FINANCIAL RATES OF RETURN ON SHORTLEAF PINE STANDS IN ARKANSAS BETWEEN 1978 AND 1995

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ABSTRACT.—The objectives of this study are to estimate the annual rate of change in value of Arkansas' shortleaf pine forests using financial maturity concepts and to compare it to the change in other forest types and alternative investment options. Timber Mart-South stumpage price data were combined with inventory data spanning 17 years from the USDA Forest Service, Southern Research Station, Forest Inventory and Analysis (FIA) unit. Two distinct FIA survey periods were utilized, resulting in a study period ranging from 1978 to 1995. The average annual real rate of return on all Arkansas timberland investments during this time frame was 5.8 percent using simple financial maturity and 3.3 percent using adjusted financial maturity. Stands comprising primarily of shortleaf pine outperformed these state averages during this period, averaging 6.5 percent and 3.9 percent annually using simple and adjusted financial maturity models, respectively. Average annual rates of change in value were computed and compared for shortleaf pine and four other forest-type groups. Additionally, comparisons were made between forest type and ecoregion to determine which scenario produced the maximum rate of return. The highest earning shortleaf stands were found in the Arkansas Valley section of the State, with value changes of 8.2 percent per year for the simple financial maturity model and 6.9 percent per year for the adjusted model.

INTRODUCTION

Historically, shortleaf pine (*Pinus echinata* Mill.) ecosystems have played an important role in Arkansas forest lands, supporting hundreds of plant and animal species. Because of its many timber, nontimber, and ecosystem benefits, there is strong interest in maintaining and restoring shortleaf pine ecosystems. For this to happen, shortleaf pine must be viewed as a viable financial investment by forest managers and landowners, particularly the private landowners who control 58 percent of the state's timberlands (Rosson 2002).

This study investigates biological and financial growth rates of undisturbed stands in Arkansas by applying Timber Mart-South (TMS) stumpage prices to Forest Inventory and Analysis (FIA) sample trees. Each FIA sample tree was assigned a dollar value based on species, size, and condition. Saw-log trees were divided into multiple products (saw log and topwood) and rough cull trees were treated as pulpwood. The tree values were summed for each plot to derive the total plot stumpage value in dollars per acre.

STUDY AREA

The study area consists of the 75 counties of Arkansas, with the emphasis on timberlands. Timberland is defined as land that is at least 10 percent stocked by trees of any size, or formerly having such tree cover, and not currently developed for nonforest uses (Fig. 1). Minimum area considered for FIA classification and measurement is 1 acre.

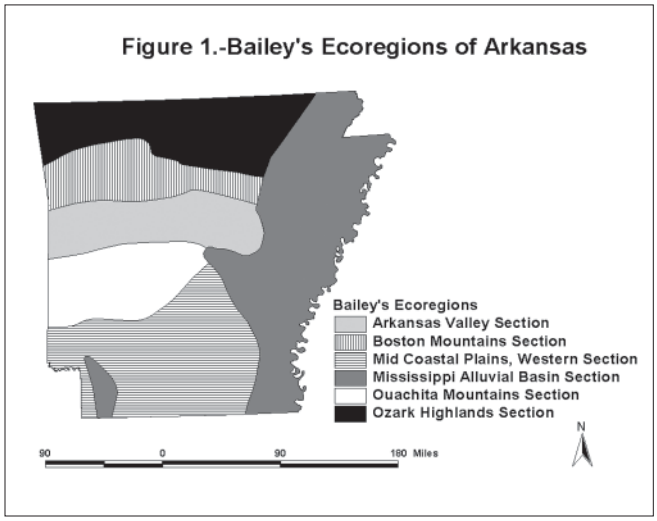

Figure 1.—Ecoregions (by section) of Arkansas (Bailey 1996).

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METHODS

Two time periods coinciding with FIA surveys of Arkansas were investigated: 1978-1988 and 1989-1995. Plots had to meet the selection for both time periods in order to be included in the study.

Plot Selection

Value change computations require input from two points in time. Therefore, when the 1978-1995 period is discussed, 1978-1988 is time 1 and 1989-1995 is time 2.

All plots must be classified as forested for all survey periods in question. All time 2 plots must be classified as saw log-size stands, while time 1 plots may be either poletimber-size or sawtimber-size stands. Stands classified as seedling/sapling in either survey are omitted. All time 2 stands must have at least 5,000 board feet per acre. Several plots classified with forest types of elm-ash-cottonwood were excluded because of insufficient sample size (less than 10 plots for each survey period). All stands with evidence of management, disturbance, or harvesting for the survey periods in question, as well as the previous survey period, were excluded. This exclusion was necessary, as total plot values and volumes depend on the inventory of the stand when visited by cruisers. In almost every case, stands had less volume and value after undergoing management practices such as thinnings. Therefore, these stands are dropped from the study and only those stands that remained relatively undisturbed were included. A total of 330 plots met the selection criteria (Table 1).

Tree Selection

All live trees greater than or equal to 5.0 inches diameter at breast height (DBH) were included in the sample set, except rotten cull trees. Rough cull tree volumes were given pulpwood value. No cull trees were used in sawtimber computations. Tree selection was performed by variable radius sampling (37.5 basal area factor). Since tree selection was performed by variable radius sampling, new trees appear over time. These new trees were included in all computations and therefore affect growth and value changes. Trees that died between survey periods were included only in the survey year(s) in which they were alive. This approach could create negative biological and economic value growth between surveys.

Timber Mart-South Data

This study uses TMS price data to calculate individual tree values. TMS has been collecting delivered prices and stumpage prices for 11 southern states since December 1976. All TMS price data are nominal. Real prices were calculated using the U.S. Bureau of Labor Statistics all commodities producer price index. As 1987 was the midpoint of the study period, all TMS prices were inflated/deflated to 1987 levels.

Tree Products and Values

The algorithm used for determining tree products was: 1) all poletimber-size trees are used for pulpwood; 2) the entire volume of rough cull trees, even sawtimber-size trees, is

Table 1.—Average annual biological growth percent (BGP)[1], real timber value growth percent (TVG)[2], and real forest value growth percent (FVG)[3] by forest type, Arkansas 1978-1995.

Forest Type	N	BGP	TVG	Land Value Dollars per Acre 250	500	750	1000	1250	1500
		percent							
Loblolly pine	11	4.92	8.47	6.99	6.06	5.39	4.88	4.47	4.13
Shortleaf pine	54	3.22	6.50	5.26	4.49	3.94	3.53	3.19	2.92
Shortleaf pine-oak	35	2.38	5.04	4.11	3.50	3.05	2.71	2.44	2.22
Loblolly-hardwood	18	3.40	7.70	5.95	4.96	4.29	3.79	3.41	3.10
Oak-hickory	122	2.50	5.72	4.31	3.53	3.01	2.63	2.34	2.12
Oak-gum-cypress	90	2.28	5.07	4.13	3.52	3.09	2.76	2.49	2.28
Statewide	330	2.67	5.80	4.57	3.84	3.34	2.96	2.66	2.42

[1]The average annual change in volume expressed as a percentage.
[2]The unadjusted annual real rate of return.
[3]The adjusted annual real rate of return uses land value to account for opportunity costs.

used for pulpwood; 3) the saw-log section of sawtimber-size trees is used for sawtimber; and 4) the section between the saw-log top and 4-inch DOB pole top is used for pulp and often referred to as topwood. Poletimber-size trees are softwoods 5.0 to 8.9 inches DBH and hardwoods 5.0 to 10.9 inches DBH. Sawtimber-size trees are all softwoods that are at least 9.0 inched DBH and hardwoods that are at least 11.0 inches. Cull trees are trees that are less than one-third sound.

In 1981, TMS began to report southern pine chip-n-saw prices. Therefore, the two survey periods after this time included a third product, southern pine chip-n-saw. Chip-n-saw trees are southern pines 9.0 to 12.9 inches DBH. All trees less than 9.0 inches are still treated as pulpwood, and trees greater than or equal to 13.0 inches DBH are treated as sawtimber trees. This modification was made for the 1988 and 1995 survey periods.

FIA traditionally computes all board foot volumes in International 1/4-inch log rule. Most of the TMS price data is in Doyle log rule. To accommodate the price data, all FIA tree volumes were recalculated using the Doyle formula. In a few instances, prices are reported in Scribner log rule. To accommodate this, the Doyle prices for these few instances were converted to Scribner prices by multiplying the Doyle price by 0.75 (Timber Mart-South 1996).

The TMS reports include a low, high, and average price for standing timber for various products. This report does not consider peeler logs or poles and piling as possible products because determining these products from FIA data is questionable. Omitting these classes allows for a slightly conservative approach to estimating tree and stand value. FIA data contain information on species, product size (poletimber or sawtimber), and quality (tree class and tree grade). Prices for each section of the tree were assigned based on these factors. These prices were then applied to the different sections of a tree.

Growth Models

Timber volumes and values are summed for each plot. These totals are then used as inputs for the growth models. Three growth models were used in this study. Each is based on the formula used in determining average annual change.

Timber value growth (TVG) is a simple financial maturity model that considers only the actual change in value for a plot for the survey period in question. Incomes derived from future stands are ignored (Hartsell 1999). The basic formula for TVG is:

$$TVG = [(TVF/TVP)^{1/t} - 1] * 100$$

where

TVG = timber value growth percent
TVF = ending sum of tree value on the plot at time 2
TVP = beginning sum of tree value on the plot at time 1
t = number of years between surveys

Forest value growth (FVG) includes the value of land in the computation of economic value change (Hartsell). The formula for FVG is:

$$FVG = [((TVF + LVF) / (TVP + LVP))^{1/t} - 1] * 100$$

where

FVG = forest value growth percent
TVF = ending sum of tree value on the plot at time 2
LVF = ending land value
TVP = beginning sum of tree value on the plot at time 1
LVP = beginning land value
t = number of years between surveys

FVG is an adjusted financial maturity model. Adjusted financial maturity concepts account for all implicit costs associated with holding timber. These are sometimes referred to as opportunity costs. In doing so, revenues from future stands are accounted for. One method of adjusting the model is to include bare land value (LV) in the equation, because bare LV accounts for future incomes and the inclusion of LV adjusts the simple financial maturity model. This study computes multiple FVGs using LVs ranging from $250 per acre to $1500 per acre in $250 increments.

Biological growth percent (BGP) is similar to TVG, except it uses timber volumes instead of timber values. The BGP model accounts for the actual annual change in tree volume for a plot over a survey period. The BGP model is the same as the TVG model, except it uses the sum of tree volumes on the plot instead of the sum of tree values (Hartsell 1999).

RESULTS AND DISCUSSION

Initial investigations analyzed value growth based on various plot strata such as county, ownership, and forest type. Table 1 details the sample size, BGP, TVG, and FVG of Arkansas timberlands by forest type. FVG is computed in $250 increments ranging from $250 to $1,500. This sample set is more likely to represent true trend for the extended period as it contains only plots that met the selection criteria for all three surveys. All financial rates of return are real, meaning that inflation has been removed, and all returns are over and above inflation. Table 1 reveals that loblolly pine (*Pinus taeda* L.) stands outperformed all other stands in terms of biological and economic growth. Average loblolly stand volume increased 4.9 percent per year, while these stands earned nearly 8 percent per year using the simple model. The adjusted rates of return for mature loblolly stands ranged from 4.1 percent to almost 7 percent per year, depending on land value.

While stands comprising primarily shortleaf pine generally failed to outperform loblolly pine, it is not to the degree that many would expect. Additionally, shortleaf pine stands grew at a faster rate (3.2 percent) than the statewide average (2.7 percent). Shortleaf pine stands outperformed the statewide averages in terms of economic rates of return as well.

Shortleaf pine stands earned 6.5 percent per year using the simple financial maturity model, while the statewide average for all stands was 5.8 percent. The same pattern holds true for the adjusted model at all land values.

Landowners may use Table 1 as a guideline for the rates they might expect to earn on their timberlands if they know the value of their land or nearby parcels. They should use an estimate representing the average land value of their tract for the time period. Table 1 illustrates the effect that land value has upon rates of return and management decisions. The interaction of land value and timber value is an interesting dynamic. As land value increases, the rate of return decreases. There may come a point where land value will play a greater role than timber values in determining land use.

Another avenue of investigation involves stratifying value change not on a plot or condition level variable such as ownership or forest type, but on ecoregion. Bailey (1966) classified six different ecoregions for the State (Fig. 1). The Arkansas Valley section proved to have the highest rates of return, both biologically and economically. Stands in this section grew on average 3.3 percent per year and earned almost 7 percent per year using the simple model and 4 percent per year using the adjusted model with a $750 per acre land value (Table 2). The Ozark Highlands section was the second fastest growing region, growing 2.9 percent per year. However, this section's economic performance did not reflect its growth rates. This section was ranked third in terms of TVG and last in FVG for a number of reasons, including species, quality, tree size, and possible products.

Stratifying the data by both forest type and ownership reveals that shortleaf pine is generally the best performing forest type in those ecoregions where loblolly pine is absent. In fact, the Mid Coastal Plains section is the only ecoregion where there is more than one pure loblolly stand in the data set (Table 3). Shortleaf pine stands are the top ranked species in the Arkansas Valley section in both biological and financial growth. And while shortleaf pine stands are only ranked third in both BGP and FVG in the Ouachita Mountains section, the top two types, loblolly-hardwood and oak-gum-cypress, have only two and three plots, respectively, in the data set. The 4.6 percent FVG for shortleaf pine stands in the Arkansas Valley section is the second highest annual rate of return of any forest type that has at least five plots in any ecoregion.

Comparing the rates of return from timberlands to other investment options yields interesting results (Table 4). Using the simple financial maturity model (TVG), shortleaf pine stands outperforms all other investment options except the Dow Jones Industrial Average and the S&P 500 Stock Index. The results differ, however, when using the adjusted model. Arkansas' shortleaf pine timberlands continue to rank higher than certificates of deposits and U.S. Treasury Bills, but fail to match the returns found in stocks and bonds. However, the 3.9 percent real annual rate of return on shortleaf stands for this period occurred on unmanaged stands. It is important to note that forest management has the potential to increase the earnings on these lands.

This study did not consider the effects of taxes. The impacts of taxes paid or tax exemptions for the various investment options were not taken into account. These have the potential to affect the final rates of return. The stands must be completely liquidated to meet the specified rate of return. The landowner maintains possession of the land. Income from selling the land is not included. Bare LV change over time is not considered. The purpose for holding LV constant is to help determine the rate of return from the timber on the

Table 2.—Average annual biological growth percent (BGP)[1], real timber value growth percent (TVG)[2], and real forest value growth percent (FVG)[3] by ecoregion, Arkansas 1988-1995.

Bailey's ecological section	N	BGP	TVG	FVG
Arkansas Valley	41	3.35	6.96	3.95
Boston Mountains	56	2.42	5.62	3.02
Mid Coastal Plains	72	2.82	6.43	3.83
Mississippi Alluvial Basin	68	2.33	4.94	2.98
Ouachita Mountains	65	2.57	5.36	3.26
Ozark Highlands	28	2.89	5.89	2.85

[1]The average annual change in volume expressed as a percentage.
[2]The unadjusted annual real rate of return.
[3]The adjusted annual real rate of return with land value = $750 per acre.

Table 3.—Average annual growth percent (BGP)[1], real timber value growth percent (TVG)[2], and real forest value growth percent (FVG)[3] by forest type and ecoregion, Arkansas 1988-1995.

Forest type	N	BGP	TVG	FVG
		percent		
Arkansas Valley Section				
Shortleaf pine	20	4.10	8.18	4.60
Shortleaf pine-oak	7	1.86	4.45	2.75
Oak-hickory	8	3.27	6.63	3.79
Oak-gum-cypress	6	2.65	6.23	3.36
Boston Mountains Section				
Shortleaf pine	2	3.43	7.51	4.32
Shortleaf pine-oak	4	4.14	7.99	4.26
Oak-hickory	50	2.25	5.35	2.87
Mid Coastal Plains Section				
Loblolly pine	9	4.97	8.51	5.50
Shortleaf pine	1	4.21	5.99	4.49
Shortleaf pine-oak	2	1.48	5.66	3.27
Loblolly-hardwood	15	3.36	7.56	4.25
Oak-hickory	17	2.44	5.93	3.45
Oak-gum-cypress	28	2.12	5.54	3.33
Mississippi Alluvial Basin Section				
Loblolly pine	1	4.65	7.35	3.23
Shortleaf pine-oak	1	0.73	4.05	2.66
Loblolly-hardwood	1	2.51	7.96	3.86
Oak-hickory	14	2.54	6.35	3.47
Oak-gum-cypress	51	2.25	4.46	2.84
Ouachita Mountains Section				
Shortleaf pine	30	2.62	5.37	3.48
Shortleaf pine-oak	18	2.14	4.47	2.82
Loblolly-hardwood	2	4.10	8.63	4.77
Oak-hickory	12	2.82	5.91	3.00
Oak-gum-cypress	3	2.56	6.33	3.85
Ozark Highlands Section				
Loblolly pine	1	4.72	9.21	6.60
Shortleaf pine	1	2.10	5.33	3.26
Shortleaf pine-oak	3	3.82	5.83	3.54
Oak-hickory	21	2.66	5.53	2.42
Oak-gum-cypress	2	3.44	8.41	4.26

[1]The average annual change in volume expressed as a percentage.
[2]The unadjusted annual real rate of return.
[3]The adjusted annual real rate of return with land value = $750 per acre.

Table 4.—Average annual real rates of return, expressed as a percentage, for Arkansas timberlands and alternative investment option, 1978-1995.

Investment options	Average annual rate of return
Timber value growth percent (TVG)[1] – all stands	5.80
Forest value growth percent (FVG)[2] – all stands	3.34
Timber value growth percent (TVG)[1] – shortleaf stands	6.50
Forest value growth percent (FVG)[2] – shortleaf stands	3.94
1-month certificate of deposit	2.68
6-month certificate of deposit	2.89
1-month treasury bill	2.10
6-month treasury bill	2.09
AAA corporate bonds	4.40
Dow Jones industrial average	5.61
S&P 500 stock index	5.92

[1]The unadjusted annual real rate of return.
[2]The adjusted annual real rate of return with land value = $750 per acre.

tract. Including changing land values is a study in real estate or land plus timber. Landowners and resource mangers need to know if managing for timber is a wise investment option for their holdings.

Regeneration costs, and other silvicultural practices, are excluded from the analysis as well. Returns from intermediate harvests, thinning, and costs of land improvements are not included. Therefore, foresters and land managers have the potential to improve upon these rates through species selection, intermediate practices, and final products the stands produce.

The results of this study indicate that shortleaf pine stands can be profiTable. In certain areas of the State, the Arkansas Valley section in particular, shortleaf appears to be the species of choice. This observation is particularly true when one considers that the rates discussed were from unmanaged stands and do not include changes in land value. Both of these factors have the potential to greatly improve upon the financial gain and make Arkansas' shortleaf pine stands competitive with other investment options.

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