sales as the primary benefit of ownership, an additional 14% said the primary benefit they receive was “beauty or land appreciation.”

Nix (1996), based on data from the 1994 National Woodland Owner Survey (see Birch 1996), found that the 445,500 forest owners in Alabama made up approximately 9% of the South’s 4.9 million owners and the 20.8 million acres of forestland they owned comprised 11% of the South’s forestland. Although a greater percentage of forest owners

owned small tracts, 78% of Alabama's forest acreage was held by owners with 50 or more acres. The study also indicated that most owners of forestland in Alabama were either white-collar professionals or older retired persons. This professional/retiree group comprised 67% of forest ownerships. Twenty-seven percent of Alabama's forestland was owned by people over 65 years old; 59% of the forestland was owned by people over 55 years old.

The "Southern Forest Resource Assessment" (Wear and Geris 2002) examined attitudes and values of southern residents toward forests and their management. In chapter 7, a variety of individuals were sampled to explore trends between forestry related topics and area of residence, age, residency, ownership, gender and race. The research found Southerners confirmed that environmental benefits from forests are valued higher than commodity benefits. Wood as a production commodity was rated the least important of four values (wood products, clean air, scenic beauty, and heritage) associated with forests (Tarrant et al., 2002).

Measells et al. (2005), from a survey to investigate the forestland owner characteristics in Arkansas, Louisiana, Mississippi and Tennessee, found that the mean age of forest owners in these states was 61; 49 percent of landowners reported having a college degree; only 6% received less than a high school education. They also found that small landowners tend to own forestland for amenity values, whereas larger landowners place a greater value on timber production.

Along with the similar research objectives of previous investigations, we wanted to know how the Alabama family forest owners have changed in the past decade, and obtain information about their diversity in terms of demographic characteristics and

management planning among the different holding sizes. These issues are important not only in forecasting future timber supply and environmental services, but also assisting family owners in their forest management. In the following sections, we will briefly introduce the data we used for the analysis, then present our results. Finally, we will end with our conclusions and discussion.

Data and Methods

The data used in this analysis were collected in 1994 and 2002-2004 as part of the National Woodland Owner Surveys (NWOS) conducted by the USDA Forest Service's Forest Inventory and Analysis program (Birch 1996; Butler et al. 2005). The NWOS is the nation's census of forest owners. On a recurring basis, it contacts a random set of forest owners from across the United States to ascertain information about their forestland, ownership objectives, forest use, forest management practices, sources of information, concerns and issues, and demographics. At a random set of sample points across the United States, the NWOS uses remotely sensed imagery to ascertain if sample points are forested. For the forested points, ownership information is collected from tax offices or other public sources. This information is used to contact the forest owners using a mixed-method survey; a self-administered mail survey is the primary data collection method and telephone interviews are used to increase response rates. Detailed information on data collection and processing procedures are described in Butler et al. (2005).

In Alabama, 329 family forest owners responded to the NWOS in the 1994 survey and 262 responded between 2002 and 2004 (response rates of 59% and 56%, respectively). The NWOS covers all private landowners, but results pertaining to corporations, partnerships, tribes, and other non-family organizations were excluded so

that the trends in family forests can be highlighted.

The methods which are employed in this study are basic statistical descriptions. Tables and figures that are generated in excel will be used to compare the differences between the two decades. Furthermore, we conduct an analysis of variance (ANOVA) to investigate the characteristics of family forest owners with different holding sizes.

Result

Rather than simply reporting survey results, we are most interested in discussing changes in holding sizes, demographic characteristics, and forest management decisions and objectives.

Holding and Track Size

Table 2.2 shows the areas and numbers of family owned forests in Alabama by size of forestland holdings in 1978, 1994 and 2004. Note that the definition of data in 1978 is slightly different from the other studies. The 1978 statistics pertain to all private owners, including industrial forest owners, although the term non-industrial private forest owners is used in their paper (Rosson and Doolittle 1987). Regarding the ownership type in 1994, the term “individual” used by Birch (1996) is synonymous with the term "family and individual" in the 2004 data.

Between 1978 and 1994, the percentage of forestland in holdings larger than 1000 acres decreased from 41% to 23% (Table 2.2). In 1994 there were an estimated 675,000 acres of forestland in holdings less than 10 acres and in 2004 there were an estimated 996,000 acres. Although the number of acres of forestland in this category increased significantly, the number of owners between the two periods decreased. This observation

may be related to the probability proportional to size sample design of the National Woodland Owner Survey (Butler et al. 2005); this sampling design leads to large sampling errors on numbers of owners with relatively small land holding sizes. More precisely, we'll look at forestland holdings less than 50 acres. We find that the average holding size for that group decreased 5%, which may indicate forestland parcelization.

Along with parcelization, there was evidence for consolidation in our findings. From 1994 to 2004, the total area of forestland in holding larger than 1000 acres increased by 1 million acres (Table 2.2), while the number of owners didn't significantly differ. This phenomenon of coexisting timberland parcelization and consolidation is consistent with the argument in Zhang et al. (2005).

From the mean tract size calculated, we find a decrease from 223 acres to 183 acres within the last 10 years based on the sampling data. This is an indication that forestland parcelization (often called fragmentation) may be occurring in Alabama. Parcelization is the process of breaking-up larger, contiguous forest holdings into smaller holdings. The growing and expanding human population is placing pressure on forest owners and this can lead to forest parcelization and threaten the integrity, traditional values, and uses of many privately owned, working forests. Forest parcelization may lead to forest fragmentation – a reduction in the area of contiguous forest.

Demographic characteristics

Our results indicate that Alabama's family forest owners are, on average, younger and more educated than they were a decade ago. In contrast to the 60 year average age of family forest owners at the national level (Butler and Leatherhead 2004), the average age of Alabama's family forest owners is 48 years. Individuals 65 years and older own more than 45% of the Alabama's family forest acres—nearly 7 million acres. At the other age extreme, individuals under 35 years old own less than 0.2 million acres (1.4 % of the forestland), and the number of owners under 35 years old consists of <1% percent of the forest owners.

The average age changes are misleading if we do not pay attention to structural change. This is very much due to the dramatic increase of the number of family forest owners from 0.1 million to 0.21 million who are between 45 and 54 years old, but total forestland under their control did not increase significantly, indicating that people in this age group have, on average, smaller forest holdings. In contrast, the number of owners older than 65 years decreased but their holding land increased from 4.9 million acres to 6.9 million acres. Thus the average holding size for individuals 65 years old or over increased considerably during the last decade.

To further investigate the characteristics of family forest owners with different holding sizes, especially owners with smaller holdings, we conducted an analysis of

variance (ANOVA), a statistical methodology for comparing several means (Moore and McCabe 2003). We divided forest owners into three groups which are: owners who hold less than 10 acres of forestland, owners whose holdings are from 10 acres to 200 acres, and owners who hold more than 200 acres of forestland.

By using the ANOVA method, we found that people with larger forest holdings tended to be older; this pattern was true for both the 1994 and 2004 data (Table 2.3). For example, in 2004, the mean age of owners whose holdings were less than 10 acres was 56 years and 42% were retirees, but the numbers increased to 64 years and 79% in holdings of 10 to 200 acres, and 65 years and 71% for holdings larger than 200 acres. The interesting point is that the means in the three groups are not significantly different (rate of retiree hasn't been listed in the ANOVA table). That indicates that age doesn't have a strong relation with the size of forest holdings. Also, the analysis indicated that forest owners with larger forest holdings were more likely to harvest when they rated timber production as a more important ownership objective.

Annual income is another important demographic characteristic of family forest owners. Unfortunately, in the most recent survey more than 40% of respondents did not release their income. Consequently, it is not appropriate to examine the change in income with the data.

A significant percentage of Alabama family forest owners are well educated people who received, at least, some college education (Figure 2.2). This structure is different from the state's general population where approximately 51% of the individuals have only a high school or lower degree (U.S. Census Bureau 2004) and this number is 40.1% for family forest owners in Alabama. The ANOVA analysis of the 2004 data also

indicates that the average education background becomes higher with larger size of forest holdings.

Objectives for owning forestland

There are many different classifications for the objectives of family forest owners. Kurtz and Lewis (1981) presented an interesting theoretical framework including the motivations and objectives of NIPF owners they used to classify owners into four types: timber agriculturalist, range pragmatist, timber conservationist, and forest environmentalist (see also Marty et al. 1988). Ferretti (1984) also concluded that forest owners can be divided into two groups based on their motives: owners driven by personal utilization of forest benefits (consumptive motive) and the group emphasizing income generation from their forest (productive motive). Butler (2005) used a utility-maximization framework to divide family forest owners into profit, multiple-objective, and amenity maximization groups.

In both the 1994 and 2004 family forest owner surveys, respondents were asked about the relative importance of reasons for owning forestland. In 1994, forest owners were asked to rank ownership objectives from 1 to 8 while in 2004, they were asked to rate each objective using a 7-point Likert scale. Because of these differences, we can only compare the relative importance of objectives. Two sets of relative importance percentages are generated. One is based on ownership while the other is based on forest area. As demonstrated in Figure 2.3 a, the relative importance of part of farm, home or cabin by owners decreased from 1 in 1994 to 0.79 in 2004. This number for legacy

increased from 0.45 to 1. Also interesting, within the latest decade, aesthetics increased by 0.88 (see Figure 2.3 b) which tells us people put much more concern on the environment. And the relative importance of timber production from an area perspective dropped from 1 to 0.09. This expected change shows more emphasis has been put on non-timber benefits. For instance, Birch (1996) suggested that aesthetics enjoyment was the most popular benefit expected in the future decade.

Future Intentions

Nation wide more than 60 percent of today's forest owners are older than 55, and more than half of these are older than 65 (Butler and Leatherberry 2004). But in Alabama, the average age is only 48 years old and 57% owners are younger than 55 years old. What uses they intend for their forestland in Alabama is a very interesting and important topic. About 7% of owners who control 25% of total family forest in Alabama intend to pass along their forestland to heirs within the next five years (Figure 2.4). One and a half percent of owners intend to buy more forestland while only 0.4% of owners intend to sell some or all of their forestland. These results represent the forest owners' intentions and their actual behavior may be mitigated by many factors. Interestingly, it has been shown that although an individual's actions may contradict his or her intentions, over-all the intentions are indicative of the group's behavior (Egan and Jones 1995, Turner et al. 1977).

Compared to the national NWOS results in which only ten percent of family forestland is owned by people who plan to transfer it to the next generation within the

next five years, Alabama will experience a more significant inter-generational change of forest ownerships. Who will be the new owners? What will the next generation do with their forestland? According to the study of Mater et al. (2006), a large portion of these next-generation owners will work in professional fields with average or higher household incomes. Most do not live near their family's forest, and do not plan to live on the family forest in the future. Though few such studies have been done in Alabama, we also can expect a similar situation for future next generation owners.

Forest management decisions

While the different management objectives indicated the primary reasons for family forest owners owning forestland, it is also important to know forest owners' management decisions. Understanding the changes in the management of family forests is especially important to forest policy and assistance programs. We examined the changes in harvesting behavior, written management plans and management advice as the indicators for the forest management activities. Unexpectedly, the harvesting activity for all products became more popular in 2004 than in 1994 even though most of the family forest owners were not timber motivated any more. In 1994, 76% of family forests were owned by people who had harvested trees and this number increased to 86% in 2004 data. Accordingly, 12% more family forests had written management plans and 9% more forest had sought advice. And from ownership perspective, compared to 1994, 4% more owners made a timber harvest, 1% more owners had written management plans and 6.6% more owners had sought advice.

The observed percentage of harvesting, having written management plans, and having sought management advice was positively correlated to the size of forest holdings (Figure 2.5). This suggests that owners put more efforts in to managing their forestland when they hold larger parcels of forestland. The overall management level based on the area increased significantly within the latest 10 years.

Conclusions and Discussion

This study shows that compared to a decade ago, family forest owners in Alabama, on average, are younger, with a better education. Diversified objectives and use interests were reported by Alabama forestland owners. The most popular objectives contain aesthetics purposes, land investment and having an estate to pass along to heirs.

To our surprise, a higher percentage of forestlands as well as owners are more actively managing forest, especially harvesting activity, having written management plans and asking for management advice. We do not have a clear explanation for the causes. It may be the result of more outreach from government extension agencies, education instructions; more forestry knowledge by the owners; or a good timber market during late 1997-2002 compared to 1987-1993. If this finding can be generalized to other states and in the future, then our concerns on family forests in supplying future timber can be relaxed to some extent. What are the impacts of the increasing intensive timber management on environmental service from forests? Further research is needed.

According to our ANOVA, the demographics of owners among different holding sizes vary, as well as their management objectives and decisions. Forestland ownership is traditionally classified into industrial forests versus non-industrial forest, public-owned versus private-owned, family versus incorporated entities. An alternative classification

for forest management may be based on size of forest holdings. Indeed, we can gain more insight by examining the changes in holding size and different behavior by different holding size. As Larson (2004) argued, “there is more consistency based on size of holding than on category. Large ownerships, whether classified as family or business, are run as a business.” Kluender and Walkingstick (2000) found that ‘Timber Manager’ type of NIPF owners held more forestland, with more than half of the respondents owning more than 75 acres each; while roughly 70% of ‘Resident Conservationists’ owned less than 50 acres of forestland each. To examine the dynamics of holding sizes and different behaviors of owners holding various sizes is important for future study and also, the result will be important politically.

It is not surprising to see that most family forest owners in Alabama have some cycles in the size of land acquisition (Figure 2.6). But what factors influence the acquisition size? Is this tendency due to rising timberland price, or because of the objectives of owning timberlands? Land parcelization is more common nation-wide, but we also see some land consolidation in Alabama (Sisock 1998). Zhang et al. (2005) provided some theoretical arguments, but more investigations are needed.

About the future intentions, for their forestland, few respondents indicate that they will sell their land or subdivide it while more owners show that they would like to buy more forestland later. Linking this finding with the trend of selling forestland by forest industry companies in the past two decades and near future, we are expecting that a significant part of the forest industry owned timber land will be transferred to the next generation of family forest owners. As the results indicate about the future intentions, twenty five percent of Alabama’s family forest will change hands soon. This will make

significant changes for profiles of Alabama's family forest owners. Will new owners then still put emphasis on aesthetic enjoyment and will timber production continue to become less important? Will a higher percentage of new owners harvest their timber? Or will they sell their land?

In sum, as more forest industry timberland comes on the market and Timber Investment Management Organizations (TIMOs) are becoming increasingly active in timberland transactions, how long will the TIMOs hold the land? It is often believed more TIMO land will end up in the hands of family owners. If that happens, family land owners will become more important. As large family forestland owners are aging, we are expecting more changes in the profile of the private forestland owners. Family forest in Alabama currently accounts for 67% of Alabama's forestland and it plays a critical role in providing timber production, outdoor recreation, etc. Their decisions will affect the fate of the forest, even society as a whole in Alabama. We need to keep an eye on the dynamic changes of Alabama's family forests. Creative policies are needed for diversified family forest owners. As our sample size of the data may be still too small, we need to continue the efforts to track the family forestland owners and how they manage their land, and what kind of policies we need to steward the forests. This information is also very important for developing effective and efficient communication programs, particularly if we are interested in communicating with family forest owners other than those who we have traditionally communicated.

III. ANALYSIS OF HOLDING SIZE DISTRIBUTION OF PRIVATE FORESTLAND OWNERSHIP IN ALABAMA

Introduction

There are an estimated 620 million acres of forestland in the conterminous United States (Smith et al. 2004). Nearly two-thirds, or 393 million acres, are in private ownership. Studies and surveys conclude that forest ownership parcelization is occurring from indicators of dramatic increase in the number of ownerships and decrease in the average holding size. Parcelization is often viewed as a precursor of fragmentation, a process of breaking-up larger, contiguous parcels into smaller parcels. The forests owned by small owners tend to be highly fragmented by buildings, roads, cultivation, and other influences. Fragmentation is receiving great attention since it tends to diminish forest functionality for wildlife, watershed, or timber production, and many studies have been carried out to address those issues (e.g., Wear et al. 1998, 1999; Rosenberg and Raphael 1986).

Most studies neglect the important issues of structural changes and regional differences. Only examination of average holding size or parcelization/consolidation is not sufficient to get the whole picture of the changes in the structure of forestland ownership. In many cases, timberland parcelization and consolidation may coexist

(Zhang et al. 2005). Therefore, we need different measures on the structural changes. In addition, it is important to understand the driving forces of such structural changes. The impacts on the structure in general are still largely unknown since the same factor may have different impacts on the different segment of the owners. On one hand, forestland consolidation may be viewed as indicative of renewed economic vitality and growth. Regions in which most forestland is concentrated in large, privately owned tracts are extremely attractive to the forest industry (Bliss et al. 1998). On the other hand, consolidation is often viewed as an indicator of a high poverty level in that region. Urbanization may cause parcelization at the urban/rural interface, but it may also lead to consolidation in areas farther away from the urban area, due to decreasing agricultural presence and population.

The purpose of this study, based on county aggregated data in Alabama, is to investigate structural changes and the driving forces of the changes in the distribution of forestland holding size. We will use an empirical model to test possible associated factors affecting the changes. Currently, there are 23 million acres of forestland in Alabama, accounting for 71% of the total land area of the State (Hartsell and Brown 2002). The vast majority (94% or 22 million acres) of the State's forestland is privately owned (Smith et al. 2004). This is an indication that forestland parcelization is occurring in Alabama.

But from 1994 to 2004 the total area of forestland in holdings of 1,000 to 5,000 acres increased by 1 million acres and forested acres in holdings larger than 5,000 acres increased by 1% in Alabama (Birch 1996; National Woodland Owner Survey 2004). Some other studies suggested that consolidation of small forest tracts into larger

ownerships appears to have taken place in Alabama since the last decade. The share of Alabama's private forestland held by the largest 1% of owners grew from 51% in 1978 to 58% in 1993 (Birch 1996; Birch et al. 1982). Moreover, a mere 8% of the owners in 1993 owned some 80% of the private forestland in the state holding tracts of at least 100 acres. In contrast, most private forest owners (68%) owned fewer than 10 acres each, and their combined holdings accounted for only 3% of the total (Bliss 1998).

We begin with a literature review, followed by measurements of distribution of forestland holding size. Then data collection, model specification and the estimated results will be given. Finally, the conclusion is presented.

Literature Review

Economists have been interested in the relationship between firm size and ownership issues for a long time. For example, when interpreting owning or using market, Coase (1937) argued that firm was determined by the relative transaction cost between co-ordination and price mechanism. While Lucas (1978) claimed that greater capital intensity, proxied by the investment per worker or R&D intensity, is associated with larger firms. Human capital is also suggested as being positively correlated with firm size by the theories in Rosen (1982) and Kremer (1993). Most studies were focused on industrial firms.

It is interesting to see the difference between agriculture and industry. While industrial organizations are changing toward bigger corporations, agriculture, however, has largely resisted the transition to large corporate ownership (Schmitt 1991; Allen and Lueck 1998). The 1992 U.S. Census of Agriculture shows that more than 85 percent of farms are organized as “family farms.”¹ Allen and Lueck (1998) explained that this is due to specialties of farms: seasonality and random shocks are the main features that

¹ U.S. Bureau of Census, 1992 Census of Agriculture, Table 2.18, at 58(1992). The census definition of a farm is “any place from which \$1,000 or more of agricultural products were produced and sold or normally would have been sold during the census year.” The Census uses the following categories: (a) individual or family, (b) partnership,(c) corporation (family held or non-family held), and (d) other(trusts, municipalities, and so on).

distinguish farm organization from “industrial” organization. The factory-corporate farm will tend to use more capital because it face lower capital costs, but its overall ability to use more farm labor will depend on the potential gains from task specialization and the costs of monitoring labor. When farmers are successful in mitigating the effects of seasonality and random shocks to output, farm organizations gravitate toward factory processes, developing the large-scale forms found elsewhere in the economy.

Small holding sizes of timberland in non-industrial private forest owners (NIPF) has been addressed for many decades since small owners might not be actively engaged in timber production and have lower efficiency. For example, Binkley et al. (1981) used a county tax register to formulate a model for determining transfers of land holdings in the Adirondack region in the northern part of New York State between 1970 and 1980. In his conclusion, large holdings were less likely to change hands than smaller ones, and the transfer rate was higher among NIPF owners than in other ownership groups. Concerns on the problem of small owners are becoming more associated with potential ecological integrity and functionality for wildlife and watershed. But what causes parcelization has not been investigated enough.

Historical patterns of land ownership found in Alabama are primarily attributable to local physiography and soil type (Sisock 1998). The state can be divided into three main physiographic regions: the Coastal Plain, Piedmont, and Upland (Healy 1985). The ante-bellum plantation system on the Coastal Plain was characterized by land concentration, production for commercial markets, a high degree of social stratification, and a dependence upon slave labor (Skee and Swanson, 1988; Sisock 1998). In contrast, the historical ownership pattern in the northern hill counties of the Upland was a

multitude of small ownerships. Slope and soil fertility were primary factors in keeping ownership small. And the Piedmont region, with its landscape fluctuating from rolling to hilly, accommodated both plantations and small farms.

Today, north Alabama supports a large number of owners and small average tract sizes, while South Alabama supports a small number of owners with larger average acreage. Cullman, Jefferson and Marshall Counties have the largest number of owners with typically the smallest average tract sizes in Alabama. Montgomery, Lowndes and Chambers Counties have the least number of owners with the largest average tract sizes. Figures 3.1 and 3.2 are examples of the difference in ownership and holding size distribution in two counties in Alabama. Landownership consolidation in southwestern Alabama dates to the Antebellum period, when vast family estates were created from the subsistence farms of earlier settlers, their growth fueled by profits from the slave based cotton economy. Land consolidation for some families in the region continued after the Civil War, through the transition from cotton to cattle, and then from cattle to timber (Walkingstick 1996).

The spatial arrangement of tract sizes across Alabama appears to be nonrandom. Forestland tends to be owned in larger tracts in counties which are home to large pulp and paper manufacturing facilities. Alabama's forest products industry is dominated by large corporations whose ownership of forest land and mills plays a major role in Alabama's rural economy (Bliss and Meuhlenfeld 1991). In recent years, the combined effects of corporate consolidation and technological change have led to increasing economic concentration in the forest products sector (Sinclair et al. 2003).

The natural conditions have some influence on the land holdings, but socio-economic factors are also important. Studies found two factors contribute to the continuity of ownership patterns. Land tenure literature as well as observation of current conditions in rural Alabama suggests that socio-economic and environmental consequences may plausibly accompany a trend toward greater forestland consolidation (Bliss et al., 1998). There are a few studies concerning the forest/farm size and some associated socio-economic factors. Much research considers the relationship between farm size and community well-being in the United States (Goldschmidt 1978, Gilles & Dalecki 1988, Swanson 1988, Labao & Schulman 1991). Farm resources are usually considered to generate wealth for the overall improvement of rural life, which include better housing, education, health services, transportation, local business diversification, and more recreational and cultural opportunities.

In the United States, the question of how socio-economic factors affect the land holdings was asked more than a half century ago. Comparing two California communities in assessing the impact of farm structure and scale on rural community life in the 1940s, Goldschmidt (1978) concluded that the small farm community had a higher standard of living, supported a higher level of physical community services and facilities, had a greater number of civic organizations, and had more and better schools. In other words, the small farm community had a higher level of social and economic well-being than did the community dominated by large scale agricultural operations (see also Sisock 1998). Recent studies confirmed that Goldschmidt's findings remain true (Rosset 1999). The other factor is Alabama's low property tax rates. Low property taxes allow owners to hold land at low cost (Sisock 1998). DeCoster (2000) suggested that the fragmenting of

forests into smaller pieces appears to be driven by powerful social and demographic forces that consistently under-tax and over-serve developed areas, while over-taxing and under-serving traditional rural land use, such as forestry.

Fewer studies investigated such socio-economic factors with the structure distribution of forestland. Sisock (1998) examined historical and current ownership patterns in Alabama to determine ownership trends, the extent of ownership concentration, and to analyze the relationship between ownership distribution and rural well-being. In her study, poverty, net migration, unemployment and education are created as an aggregate measure of well-being. She concluded that forest resources in Alabama belonged to relatively fewer owners and concentration of forestland ownership is negatively associated with well-being in rural counties.

Mehmood and Zhang (2001) was among the first explicit and empirical examination of the causes of parcelization. Death, urbanization, income, regulatory uncertainty, and financial assistance for landowners were found to have significant impacts on the change in average parcel size in the United States. But they only examined the change in mean of the holdings rather than structural change. Gobster and Rickenbach (2003) suggested that economics, demographics, values and motivations, globalization and technology, natural capital and policies are six main drivers of forestland parcelization. An aging population was especially cited as driving forestland parcelization.

Forestry has some similarities with agriculture, but using the theory of farm size to explain holding size of timberland may not be appropriate since timberland holdings have two extreme cases: timberland held by the forest industry tends to be larger and

larger (at least in the 1950s-1980s), but the size of family type holdings have been decreasing for many decades. In addition, the objectives of owning timberland have some fundamental differences from farmland. So we need to distinguish the forest industry type of timberland holding and the non-industry forestland ownership. The difference between these two types in terms of holding sizes and production behaviors have been investigated in Newman and Wear(1993) and Zhang et al (2005) among others. The forest industry holds timberland for production purposes, while NIPFs have more diversified objectives and consumption is among the most important objectives.

METHODS

Data

The data we collected and analyzed for this study are based at the county level. The data of forest ownership are generated from 55 of 67 counties in Alabama in the PFMT (Private Forest Management Team) landowner database. The original data were obtained based on the \$0.10 fire tax on forest land from county tax offices in a variety of formats with names, address, and acres of forest land for all forest landowners (public holdings were excluded).

Given the way landowner names are recorded in Alabama's county tax system, it is practically impossible to determine how much land an individual owns. A person can own land individually or with a spouse, sibling, business partner or friend. It can be part of a Trust or LLC (or other legal entity) or listed within a county or in multiple counties with a variety of names or addresses. We have chosen to call the landowner unit a "Landowner Group." A Landowner Group is defined as a unique set of landowners. This may be an individual, spouses, siblings or any number of other ownership arrangements. Although one individual may be a part of one or more Landowner Groups, Landowner Groups are not combined in this analysis. In other words, even in situations where it was obvious that a family ownership was divided among family members, sometimes with a common individual, each group was considered a unique Landowner Group. Another

limitation of the ownership data set is that since fire taxes are not collected on forest holdings of less than 10 acres, forest land of less than 10 acres is not reported in quite a few counties. This indicates that the data on the small holdings may not be as accurate as large forest holdings.

Socio-economic data were collected from the US Census Bureau, state and county quick facts in 2000. Percent of forest cover was calculated from data in Forest Statistics for Alabama (Hartsell and Brown 2002). And the data on land quality were generated by the USDA. Seven kinds of socio-economic data are included in our study (Table 3.1). Population density is a significant demographic factor. As the population increases, more land is needed for urban use. Therefore, population density is suggested as a key factor in the conversion of timberland and agricultural land to urban use (Nagubadi and Zhang 2005). The definition of population density in our study is persons per square mile. The mean value for the 55 counties is 75.

The average percent of persons 65 years old and over for the 55 counties in Alabama we examined is 14%. Also, rural population comprises about 70% of 55 counties' population in Alabama. Technically, "rural" stands for places of less than 25,000 (US Census Bureau, 2000) and correspondingly, rural population specifies the population in rural area. We may link rural population with poverty level. And opposed to rural population, urban population is a critical indicator of urbanization. All of these issues will be discussed in detail later. The average percent of black or African American persons in the 55 counties is 27%, which comprises a considerable proportion of the population in Alabama. We hypothesize that a higher percent of black or African American persons will result in larger forestland holdings and even consolidation.

Data on per capita income levels in each county are provided to indicate the average income available in that county, if income were equalized per person. It is not meant to suggest that each person actually has access to that much income. But per capita income is a good relative measure of the income totals available in each county (Bukonya, 2002). The mean value of per capita income is \$15691 for our study area, compared to \$22,972 for the whole state and \$28,546 for the nation in 1999. This difference may be consistent with our previous explanation that we missed many wealthy counties located in metropolitan areas. For instance, two counties Shelby and Jefferson had above the national average per capita income, but they are not included in our 55 counties.

A concise and universally accepted definition of poverty is elusive largely because it affects many aspects of the human condition, including physical, moral and psychological. Accordingly, some researchers had briefly defined poverty as an barrier to prosperity while others have used different criteria such as: lack of resources and opportunities, feelings of being disenfranchised from various support systems(i.e., educational, economic, cultural, and social), and diminished feelings of empowerment to obtain these resources and opportunities (Eastern Idaho Prosperity, 2003). We use the percent of population below the poverty line to describe poverty in our study area. Poverty line is a threshold that is used to differentiate the poor from the non-poor. In the United States, there are two slightly different versions of the federal poverty line. We employ the poverty threshold, which is updated annually by the Census Bureau. The average percent of the population below the poverty line was 19% in the 55 counties

within Alabama, compared to 16.1% for the whole state and 12.4% for the nation in 1999.

Educational attainment is a critical sign in evaluating a society. The idea of human resource development as having an important bearing on economic development has long been recognized by prominent economists like Adam Smith and Alfred Marshall (Machethe, 1990). The basic theoretic argument is simple: education improves the quality of the labor force, making it more a valuable input to the production process. The variable we use to describe educational attainment is the percent of the population older than 25 years old with bachelor's or higher degree. The average percent in the 55 counties is 13%.

Percent of forest cover is also a critical variable in affecting the distribution of forestland in each county. We calculated this variable from the data shown in Forest Statistics for Alabama (Hartsell and Brown 2002). Percent of forestland is calculated as the ratio of forestland area and total land area. As demonstrated in Table 3.1, the average forest cover in our study area is 65%.

The U.S. Department of Agriculture (USDA) classifies land into eight land capability classes (LCC) in decreasing order of land quality (Klingebiel and Montgomery, 1961; see also Nagubadi and Zhang 2005). Empirical analyses show that the proportion of two higher land quality classes in the total land affects whether the land is put into agricultural or forestry use. The ratings for a land parcel range from 1 to 8, in which 1 stands for the most productive and 8 the least productive. The average land quality index (AVLQ) was calculated as a weighted average of acres in each land class in the county (Nagubadi and Zhang 2005).

Distribution of forestland holding size

Before we analyze the causes, we first must have some measurement of holding size distribution. We introduced four measures of forestland distribution. The average holding size is used to measure the general trend of the holding size; the Gini coefficient of forestland distribution and two ratios of forestland in small and large holdings are used to measure the structural changes.

Mean forestland holding size. Mean value is the most important statistic. We calculated the average forestland area for 55 counties. As demonstrated in Table 2.2.1, the average forestland holding is 150 acres while the SD for that value is 83 based on 55 counties. In our study, all kinds of private ownerships such as forest industry are included.

Gini coefficient of forestland distribution. The Gini-coefficient is a powerful tool to measure inequality. Although the Gini-coefficient is often used to describe the inequality of wealth or income within a population using measures between 0 and 1, it can also be used to measure other inequalities such as health inequality (Epidemiological Bulletin, 2001).

We can get the essential idea of the Gini coefficient by looking at the Lorenz curve. Different from the normal Gini coefficient, the x axis stands for the cumulative percent of forestland owners while the y axis is the cumulative percent of forestland. As

marked in Figure 3.3, the Gini coefficient is the ratio of A/(A+B). Technically, the formula for the Gini coefficient is as follows:

$$G = 1 - \sum_{i=0}^N (\sigma_{Y_{i-1}} + \sigma_{Y_i})(\sigma_{X_{i-1}} - \sigma_{X_i}) \quad (1)$$

Where σ_X and σ_Y are cumulative percentages of forest owners and acres of forestland, respectively. Based on the data from the PFMT landowner database, we calculated the Gini coefficients of forestland distribution for 55 counties in Alabama. As demonstrated in Figure 3.4, with the mean value of 0.71, the Gini coefficients have been divided into five categories. White is used to stand for the missing data for the other 12 counties in Alabama. The other four categories are described by different patterns. It indicates that forestland is distributed extremely unequally in the southwestern area, while it's comparably distributed equally in the northern part and the regions close to the metropolitan areas such as Birmingham and Montgomery. Land ownership consolidation in southwestern Alabama dates to the Antebellum period, when vast family estates were created from the subsistence farms of earlier settlers, their growth fueled by profits from the slave based cotton economy. Land consolidation for some families in the region continued after the Civil War through the transition from cotton to cattle, and then from cattle to timber (Walkingstick 1996).

The Gini coefficient is the most commonly used measure of inequality of income. It can be used to measure inequality of timberland holdings. The coefficient varies between 0, which reflects complete equality and 1, which indicates complete inequality (one person has all the income or consumption, all others have none). Graphically, the

Gini coefficient can be easily represented by the area between the Lorenz curve and the line of equality. Perfect equality of distribution would be a straight line at 45 degrees. It is sometimes argued that one of the disadvantages of the Gini coefficient is that it is not additive across groups, i.e. the total Gini of a society is not equal to the sum of the Ginis for its sub-groups.

Percent of forestland in holding less than 200 acres. A higher percent of forestland in a county owned in tracts of 200 acres or less is considered as the indicator of ownership parcelization. An attempt was made to calculate the percent as forestland in holding less than 50 acres to make it more persuasive as the parcelization indicator. Unfortunately, the forestland holding data in quite a few counties were collected from holdings larger than 10 acres. Thus, the percent of forestland in holdings of less than 50 acres is not accurate enough for our study.

Percent of forestland in holding larger than 2000 acres. A higher percent of forestland in a county owned in holdings of 1000 acres or more is considered indicative of ownership concentration. Comparison of 1978 and 1993 Forest Service surveys indicated a slight national trend toward fragmentation in private forest ownership (Birch 1996, Birch et al. 1982, Bliss et al., 1998) . In contrast to this aggregate national trend, consolidation of small forest tracts into larger ownerships appears to have taken place in Alabama over the same period (Bliss et al., 1998) From the results of woodland owner surveys in 1994 and 2004, we may find forestland parcelization and consolidation are coexisting in Alabama (Pan et al. 2006, Zhang et al., 2005).

Model Specification

Based on the literature review, we know that both natural and socio-economic factors are associated with timberland holding size. Usually the population, urbanization and well-being are considered as the underlying forces of the change. The quality of land has a major influence on the use of land for agricultural or forestry purposes (Ahn et al., 2001; Hardie and Parks, 1997; Mauldin et al., 1999). Higher-quality land is naturally used for agriculture, and lower-quality land is used for forestry.

Our econometric models are to test the factors. The empirical models are specified as shown in equation 2. All of these equations share the same independent variables, but have different measures as the dependent variables. An equation that specifies a linear relationship among the variables gives an approximate description of some economic behavior.

We used the log transformation in both sides of equation (2), except for the independent variable AVLQ which represents the average land quality index. It because that AVLQ is a categorical variable that is inappropriate to make such a transformation. One important characteristic of our model is that almost all of the coefficients of this model have an interpretation as elasticity, except the one for AVLQ. Results and discussions will be provided in a later discussion.

$$\begin{aligned}
\text{Ln}Y_i = & \alpha_0 + \alpha_1 \text{Ln}POPD + \alpha_2 \text{Ln}OLDP + \alpha_3 \text{Ln}RURP + \alpha_4 \text{Ln}BLAK + \alpha_5 \text{Ln}INCP + \\
& \alpha_6 \text{Ln}POVT + \alpha_7 \text{Ln}EDUC + \alpha_8 \text{Ln}FORC + \alpha_9 \text{AVLQ} + \varepsilon_i
\end{aligned} \tag{2}$$

Where, $i= 1, 2, 3, 4$, Y_1 is the mean (mean holding size of forestland), Y_2 is the Gini (Gini coefficient of forestland distribution), Y_3 is LE200 (percent of forestland in holding less than 200 acres), Y_4 is LA2000 (percent of forestland in holding larger than 2000 acres). We expect these 4 regressions can catch the structural difference among the Alabama counties.

Results

The estimated results are presented in Table 3.2. In general, compared with the other 2 regression models the MEAN model and the LE200 model are better with adjusted R^2 0.47 and 0.53, respectively. On the one hand, that means our variables used to explain the average holding size (the mean) and small owners (the percentage of land held less than 200 acres) much better than the other two aspects of timberland owning behaviors. On the other hand, it also indicates that the ownership structure change is quite complicated and has different trends in each category. Otherwise, the changes in big owners are exactly the opposite of the small owners.

It is interesting to see that the population density has nothing to do with our 4 kinds of measures. But the “old population” and “rural population” play an important role in the timberland holding structure. A one percent increase in old population drives down the GINI coefficient by 0.146 percent, indicating more land equally distribution. Meanwhile a higher percent age of “old population” is proven to be significantly associated with parcelization by the LE200 model and its elasticity is 0.662. Some studies show that death rate is one of the major driving forces behind fragmentation and parcelization (Mehmood and Zhang, 2001; DeCoster, 1998). We may link these findings with our estimated results of old population. In the LE200 model, the percent of persons 65 years old and over is closely related to parcelization. This result is consistent with

previous studies.

Rural population has a statistically negative impact on the Gini coefficient and percentage of forestland in holding larger than 2000 acres, indicating more equality and a comparatively smaller holding size of forestland (less than 2000 acres) as the proportions of rural population go up. Our interpretation is that it is likely that rural individuals most often hold forestland in medium size. So the large land holdings were parcelized into medium size instead of very small sizes in rural areas. The inference is consistent with the result that “rural population” isn’t significant in the LE200 model. Black population does not have a significant impact on any of the 4 regressions.

Per capita income and poverty share have quite the same kind of impacts on the Gini coefficient and the percentage of forestland in holding larger than 2000 acres. Theoretically, they should have the opposite impacts since it’s more likely that higher per capita income will result in a lower percent of the population below poverty. Our interpretation for this is that not only the average per capita income but also the income distribution affects the land holdings. Generally, poverty makes timberland more unequally distributed, particularly promoting large land consolidation. This may be true in Alabama as farmers still hold a lot of timber land. But this may not be the same in other places where more NIPF owners are professional and are high income people who use timberland more for recreation and investment purpose. Higher attainment of college education does make land more equally held and reduces timberland consolidation to larger ownerships.

The percentage of forestland has a statistically significant impact on all of the 4 models. This result is under our expectation since more timberland will correlate with

higher probabilities of having larger average holding size. Furthermore, a higher percentage of forest cover results in less equally distributed forestland due to the presence of forest industry, which cannot be compared with most family forest owners. Also, the average land quality index does not show any impact on any of the 4 models.

Conclusions

This paper analyzes the current ownership distribution of forestland from different perspectives. Our results indicate that forestland holding not only changes the trend such as average holding size, but also experience structural changes. For example, the increase of small owners does not mean a decrease in large owners. It can come from a decrease of land held by medium sized owners. It also can come from new people buying new land. Such studies have not been addressed so far, but would definitely be important.

Previous studies connected population growth and urbanization with possible changes in forestland ownership and forestland use change (Alig and Plantinga, 2004; Kline et al., 2004). Private forestlands in the United States face increasing pressures from growing populations, resulting in greater numbers of people living in closer proximity to forests (Kline et al, 2004). Our estimated results indicate that the main force behind forestland ownership distribution is the internal population structure such as the proportion of older population and the rural population rather than the total population.

Previous studies suggested that forestland tended to be owned in larger tracts in counties which were home to large pulp and paper manufacturing facilities (Bliss, 1998). Also, the forest products industry of Alabama was most heavily concentrated in the state's timber dependent Black Belt counties, where problems associated with poverty and unemployment are most severe (Walkingstick 1996; Bliss et al, 1998). Compared to

other measures, the consolidation model is not as powerful as expected. One possible explanation is that the LA2000 model is not fitted well. In the early 1990s, Alabama's forest products industry was dominated by large corporations whose ownership of forest land and mills played a major role in Alabama's rural economy (Bliss and Meuhlenfeld 1991). At the end of 1990s, major forest products companies began to sell their timberland, most of which changed hands to TIMOs and NIPFs. Such transfer may have some impacts on forestland parcelization.

Alabama is the fifth most forested state in the United States (Smith et al. 2004). To address the future challenges of preserving biodiversity, protecting water quality and meeting increasing demands of timber and recreational amenities, an accurate prediction of ownership distribution of forestland is needed. The prediction can be improved if more efficient measures are created.

IV. SUMMARY

From the previous discussion, our exploration about private forest owners indicates that during the latest decade, the composition has been changing considerably as have many socio-economic and natural factors which contribute to the current distribution of forestland ownership in Alabama.

As a core subset of the private forest owner, Alabama family forest owners, compared to a decade ago, are younger and better educated. The changes in demographic characteristics suggest corresponding alterations in the motivation for owning forestland as well as forest management decisions and future intentions. Also, the table of area and number of family owned forests by size of landholdings indicates that parcelization and consolidation may coexist in Alabama, which is far different from the national trend. As more forest industry timberland comes on the market and Timber Investment Management Organizations (TIMOs) are becoming increasingly active in timberland transactions, how long will the TIMOs hold the land? It is often believed more TIMO land will end up in the hands of family owners. If that happens, family land owners will become more important. As family forestland owners age, we expect more changes in the profile of private forestland owners.

How can we measure the private forestland ownership distribution regionally? What kind of associated factors may affect such a distribution? Based on our county level data, we find the percentage of population over 65 years old and rural population play an important role in forestland ownership distribution. Meanwhile, higher numbers in per capita income, percent of population below poverty and percent of forest cover will result in land consolidation, while counties with higher educational attainment will resist forestland consolidation. Furthermore, to our surprise, population density, percent of black population and average land quality index are not statistically significant in any of the four models.

All these results seem important to the policy makers focusing on private forests and their corresponding owners in Alabama. Also, further study may continue to provide the better profiles of private forest owners in Alabama and also differentiate forest industry from non-industrial private forest owners when investigating ownership distribution. Furthermore, the lessons learned from this analysis of private forestland ownership in Alabama have applications throughout much of the South. We expect that similar research could be done in other states.

References

- Ahn, S.R.C. and A.J. Plantinga. 2001. Land use in the south central United States: a further investigation on land use practices by forestland ownership. *Forest Law and Economics*. Southern Forest Economics Workgroup: 165-71.
- Alig, R.J. 1986. Econometric analysis of factors influencing forest acreage trends in the southeast. *Forest Science* 32: 119-34.
- Allen, Douglas W. and Dean Lueck. 1998. Risk Sharing and Agricultural Contracts. Unpublished manuscript. Bozeman: Montana State University.
- Best, C. and L.A. Wayburn. 2001. *America's Private Forests: Status and Stewardship*. Island Press. Washington DC. Pp 8.
- Binkley, C.S. 1982. Timber Supply from Private Forests. A microeconomic Analysis of Landowner Behavior. Yale University, School of Forestry and Environmental Studies. Bulletin 92.97p.
- Birch, T. W., D. G. Lewis and F. H. Kaiser. 1982. The private forest-land owners of the United States, 1978. U.S. Department of Agriculture, Forest Service Research Bulletin WO-1.
- Birch, T.W. 1996. Private forestland owners of the United States, 1994. Resource Bulletin NE-134. Washington, DC: USDA Forest Service.
- Bliss, J. C., M.L. Sisock and T. W. Birch. Ownership matters: forestland concentration in rural Alabama. 1998. *Society and Natural Resources*. Vol.11. Issue 4.
- Bliss, J.C. and K. Muehlenfeld. 1991. Timber and the economy of Alabama. *Agricultural and Natural Resources Circular ANR-602-DTP*. Alabama Cooperative Extension Service, Auburn University.
- Bliss, J.C. 1992. Survey Yields Insight into Alabama Forest Owners' Attitudes. Alabama Agricultural Experiment Station.

- Bukenya, J.O. and R. Fraser. 2002. Estimation of the human development index for Alabama counties. Research Paper AGB2002-02. Alabama A&M University.
- Butler, B. J. 2005. The timber harvesting behavior of family forest owners. Ph.D. dissertation. Oregon State University, Department of Forest Science, Corvallis, OR.
- Butler, B. J., E. C. Leatherberry and M. S. Williams. 2005. Design, implementation, and analysis methods for the National Woodland Owner Survey. U.S. Department of Agriculture, Forest Service, Northeastern Research Station, Newtown Square, PA. Gen. Tech. Rep. NE-GTR-336. P. 43
- Butler, B.J. and E.C. Leatherberry. 2004. America's family forest owners. *Journal of Forestry* 102 (7): 4-14.
- Census of Population for Alabama. 2000. <http://bcber.cba.us.edu/edata/census2000.html>.
- Ciaramitaro, Bridget, Stanley Hyland, James Kovarit and Michael Timberlake. 1988. The development of Underdevelopment in the Mid-South: Big farmers and the persistence of Rural poverty. *Humanity and Society* 12:347-365.
- Coase, R.H. 1937. The Nature of the Firm. *Economica* 4: 386-405
- DeCoster, L.A. 1998. The boom in forest owners—A bust for forestry? *Journal of Forestry* 96(5): 25-28.
- DeMarsh, P., P. Sanders and T. Beckley. 2004. Exploring the Contribution of Family Forestry to the Social Health and Sustainability of Rural Communities. *Proceedings of Human Dimensions of Family, Farm, and Community Forestry International Symposium*: 21-26.
- Dennis, D.F. 1992. Parcelization and Affluence: Implications for Nonindustrial Private Forests. *Northern Journal of Applied Forestry* 9(1992): 33-35.
- Eastern Idaho Prosperity. 2003. Definitions of Poverty and Prosperity. <http://www.easternidahoprosperty.org/PDFReport/DefinitionofPoverty.pdf>
- Egan, A. F. and S. B. Jones. 1995. The reliability of landowner survey responses to questions on forest ownership and harvesting. *Northern Journal of Applied Forestry* 12 (4): 184-186.
- Ferretti, W.M.. 1984. A pilot study of non-industrial private forest landowner motivation. Doctoral dissertation. State University of New York, College of Environmental Science and Forestry, Syracuse. 273 p.

- Gaventa, John and Bill Horton. 1984. Land ownership and land reform in Appalachia. Land reform American style. Totowa, NJ: Rowman & Allenhead.
- Gilles, Jere Lee and Sonya Salamon. 1993. Returnin land tenure to the forefront of rural sociology. *Rural Sociology* 58:529-531.
- Gobster, P.H. and M.G. Rickenbach. 2003. Private forestland parcelization and development in Wisconsin's Northwoods: perceptions of resource-oriented stakeholders. *Landscape and urban planning* 69: 165-182.
- Goldschmidt, Walter. 1978. As you sow: three studies in the social consequences of Agribusiness. Montclair, NJ: Allenhead, Osmun.
- Griffin, Keith. 1981. Land concentration and rural poverty. Second edition. London: The Macmillan Press.
- Grilles, Jere Lee and Michael Dalecki. 1988. Rural well-being and Agricultural Change in twofarming regions. *Rural society* 53: 40-55.
- Gujarati, D. 1995. Basic Econometrics, 3rd Edition. McGraw-Hill, New York.Pp387.
- Hall, Anthony. 1987. Land concentration crisis in Brazilian Amazonia: The grande Garajas Programme. *Journal of Development Studies*23:522-552.
- Hardie, I.W., P.J. Parks, P.Gottlieb and D,N, Wear. 2000. Responsiveness of Rural and Urban land uses to land rent determinants in the U.S. South. *Land Economics*:659-73.
- Hardie, I.W. and P.J. 1997. Parks. Land use in a region with heterogenerous land quality: an application of an area base model. *American Journal of Agricultural Economics* 79: 299-310.
- Hartsell, A.J. and M.J. Brown. 2002. Forest Statistics for Alabama, 2000. Resource Bulletin SRS-67. USDA Southern Research Station.
- Healy, Robert G.1985.Competition for Land in the American South. Washington, DC: The Conservation Foundation.
- Klingebliel, A.A. and P.H. Montgomery. 1961. Land capability classification. U.S.D.A. Agricultural Handbook No. 210. Washington, DC.
- Kluender, R.A. and T.L. Walkingstick. 2000. Rethinking how nonindustrial landowners view their lands. *South. J. Appl. For.* 24(3):150-168.

- Kurtz, W.B. and B.J. Lewis. 1981. Decision-making framework for non-industrial private forest owners: an application in the Missouri Ozarks. *Journal of Forestry* 79(5): 285–288.
- Kusel, Jonathan. 1995. A new approach to well-being in Forest Dependent Communities. Sierra Nevada ecosystem project social assessment.
- Labao, Linda M. and Michael D. Schulman. 1991. Farming patterns, rural restructuring, and poverty: A comparative regional analysis. *Rural sociology* 56: 565-602.
- Larson, K. 2004. Family forests—the bigger picture. *Journal of Forestry* 102 (Oct./Nov): 13-14.
- Lott, Charlotte. 1979. Land concentration in the third world: Statistics on Number and Area of small farms classified by size of farm. Madison, WI: Land tenure center library, University of Wisconsin.
- Lucas, Robert E. Jr. 1978. On the Size Distribution of Business Firms. *Bell Journal of Economics* 9, 508-523.
- Machethe, C.L. The role of Universities in Human Resource Development for Agricultural Development in Less Developed Countries.. In C. Csaki, et al. (Eds). *Agricultural Restructuring in Southern Africa*, pp. 305-311. IAAE/AAE, International Symposium, Namibia, July 24-27, 1990.
- Marty, T.D., W.B. Kurtz and J.H. Gramann. 1988. PNIF owner attitudes in the midwest: a case study in Missouri and Wisconsin. *Northern Journal of Applied Forestry* 5(3): 194–197.
- Mater, M.C., V.A. Sample and B.J. Butler. 2006. Family Forest Owners: What Will the Next Generation Do? *Journal of Forestry*. (In press).
- Mauldin, T.E., A.J. Plantinga and R.J. Alig. 1999. Land use in the lake states region: an analysis of past trends and projections of future changes. Research paper PNW-PR-519. Portland. OR:U.S. Department of Agriculture, Pacific Northwest Research Station.
- Measells, M. K., S.C. Grado, H.G. Hughes, M.A. Dunn, J. Idassi, B. Zielinske. 2005. Nonindustrial private forest land owner characteristics and use of forestry services in four southern states: results from a 2002-2003 mail survey. *Southern Journal of Applied Forestry* 29 (4): 194-199.
- Mehmood, S.R. and D. Zhang. 2001. Forest parcelization in the United States. *Journal of Forestry* 99(4), 30-34

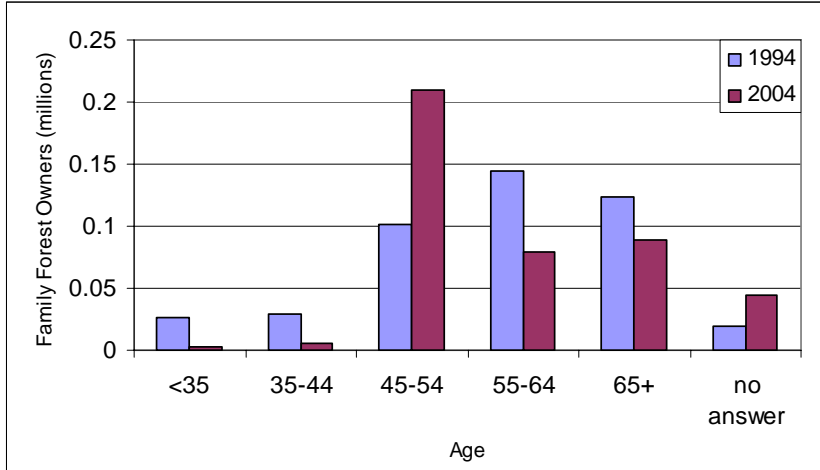
- Moore, D.S. and G.P. McCabe. 2003. Introduction to the practice of statistics 4th edition. W.H.Freeman and Company. New York.746p.
- Muller, Edward N., Mitchell A. Seligson and Hung-der Fu. 1989. Land Inequality and Political Violence. *The American Political Science Review* 83: 577-86.
- Nagubadi, R.V. and D. Zhang. 2005. Determinants of timberland use by ownership and forest type in Alabama and Georgia. *Journal of Agricultural and Applied Economic s* 37(1): 173-186.
- Nix, S.1996. Alabama's Forest Land –Who is in Control? Presentation at Alabama Forestry Association Woodland Managers Meeting, August 21, 1996.
- Ntional woodland owner survey. 2004. 2004 results for Alabama. USDA Forest Service.
- Pan, Y. and Y. Zhang,. 2005. Land ownership parcelization, urban sprawl and timberland value. *Proceedings of emerging issues along urban/rural interfaces: linking science and society.*
- Reynolds, J.E. 2001. Land use change and competition in the south. *Journal of Agricultural and Applied Economics* 33: 271-81.
- Rosen, J.F. and L. Doolittle.1987. Profiles of Midsouth Non-industrial private forests and owners. Resource Bulletin. SO-125. New Orleans, LA: United States Department of Agricultural, Forest Service, Southern Forest Experiment Station.
- Rosen, Sherwin.1982. Authority, Control, and the Distribution of Earnings. *Bell Journal of Economics* 18: 360-368.
- Rosenberg, K.V. and M.G.. Raphael. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests. In *Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates*, ed. J. Verner, M.L. Marrison, and C.J. Ralph, 263–72. Madison: University of Wisconsin Press.
- Rosset, P. 1999. On the benefits of small farms. *Food First* 6(4):1-5.
- Roth, Michael. 1993. Somalia land policies and tenure impacts: the care of the lower shabelle. *Land in African Agrarian Systems*. Crummey. Madison. WI. University of Wisconsin Press.
- Sampson, N. and L. DeCoster. 2000. Forest Fragmentation: Implications for Sustainable Private Forests. *Journal of Forestry* 98 (3): 4-8.
- Sampson, N. 2000. People, Forests and Forestry: New Dimensions in the 21st Century. Presented at Fragmentation 2000. Annapolis, MD, September 18, 2000.

- Sampson, R. Neil and Lester A. DeCoster. 1997. *Public Programs for Private Forestry: A Reader on Programs and Options*. Washington, DC: American Forests. 100 pp.
- Schallau, C.H. 1965. Fragmentation, absentee ownership, and turnover of forest land in northern lower Michigan. U.S. Department of Agriculture, Forest Service. Lake States Forest Experiment Station. Research Paper 17.14 p
- Schmitt, G. 1991. Why is the agriculture of advanced western economies still organized by family farms? Will this continue to be so in the future? *European Review of Agricultural Economics* 18: 443-458.
- Sinclair, P.R., C. Bailey and M. Dubois. 2003. One engineer and a dog; restructuring capital and labor in Alabama's pulp and paper industry. *Southern Rural Sociology*.
- Sisock, M. L. 1998. *Unequal Shares: Forest Land Concentration and Well-being in the Rural Alabama*. Master Thesis, Auburn University. AL, USA.
- Skees, J. R. and L.E. Swanson. 1988. Farm structure and rural well-being in the South. Pp. 238-321 in *Agriculture and Community Change in the U.S.*, edited by Louis E. Swanson. Boulder, CO: Westview Press.
- Smith, W. B., P. D. Miles, J. S. Vissage and S. A. Pugh. 2004, *Forest resources of the United States, 2002*. U.S. Department of Agriculture, Forest Service, North Central Research Station, St. Paul, MN. Gen. Tech. Rep. NC-241. 137 pp.
- Somberg, S.I. 1971. *Characteristics of Private Non-industrial Forest Landowners in Alabama*. Bulletin 185. Alabama Agricultural Experiment Station, Auburn University.
- Swanson, Louis E. 1988. *Agriculture and community change in the U.S.* Boulder. CO: Westview Press.
- Tarrant, M.A., R. Porter and H.K. Cordell. 2002. Sociodemographics, values and attitudes. *Southern Forest Resource Assessment: USDA Forest Service Southern Station*.
- Tomaskovic-Devey, Donald and Vincent J. Roscigno. 1997. Uneven development and local inequality in the U.S. South: The role of outside investment, land elites, and racial dynamics. *Sociological forum* 12:565-597.
- Turner, B. J., J. C. Finley and N. P. Kingsley. 1977. How reliable are woodland owners' intentions? *Journal of Forestry* 75 (8): 498-499
- U.S. Bureau of Census. 1992. *1992 Census of Agriculture*. Table 2.2.18, at 58.

- US Census Bureau. 2000. Census 2000 Data for the State of Alabama. http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=04000US01&-qr_name=DEC_2000_SF3_U_DP3&-ds_name=DEC_2000_SF3_U&-redoLog=false
- US Census Bureau. 2004. 2004 American Community Survey. http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=04000US01&-qr_name=ACS_2004_EST_G00_DP2&-ds_name=ACS_2004_EST_G00_&-lang=en&-sse=on
- Vesterby, M. and R.E. Heimlich. 1991. Land use and demographic change: results from fast growth counties. *Land Economics* 67: 279-91.
- Walkingstick, T. L. 1996. Pulpwood, dinettes and doublewides: A case study of forest dependency in Alabama. Unpublished Ph.D. dissertation, Auburn University, Auburn, Ala.
- Wear, D. N. and J. G. GREIS. 2002. Southern forest resource assessment. U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC. Gen. Tech. Rep. SRS-53. 635 pp
- Wear, D. and D. Newman. 2004. The speculative shadow over timberland values in the U.S. South. *Journal of Forestry*:102(8): 25-31.
- Wear, D.N., R. ABT and R. Mangold. 1998. People, space, and time: Factors that will govern forest sustainability. In *Proceedings of the 63rd North American Wildlife and Natural Resources Conference*, 340–61. Research Triangle Park, NC: USDA Forest Service.
- Wunderlich, Gene. 1995. Property in, Taxes on, Agricultural Land. Paper presented at the ‘Who owns America? Land and Natural Resource Tenure Issues in a Changing Environment’ Conference. Wisconsin. June 21-24.
- Zhang, Y., D. Zhang and J. Schelhas. 2005. Small-scale non-industrial private forest ownership in the United States: Rational and Implications for forest management. *Silva Fennica* 39 (3):443-454.

FIGURES AND TABLES

a)



b)

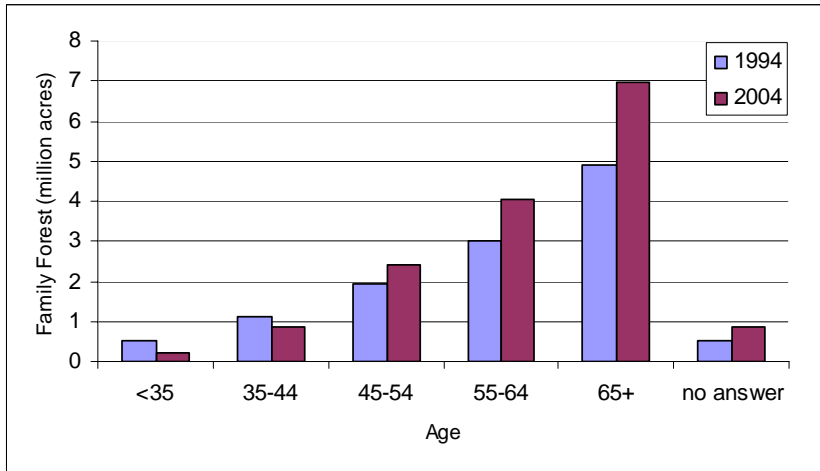


Figure 2.1 a): The age of family forest owner in Alabama weighted by ownership

2.1 b): The age of family forest owner in Alabama weighted by area

1994 Data source: Birch 1996

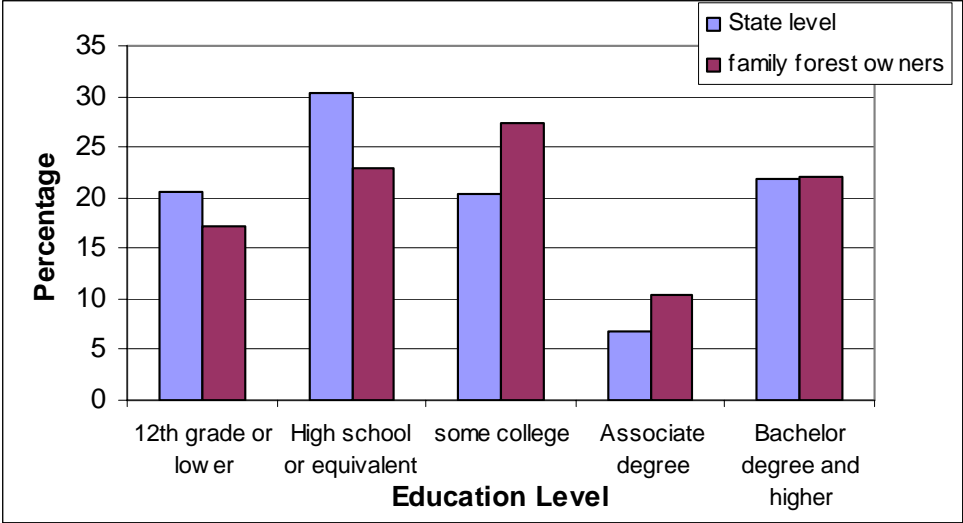
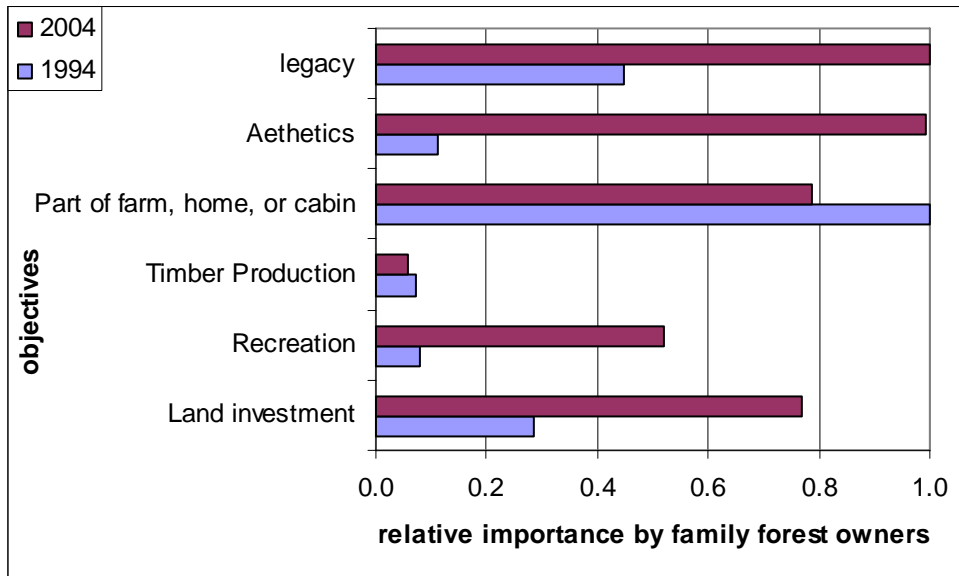


Figure 2.2: Education level of the family forestland owners
 Source: 2004 American Community Survey.

a)



b)

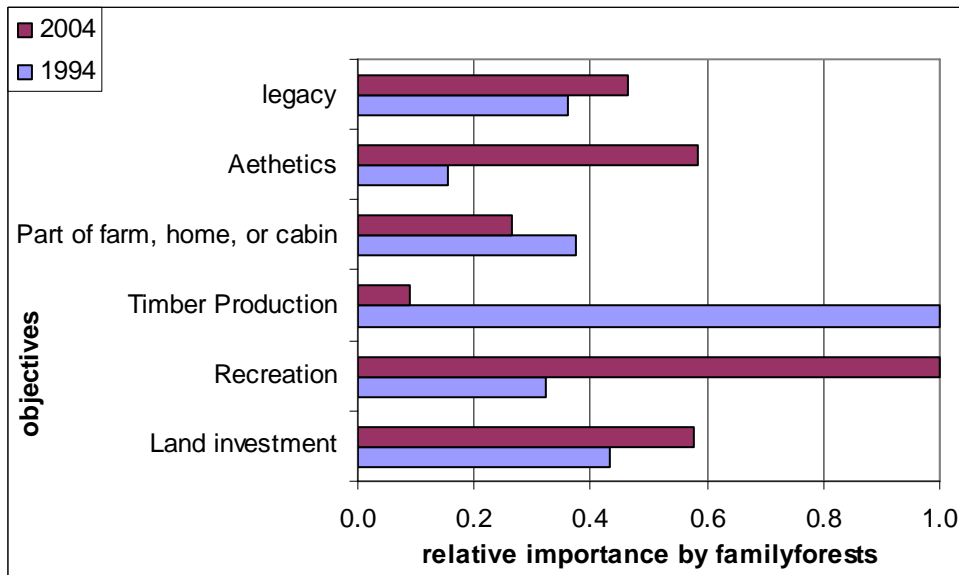


Figure 2.3 a): Ownership objectives of the family forestland owners in Alabama weighted by ownership

b): Ownership objectives of the family forestland owners in Alabama weighted by area

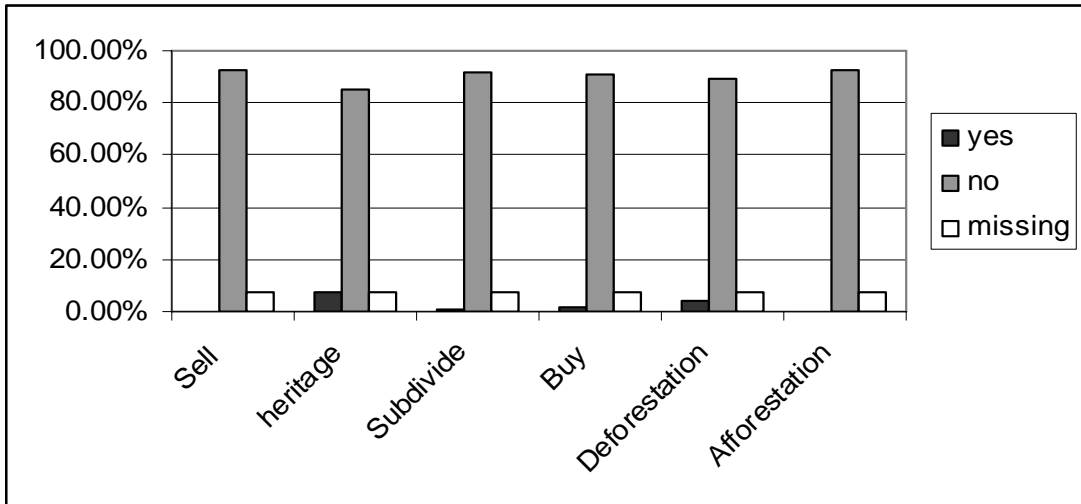
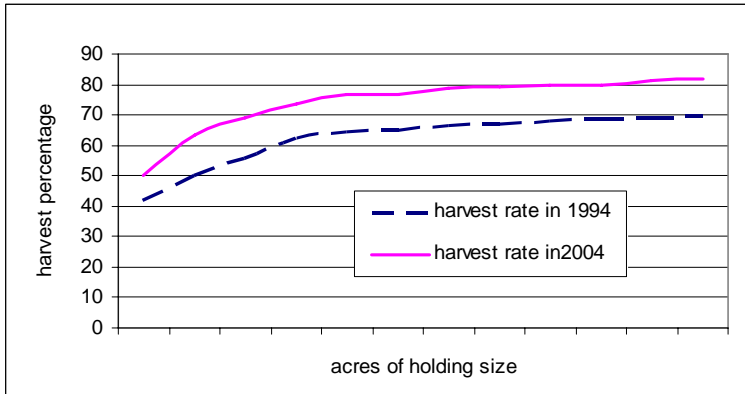
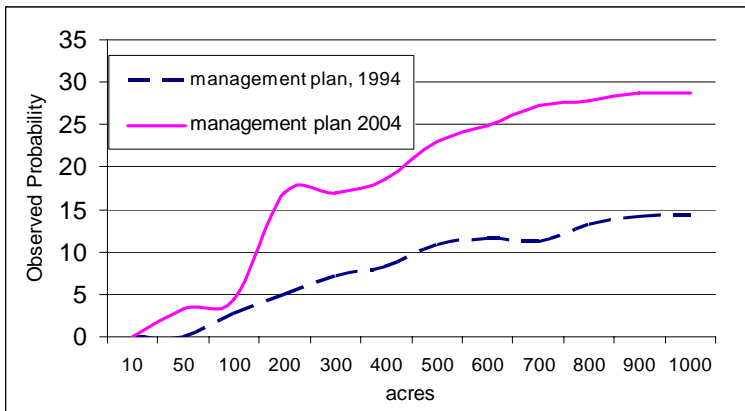


Figure 2.4: Future Intention of the family forestland weighted by ownership in 2004.

a)



b)



c)

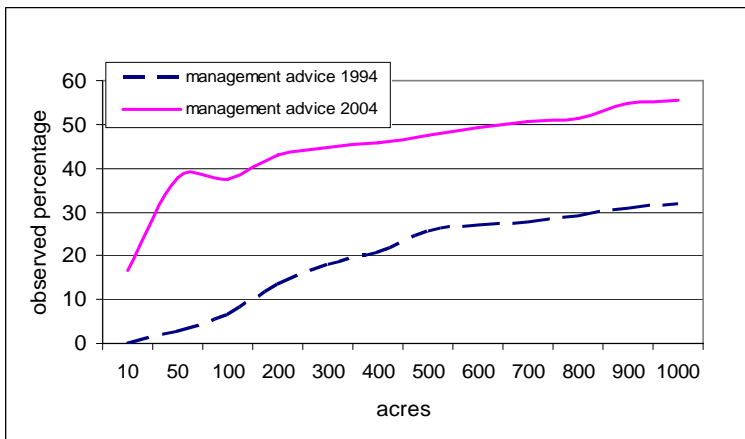


Figure 2.5a): Timber harvesting rate reported, 1994 and 2004; 2.5b) Percentage of written management plan, 1994, 2004; 2.5c) Management advices received, 1994, 2004.

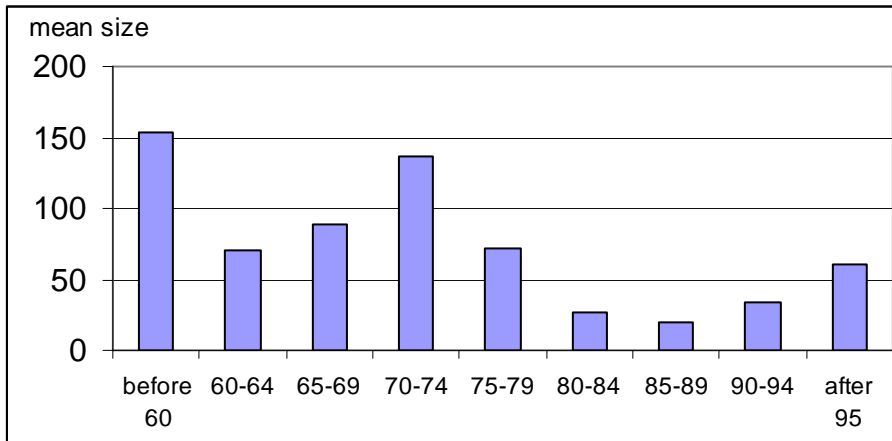


Figure2.6: Mean of holding size and the year of land acquisition in Alabama
Note: The mean is estimated based on the transaction for every 5 years.

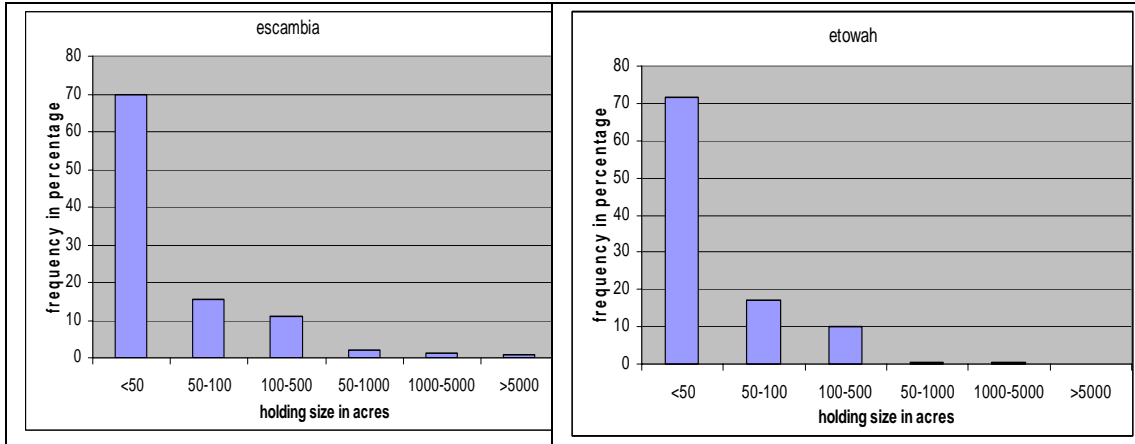


Figure 3.1: Frequency of owners by holding size in Escambia and Etowah county

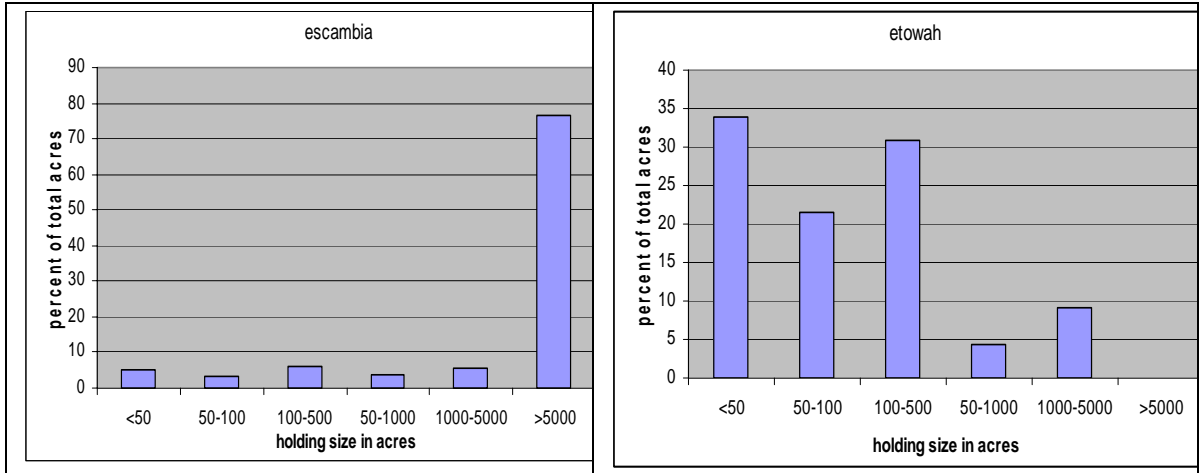
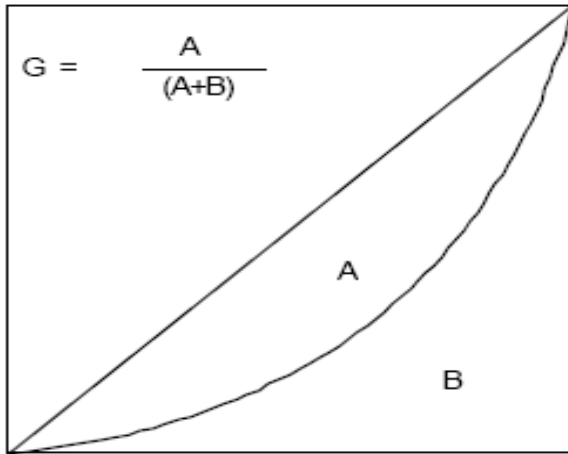


Figure3.2: Percentage of total acres by holding size in Escambia and Etowah county

Percent of acres



Percent of owners (from small owners)

Figure 3.3: Lorenz curve for forestland distribution

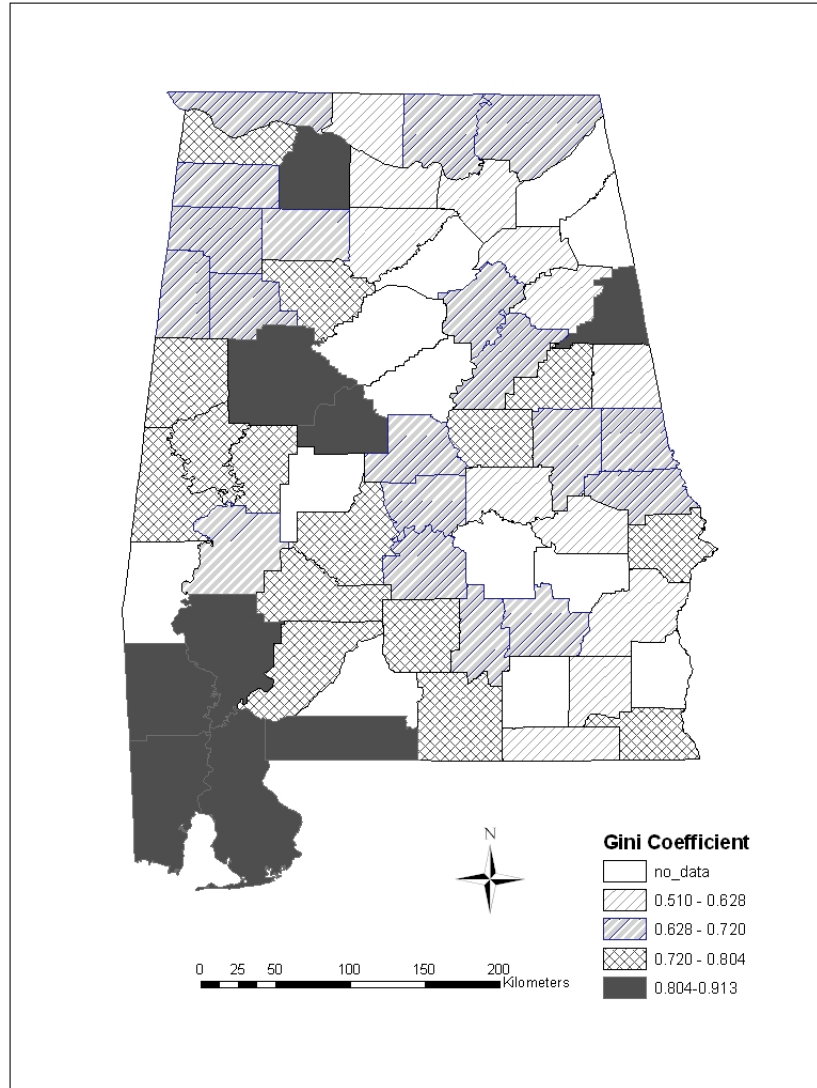


Figure 3.4: Gini coefficient of forestland distribution in 55 counties in Alabama

Table 2.1: Forestland area in Alabama by ownership, 2004 (1000 acres, standard errors in parentheses)

All ownerships	Public				Private		
	Total ^a	Federal ^a	State ^a	Local ^a	Total ^a	Family ^b	Business ^b
22,987	1,291	928	241	122	21,696	15,343	6,353
(196)	(95)	(85)	(36)	(25)	(204)	(212)	(166)

^a Source: Smith et al. (2004).

^b Including corporations, non-family partnerships, tribal lands, non-governmental organizations, clubs, and other non-family groups.

Table 2.2: Area and number of family owned forests by size of landholdings, 1978, 1994, 2004

Size of holdings (Acres)	Area			Number		
	1978 ¹	1994 ²	2004	1978 ¹	1994 ²	2004
	<i>Thousands (Percentage)</i>			<i>Thousands (Percentage)</i>		
1-9	634.1 (3.2)	675 (6)	996 (6.5)	326.4 (76.1)	308 (69)	284 (65.9)
10-49	1049.9 (5.3)	1953 (16)	1,342 (15.3)	36.1 (8.4)	91.8 (21)	95 (22.1)
50-99	2069.1 (10.5)	1243 (10)	1,347 (8.8)	29.3 (6.8)	19.8 (4)	21 (4.9)
100-499	5980.8 (30.3)	4985 (34)	4,802 (31.3)	31.9 (7.4)	22.5 (5)	26 (6.1)
500-999	2018.7 (10.2)	1314 (11)	1,815 (11.8)	3 (0.7)	2.1 (0.47)	3 (0.6)
1000-4999	3413.8 (17.3)	1882 (16)	2,869 (18.7)	1.8 (0.4)	1.2 (0.27)	2 (0.4)
5000+	4589 (23.3)	852 (7)	1,171 (7.6)	<1 (<0.1)	<1 (<0.1)	<1 (<0.1)
Sub Total over 10	19121.3 (96.8)	12229 (94)	13,346 (93.5)	102.1 (33.9)	137.4 (31)	147 (34.1)
Total	19755.4 (100)	12005 (100)	15,343 (100)	428.8 (100)	445.5 (100)	432 (100)

Source:

1. Rosen, J.F. and L. Doolittle (1987)
2. Birch, T.W. (1996).

Table 2. 3: Holding sizes with age, income, land tenure and harvests (ANOVA)

		Holding sizes			F-test	P-Value
		1-10 acres	10-200 acres	>200 acres		
Age (year)	N	22	143	150	4.47	0.0122
	MEANS	48.4	53.3	55.4		
	(S.D.)	(15.54)	(12.99)	(12.87)		
Income (\$)	N	21	124	137	18.53	<0.0001
	MEANS (\$in1994/in2004)	31,111 /39,511	34,533 /43,857	52,715 /66,948		
	(S.D.)	(20,144)	(24,200)	(28,799)		
Land tenure (year)	N	19	140	149	15.9	<0.0001
	MEANS	18.47	22.47	31.75		
	(S.D.)	(4.14)	(4.97)	(7.59)		
^a Harvest (a)	N	23.00	150.00	156.00	26.01	<0.0001
	MEANS	0.35	0.67	0.90		
	(S.D.)	(0.49)	(0.47)	(0.30)		
^b Motivation for Timber Production	N	3.00	68.00	120.00	22.51	<0.0001
	MEANS	4.67	3.01	1.62		
	(S.D.)	(1.53)	(2.10)	(1.06)		
2004 data						
Age	N	10	83	111	2.23	0.1105
	MEANS	56	63.73	64.68		
	(S.D.)	(9.66)	(11.45)	(13.4)		
Income	N	10	71	97	16.55	<0.0001
	MEANS	34,500	46,900	93,970		
	S.D.	(13,430)	(39,310)	(68,360)		
Land tenure	N	9	66	91	6.15	0.0027
	MEANS	28.89	27.64	38.56		
	S.D.	(7.46)	(4.95)	(13.65)		
^a Harvest	N	19.00	105.00	135.00	21.27	<0.0001
	MEANS	0.53	0.78	0.97		
	S.D.	(0.51)	(0.42)	(0.17)		
^b Motivation for Timber Production	N	18.00	96.00	128.00	44.69	<0.0001
	MEANS	6.22	3.56	1.97		
	S.D.	(1.48)	(2.37)	(1.7)		

Note:

a. Harvest in 1994 and 2004 are dummy variables within which 1 stands for yes and 0 stands for no.

b. Motivation for timber production in 1994 was ranked among other 9 motivations. And in 2004, this variable was rated as numbers from 1 to 7 in which 1 stands for most important and 7 stands for least important.

Table3.1. Summary Statistics and Description of Dependent and Independent Variables

Variable	Description	Mean	Std Dev
GINI	Gini coefficient of forestland distribution	0.71	0.08
MEAN	Mean holding size of forestland	150.34	83.42
LE200	Percent of forestland in holding less than 200 acres	0.37	0.17
LA2000	Percent of forestland in holding larger than 2000 acres	0.32	0.16
POPD	Persons per square mile	75.74	71.23
OLDP	Percent of persons 65 years old and over	0.14	0.02
RUPO	percent of rural population	0.7	0.24
BLAP	Percent of black or African American persons	0.27	0.22
INCP	Per capital money income (\$10000)	1.57	2.24
POVT	Percent of population below poverty	0.19	0.07
EDUC	Percent of population 25+ with bachelor's degree or higher	0.13	0.05
FORC	Percent of forestland(thousand acres/square miles)	0.65	0.15
AVLQ	Weighted average land capacity class of counties	4.38	0.79

Table 3.2: Regression results on factors influence forestland holding and distribution

	MEAN	GINI	LE200	LA2000
Variables	Coeff. (t-ratio)	Coeff. (t-ratio)	Coeff. (t-ratio)	Coeff. (t-ratio)
ONE	89.152 (0.057)	-5.273*** (-2.711)	11.008 (1.640)	-41.204*** (-2.606)
POPD	-23.343 (-0.984)	-0.020 (-0.737)	0.116 (0.827)	-0.154 (-0.604)
OLDP	-87.811 (-1.619)	-0.146** (-2.463)	0.662** (2.337)	-0.738 (-1.199)
RURP	0.195 (0.400)	-0.002*** (-3.242)	0.002 (1.021)	-0.011** (-2.116)
BLAK	14.010 (1.407)	-0.013 (-1.132)	-0.034 (-0.639)	-0.188 (-1.523)
INCP	22.622 (0.134)	0.603*** (2.902)	-1.303* (-1.787)	4.037** (2.410)
POVT	53.766 (1.035)	0.125* (1.888)	-0.559** (-2.136)	1.000* (1.723)
EDUC	6.503 (0.162)	-0.126** (-2.499)	0.230 (1.075)	-0.941** (-2.204)
FORC	46.010** (2.088)	0.086*** (3.066)	-0.390*** (-2.768)	0.800** (2.538)
AVLQ	-9.602 (-0.905)	0.001 (0.107)	0.052 (0.800)	0.145 (1.047)
R2	0.56	0.38	0.61	0.42
Adjusted R2	0.47	0.26	0.53	0.3

Note: *, ** and*** denote significances at 0.10, 0.05 and 0.01.