Journal of the Arkansas Academy of Science

Volume 48 Article 17

1994

Effect of Product Price, Interest Rates and Forestry Incentives on Financial Returns from Arkansas' Nonindustrial Private Forests

James R. Jolley
University of Arkansas at Monticello

Richard A. Kluender
University of Arkansas at Monticello

The Effect of Product Price, Interest Rates and Forestry Incentives on Financial Returns from Arkansas' Nonindustrial Private Forests

James R. Jolley and Richard A. Kluender
School of Forest Resources
University of Arkansas at Monticello
Monticello, AR 71656

Abstract

As the U.S. population increases, demand for Arkansas' forest production will continue to increase. Nonindustrial private forests (NIPF) will be increasingly relied upon to meet future demand. Restocking following harvest and good forest management techniques have not always been practiced on NIPF lands. Federal cost sharing programs exist which encourage investment in forestry; federal programs may pay up to half of establishment and management costs. Special federal capital gains treatment and other tax incentives also exist for nonindustrial landowners; however, nonindustrial use of incentives is not great.

Models were developed to determine whether actual stumpage prices and existing economic incentives were sufficient to cover the investment cost of establishment and owning and holding the stand. Using site indexes of 70 and 80 (base 50) for loblolly pine plantations, stand value and opportunity costs were compared annually over the life of a 40 year rotation. Long-term U.S. Treasury Bond rates and a flat 6% rate of return were used to estimate opportunity costs on an after tax basis. Investment costs were estimated with and without using existing economic incentives.

Results show that if front-end costs of establishment are low, stand value is virtually certain to be greater than opportunity costs. This was true even on low site index tracts with high opportunity costs. Without incentives, investment success is subject to stumpage price fluctuations especially when high opportunity costs are in place. Policy recommendations include increasing present efforts to inform NIPF landowners of incentive opportunities to encourage development of private forest resources. If private landowners have the proper information, they are more likely to improve their personal situation and enhance forest productivity.

Introduction

Non-industrial private landowners (NIPL) hold 57% (9.8 million acres) of the timber land in Arkansas. The forest industry controls 25% (4.4 million acres), and public agencies the remaining 18% (3.1 million acres) (USDA, 1992a). Approximately 52% of the Arkansas' softwood harvest and 29% of the hardwood harvest come from private forest industry lands. Public agencies supply 9% of the State's hardwood and softwood harvest. Nonindustrial private land provides the remaining 39% of the state's softwood harvest and 62% of the hardwood harvest (USDA, 1988).

In Arkansas during 1988 for all ownership and forest types (17.2 million acres), approximately 4.0 million acres (24%) were ready for final harvest. Some 8.0 million acres (46%) of the timberland supported young, well-stocked stands where no obvious treatment was required to enhance growth. However, about 2.9 million acres (17%) of the State's timberlands were so poorly stocked that establishment of new stands was needed. The remaining 2.4 million acres (13%) required commercial thinning or other stocking control. Of the 9.8 million nonindustrial acres in Arkansas, approximately 2.5 million acres (26%) were ready for final harvest. Some 4.1 million acres (41%) were in no obvious need of treatment to enhance prospective growth. About 1.3 million acres (13%) required commercial thinning or other stocking control. The remaining 1.9 million acres (20%) were poorly stocked and needed to be reestablished. Of the state's poorly stocked timberland requiring reestablishment, 67% was on nonindustrial private lands (USDA, 1992a).

After growth and removals from 1978 to 1988, the average annual net growth in Arkansas declined from 50 to 45 ft^3 per acre. The average annual net growth of pine was down 16%, while hardwood growth increased by 5%. Most of the reduction in pine growth occurred on nonindustrial private lands where net pine growth was down 22%. At the same time, most of the increase in net hardwood growth was on nonindustrial private lands (USDA, 1992a). It is not surprising that in a recent study Greene and Blatner (1987) found that over two thirds of the nonindustrial private landowners did not practice forest management, even though 38% of nonindustrial private landowners had named timber as a primary goal of holding forest land.

As the population in the U.S. increases, demand for Arkansas' forest production will increase. Public forests are increasingly coming under scrutiny. Limitations on

harvesting methods and annual harvest quotes are being enacted. Private industrial forests are producing at near maximum levels. Nonindustrial forests remain as the only domestic source to draw from (USDA, 1988).

Arkansas' nonindustrial forest landowners have cost sharing and tax incentives available to encourage investment in their forests; however, these incentives are often not used. Given the non-use of cost sharing and tax incentives, the question arises whether stumpage prices are sufficient for forestry investment to compete with alternative investment choices.

Cost Sharing Incentives.--Incentive programs have been instituted by Congress to encourage nonindustrial private landowners to establish and manage forests. The cost sharing programs include: the Stewardship Incentives Program (SIP), the Forestry Incentives Program (FIP), and the Conservation Reserve Program (CRP). In order to receive SIP funds, the landowner must have an approved management plan developed under the Stewardship Program (SP) which provides technical assistance instead of cost sharing (Arkansas Forestry Commission, 1990).

The SP began in 1990 and is administered by the USFS. The program is intended to promote and recognize good land stewardship by private nonindustrial landowners. To be eligible for the SP, a private landowner must own a minimum of 40 acres with at least 10 acres of it in forests, and must have the desire to manage the land for multiple resources (Arkansas Forestry Commission, 1990). SP is administered cooperatively at the state level by the Arkansas Forestry Commission (AFC) and several other agencies. Management objectives in addition to timber production include: wildlife, recreation, soil and water protection, and aesthetics. Once a landowner has an approved management plan. he can apply under SIP for cost share assistance to carry out recommended practices.

SIP cost sharing is set at 50% of the state wide average cost so the landowner must make a commitment to invest some his own capital as well. Areas of cost sharing include: 1) tree planting, 2) timber stand improvement, 3) soil/water protection and improvement, 4) riparian and wetlands protection and improvement, 5) fisheries habitat protection and improvement, 6) wildlife habitat protection and enhancement and 7) forest recreation enhancement.

FIP was authorized by Congress in 1973 to provide cost sharing with private landowners solely for tree planting and timber stand improvements. Funding for FIP ceases in 1995 and the program is being augmented/replaced by SIP (M. Phillips, pers. comm.). SIP has multiple management objectives, whereas FIP only has timber as the objective. The percentage of cost sharing is based on U.S. Forest surveys of total, eligible, private timber acreage and acreage potentially suitable for production of timber products. Cost sharing state wide for Arkansas is set at 50%. Cost share income is generally considered to be tax free (USDA, 1981). Monitoring for compliance with FIP regulations and technical assistance are provided by the Arkansas Forestry Commission (D. Grimmett, pers. comm.).

CRP was authorized by the Food Security Act in 1985. The intent of the program is to protect the nation's natural resource base by removing highly-erodible and eroding cropland out of production. In addition to protecting soil, benefits are expected to include: 1) improved water quality, 2) reduction in surplus commodities, 3) reduced sedimentation, 4) long-term timber supplies, 5) improved wildlife habitat (AGFC, 1986). CRP is administered by Agricultural Stabilization and Conservation Service (ASCS) at the federal level and carried out by the Soil Conservation Service (SCS) on the local level. Under CRP the landowner makes an agreement with the USDA to set aside an area of land for a period of at least ten years to establish trees. During the agreement period, the USDA pays the landowner up to $50 per acre annually for rent of the land and 50% of the establishment costs. When a landowner applies for CRP, the SCS informs the landowner how much will be paid in rent and cost-share benefits (M. Phillips, pers. comm.).

Nonindustrial Landowner Use of Cost Share Incentives in Arkansas.--Table 1 shows the number of acres planted in Arkansas under SIP, FIP, and CRP from 1986 to 1993. During the period from 1975 to 1989, the number of acres planted to trees under FIP and CRP was 247,931.2 acres. For the same period, 372,000 acres were planted on nonindustrial private lands (USDA, 1992a). Thus, approximately 67% of the acres planted on nonindustrial private lands was done with the benefit of FIP and CRP. Most nonindustrial private landowners do not exercise enough foresight to achieve adequate stocking using natural regeneration methods (D. Grimmett, pers. comm.).

Tax Incentives.--Federal tax legislation provides significant advantages to nonindustrial private forest landowners. The 1943 Revenue Act and Section 631 of the Internal Revenue Code allow income from both timber sales and timber use by owners to be taxed under capital gains rates which are lower than the marginal rates for ordinary income. This treatment continues to exist to present, although the capital gains rate is now significantly higher than it once was. In 1980 Public Law 96-451 was passed to encourage investment by nonindustrial landowners (USDA, 1988). This law stipulates a 10% investment tax credit plus an initial seven year amortization on the first $10,000 of capitalized reforestation expenditures during one year (USDA, 1988).

The Tax Reform Act of 1986 established two tax brackets of 15% and 28% (Church, 1986). The effect is that capitalized forestry expenses are taxed at the marginal tax rate. The seven year amortization schedule, 10% investment tax credit for reforestation, and the expensing of

annual management costs is retained (USDA, 1988). The Tax Reconciliation Act of 1993 added a 36% and 39.6% marginal tax rate to the existing 31% bracket for ordinary income. The 31% bracket was added under the 1990 Revenue Reconciliation Act. Timber income qualifying for capital gains treatment can take advantage of a substantially lower rate than required for ordinary income (Haney, 1993).

Table 1. Acres planted in Arkansas under various incentive programs, 1975 to 1993.[A]

Fiscal Year	CRP	FIP	SIP	Year Total	NIPF Area Planted [B]
1975-1982	-	67,328	-	67,328	118,000
1983	-	11,057	-	11,057	20,000
1984	-	11,925	-	11,925	16,000
1985	-	13,948	-	13,948	23,000
1986	10,487.2	13,823	-	24,310.2	24,000
1987	31,908.9	8,547	-	40,455.9	45,000
1988	27,523.3	11,146	-	38,669.3	64,000
1989	28,202.3	12,035.5	-	40,237.8	62,000
1990	13,464.4	12,618.8	-	26,083.4	C
1991	7,407.3	11,673.3	-	19,080.6	C
1992	7,962.9	12,652.4	-	20,615.3	C
1993	9,879.4	13,575.2	1,355.5	24,810.1	C
Totals	136,835.9	200,329.2	1,355.5	338,520.6	372,000

A Sources: U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service. Internal Report, and U.S. Department of Agriculture. [Annual Issues.] Agricultural statistics 19xx. U.S. Government Printing Office, Washington: 19xx.
B Sources: U.S. Department of Agriculture, Forest Service, [Annual Issues.] U.S. forest planting report. Washington, DC.
C Data not available.

Nonindustrial Private Landowners as Forest Investors.--The main issue for nonindustrial land owners considering forest investment is whether or not forestry is as profitable as other investments. The forest investment must meet or exceed the rate of return on alternative investments or the investor faces an opportunity cost. The yearly opportunity cost of holding timber as a capital asset is the interest charge on the value of the timber. The appropriate rate of return is the highest rate that the investor could earn on capital invested elsewhere with similar risk and duration (Pearse, 1967). With an appropriate interest rate, the total holding cost of a stand can be compared annually to the value received if the standing timber were liquidated. If the stand value is greater than or equal to the total holding cost, then the nonindustrial owner knows that if he were to sell his timber, the price received would cover his owning and holding cost. Additionally, if this condition exists, then price is at least the long-run equilibrium price which is sufficient to prompt reinvestment.

Given the non-use of cost sharing and tax incentives, the question arises whether stumpage prices are sufficient for forestry investment to compete with alternative investment choices. The objectives of this research were: 1) to determine whether stumpage prices that a NIPF landowner would receive at any point in the rotation would cover the owning and holding costs of growing timber up to that time; 2) to examine historical trends in stumpage prices and existing economic incentives to determine if a suitable environment is present for the landowner to invest in forestry and; 3) to compare investment opportunities with and without forestry incentives.

Methods

The total cost of owning and holding and the value of a forest stand were examined annually for a nonindustrial private landowner. A routine treatment regime was used to simulate a cut-over loblolly pine plantation. PCWTHIN version 2.0, growth and yield forecasting and planning tool (Weih and Scrivani, 1990) was used to predict growth and yield for a 40 year sawtimber rotation in Arkansas. Assumptions for the simulation were that pine seedlings were hand planted with 8' by 10' spacing on two Coastal Plain soils having a site index of 70 and 80 (base 50). A site index of 70 is low for the Arkansas' Coastal Plain, while site index 80 is average. The two sites were used to determine the effect of timber volume changes in the model. Several treatments were applied during the simulated rotation. Site preparation consisted of a prescribed burn and single chop disking. A chemical release was performed to control undesirable vegetation. Prior to harvests, prescribed burns were performed to gain better access for subsequent inventory/marking and control of undesirable vegetation. Between harvests, a prescribed burn was executed for fuel reduction to decrease the risk of wildfire and to control undesirable vegetation. Tables 2 and 3 show the silvicultural activity, costs with and without SIP incentives, and timber volumes for the simulated stands. Estimated yields from the program for site 70 and site 80 were compared with actual yields in Arkansas to validate the model (R.A. Williams, pers. comm.).

Treatment costs (1992) were used for Coastal Plain sites were taken from Belli et al. (1993). Seedling costs (1993) were taken from Arkansas Forestry Commission nursery price schedules (D. Grimmett, pers. comm.). Stumpage prices for 1960 to 1992 in Arkansas were taken from Timber Mart-South (Data Resources Inc, 1986), and USFS data for Louisiana (USDA, 1990).

Table 2. Simulated treatments used in model development, Site index 70 (base 50).

Year	Activity	Cost*	Volumes**	
Date / No.	Establishment, Harvest, or Treatment	Nominal / Real	Pulpwood Cords Bfr/After	Sawtimber BDFT Doyle BftAfter
1953 / 0	Prescribed burn, Single chop, Hand Plant 8x10, Chemical Release	216/154 / 110/78	0	0
1967 / 15	Prescribed Burn	8/6 / 3/2	7.8	0
1972 / 20	Prescribed Burn, Inventory, Marking, Row-Low Thin 1:4 Rows BA 60	21/15 / 16/12	14.4/ 10	262.6/ 241.1
1977 / 25	Prescribed Burn	8/6 / 3/2	9.8	1921.9
1982 / 30	Prescribed Burn, Inventory, Marking, Free Thin BA 60	21/15 / 16/12	9.6/ 4.7	4023.1/ 2802.4
1987 / 35	Prescribed Burn	8/6 / 3/2	3.8	4755.2
1992 / 40	Prescribed Burn, Inventory, Marking, Final Harvest	21/15 / 16/12	2.6/ 0	7196/ 0

*Cost $/acre without SIP/with SIP, constant dollar (real) dollars are from 1983 base. Amounts rounded to whole dollars.
**Volumes are on a per acre basis.

Table 3. Simulated treatments used in model development, Site index 80 (base 50)

Year	Activity	Cost*	Volumes**	
Date / No.	Establishment, Harvest, or Treatment	Nominal / Real	Pulpwood Cords Bfr/After	Sawtimber BDFT Doyle BftAfter
1953 / 0	Prescribed burn, Single chop, Hand Plant 8x10, Chemical Release	216/154 / 110/78	0	0
1965 / 13	Prescribed Burn	8/6 / 3/2	9	0
1970 / 18	Prescribed Burn, Inventory, Marking, Row-Low Thin 1:4 Rows BA 70	21/15 / 16/12	14.5/ 11.6	482/ 445.4
1974 / 21	Prescribed Burn	8/6 / 3/2	11.4	2119.2
1977 / 25	Prescribed Burn, Inventory, Marking, Free Thin BA 70	21/15 / 16/12	11.2/ 6	3792.9/ 3079
1980 / 28	Prescribed Burn	8/6 / 3/2	5.3	4397
1984 / 31	Prescribed Burn, Inventory, Marking, Low Thin BA 60	21/15 / 16/12	4/ 1.6	7033/ 4978.3
1988 / 36	Prescribed Burn	8/6 / 3/2	1.5	6931.6
1992 / 40	Prescribed Burn, Inventory, Marking, Final Harvest	21/15 / 16/12	1.3/ 0	9335.9/ 0

*Cost $/acre without SIP/with SIP, constant dollar (real) dollars are from 1983 base. Amounts rounded to whole dollars.
**Volumes are on a per acre basis.

The cost of each management treatment was compounded from the year it was incurred during the rotation using annual yield (annual interest rate) during June for long-term U.S. Treasury Bonds. The U.S. Treasury Bond yields are commonly used in economic analysis as a comparison against forestry investments because the bonds are

of low risk and long duration. Treasury Bond yield data was obtained form the Federal Reserve Bank in Dallas, Texas (U.S. Federal Reserve, 1994a). The compounded costs were summed as they occurred. Since the nonindustrial private landowner owner makes the decision each year whether to liquidate the stand or allow it to grow, there is an annual opportunity cost in addition to the compounded costs. The annual opportunity cost was represented by multiplying the current value of the stand by the Treasury Bond annual yield. The annual opportunity cost was added to the compounded costs to simulate total holding cost for each year. The stand value for the year is the volume of the standing timber times the current price. Sawtimber and pulpwood were the only products considered in stand value. During harvest years, volume was removed form the stand. Stand value was accordingly reduced. The disposition of revenue garnered from harvests was not reinvested in the forest or used to diminish the total holding cost. Nonindustrial private forest owners commonly use the harvest revenue to purchase desired goods and services such as a new car, college education for children, etc. (R.L. Willett, pers. comm.). All dollar amounts were adjusted to constant dollars using average annual Consumer Price Index (CPI) data from the Federal Reserve Bank in Saint Louis, Missouri (U.S. Federal Reserve, 1994b). The previously cited CPI data was also used to adjust all annual interest rates to real interest rates (Buongiorno and Gilless, 1987). The equation used to calculate the annual stand value was:

$$S_t=(V_{Pt}xP_{Pt})+(V_{St}xP_{St})$$

S_t = Stand value at year t
V_p = Pulpwood volume, time t
P_p = Pulpwood price, time t
V_s = Sawtimber volume, time t
P_s = Sawtimber price, time t

The annual holding cost was calculated by:

$$TC_t=(S_t \cdot i_t)+\Sigma[c_n \cdot (1-m) \cdot (1 + i_n)^{t-n}]$$

TC_t = Total holding cost in year t
S_t = Stumpage value of stand in year t
i_n = Annual yield or opportunity cost of alternative investment in year n
c_n = Treatment cost that occurred in year n
m = Marginal tax rate
t = Time (years) since rotation was initiated
n = Year treatment performed

The total holding cost was adjusted to an after-tax basis using both federal and state rates for Arkansas. The owner's income was assumed to be in the 28% bracket for federal and the 6% bracket for state taxes for an aggregate tax of 34%. (Arkansas Department of Revenue, 1993). Three pairs of total holding cost series were calculated. In the first pair, one series included the reduction of costs provided by SIP federal cost sharing funds along with seven year amortization of capitalized reforestation expenditures on federal income taxes. The other series did not include any incentives or tax considerations. The second pair was the same as the first except a 6% (after tax) rate for the entire period was used vice the Treasury Bond Yield rates. The 6% rate was used to show sensitivity to changes in rates and represents a realistic long-term rate for investment. The third pair used the 6% (after-tax) rate and average period constant-dollar prices (pulpwood \$12.58/cd, sawlogs \$132.40/mbf) to show sensitivity to stumpage price change.

Results

Figures 1 and 2 show constant dollar and nominal prices for pulpwood and sawtimber respectively. Constant dollar pulpwood prices increased from 1982-84 and decreased from 1985-91. Otherwise they remained relatively constant throughout the rotation. Constant dollar sawtimber prices increased from 1972-79 and in 1992. Otherwise prices remained relatively constant throughout the rotation.

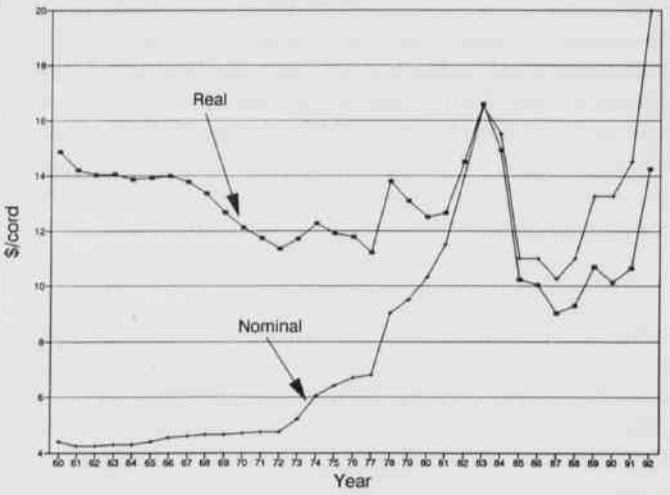

Fig. 1. Constant dollar and nominal pulpwood prices for Arkansas, 1960 - 1992.

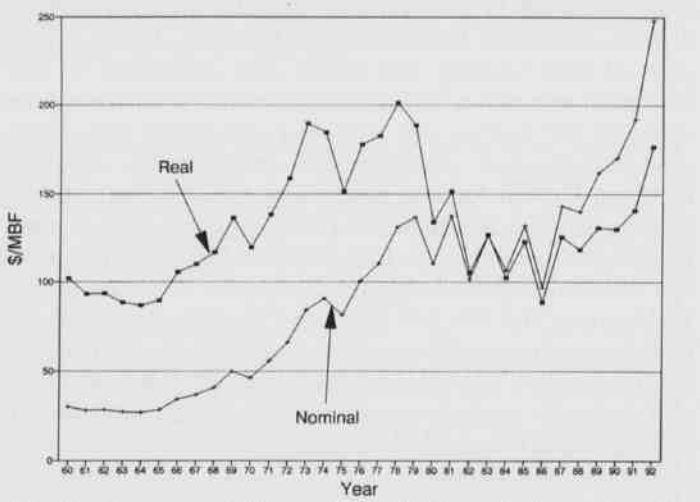

Fig. 2. Constant dollar and nominal sawtimber prices for Arkansas, 1960 - 1992.

Figure 3 shows the results for the model of the plantation on site index 70 with the yield of a then-current Treasury Bond (real) used as the investment opportunity cost to estimate total holding cost. When SIP and amortization incentives are used, the stand value clearly exceeds the total holding cost throughout the rotation after the trees reach merchantable size. When SIP and tax incentives are not included, the stand value exceeds the total holding cost from 1974 to the end of the rotation. Fig. 4 shows the model on site index 80 soil with Treasury Bonds (real) used to estimate total holding cost. With SIP and amortization, again the stand value overwhelmingly surpasses the total holding cost once the trees attain merchantable size. With no incentives, the stand value exceeds total holding cost from 1967-92, except in 1971 after the first thinning.

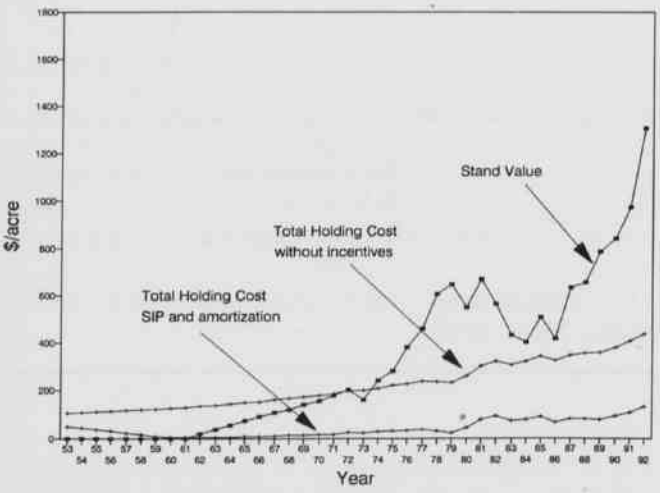

Fig. 3 Simulated stand value, and total owning and holding cost based on constant dollar stumpage prices with and without investment and tax incentives for SI 70, after tax basis using U.S. Treasury Bond interest rates (real) 1953-1992.

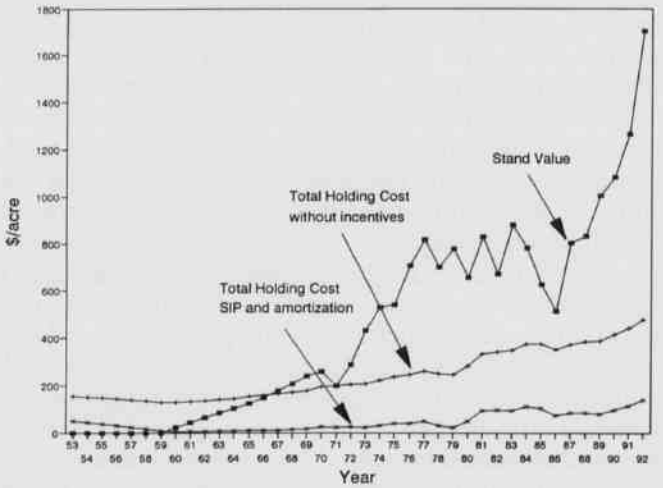

Fig. 4. Simulated stand value, and total owning and holding cost based on constant dollar stumpage prices with and without investment and tax incentives for SI 80, after tax basis using U.S. Treasury Bond interest rates (real), 1953-1992.

Figure 5 depicts the Treasury Bond annual yields (nominal and real) for each year during the rotation. Note when treatment costs were incurred, the real annual yields were between 2% and 4%. Exceptions were 9% in 1982 and 5% in 1970 for site indexes 70 and 80 respectively. Treatment costs during these years were low compared to the cost of establishment. Figures 6 and 7 portray the two simulated rotations with a flat 6% (real) rate during the entire rotation driving total holding costs. The 6% (real) rate causes the total holding costs to increase markedly and shift upward compared to the Treasury Bond (real) rates. Note that a 6% (real) rate more appropriately reflects a true opportunity cost for long-term investment than does the Treasury Bond (real) rate. For the site index 70 plantation, the stand value only surpasses the total holding cost from 1978-81 and in 1992 (Fig. 6). For site index 80, the stand value exceeds the total holding cost during 1973-84 and 1991-92 (Fig. 7). Recall that when the Treasury Bond (real) rates were used to estimate total holding costs, the periods which the stand value exceeded the total holding costs were much longer. Additionally, the margins between stand value and the total holding costs were greater. The 6% (real) rate used for estimating total holding costs shows that without SIP and tax incentives, nonindustrial private landowners are more susceptible to

loss when stumpage prices fall. At the 6% (real) rate, the problem is exacerbated when the site index is low (70) as shown in Fig. 6. The stand value only exceeds the total holding costs for brief periods. However, when the 6% rates were used along with SIP and tax incentives, for both site indexes, the stand value was greater than the total holding costs from the time the trees became merchantable until the end of the rotation.

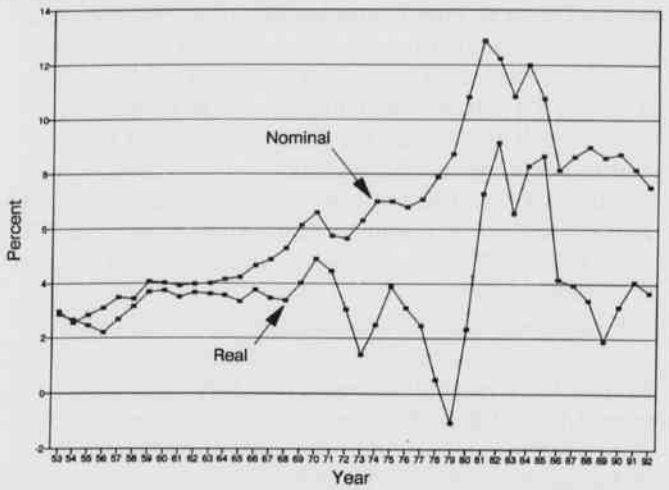

Fig. 5. U.S. Treasury Bond yield rate (nominal and real), 1953-1992.

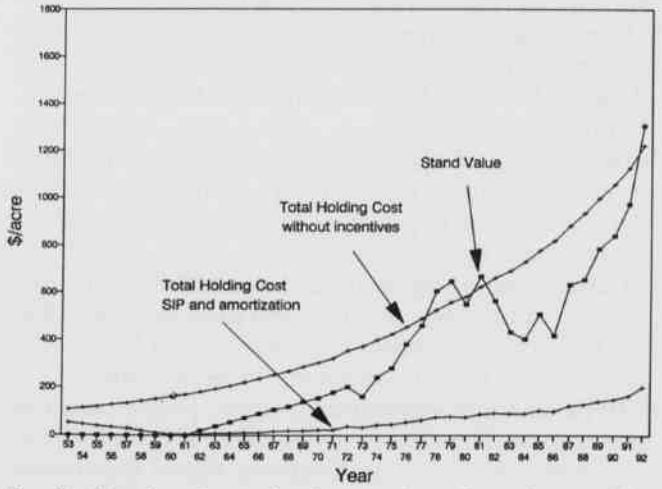

Fig. 6. Simulated stand value, and total owning and holding cost based on constant dollar stumpage prices with and without investment and tax incentives for SI 70, after tax basis using 6% real alternative interest rates, 1953-1992.

Figures 8 and 9 show the two site indexes with the 6% (real) rate and average period constant-dollar stumpage prices. Again for both site index 70 and 80 when SIP and

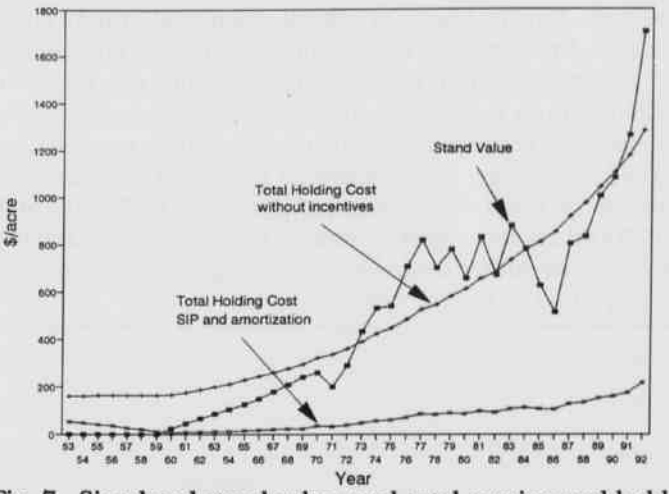

Fig. 7. Simulated stand value, and total owning and holding cost based on constant dollar stumpage prices with and without investment and tax incentives for SI 80, after tax basis using 6% real alternative interest rates, 1953-1992.

tax incentives are employed, stand value exceeds total holding cost for the entire period once timber is merchantable. However, for site index 80 without economic incentives, the number of years when stand value surpassed total holding cost decreased compared to when price were not averaged (Fig. 7). Similarly, without economic incentives on site index 70 (Fig. 8) stand value is never greater than total holding cost. Averaging prices over a long period such as a 40 year rotation removes the variability of business cycles from stumpage returns. It is this average price that an investor must use in making investment plans, although high markets concurrent with timber maturity are always yearned for.

Conclusions

Reducing or eliminating the high front-end costs (capitalized costs) of site preparation and planting is critical for NIPF landowners. Reduction of front-end costs becomes more important as opportunity costs rise and is especially critical on lower quality sites. Tax and cost sharing incentives available for regeneration and management activities can provide the single most effective means for overcoming front-end and opportunity costs for NIPF landowners once the decision concerning site preparation and regeneration method has been made. As the SI increases, the NIPF landowner is more assured of not suffering a loss when prices decrease. Better sites will always be better investments. NIPF landowner success in forest investment relies heavily on selling when product prices

Journal of the Arkansas Academy of Science, Vol. 48 [1994], Art. 17

are high. This is especially critical when opportunity costs are high. Product price information is critical to sale timing.

Policy recommendations following from this research include: (1) an increased educational effort by consultants, universities and extension agents should be targeted on NIPF landowners; (2) educational programs should stress the use of federal cost sharing programs (FIP, SIP, and CRP) and tax incentives to reduce front end costs; and (3) educational efforts should stress the importance of market timing in NIPF timber sales.

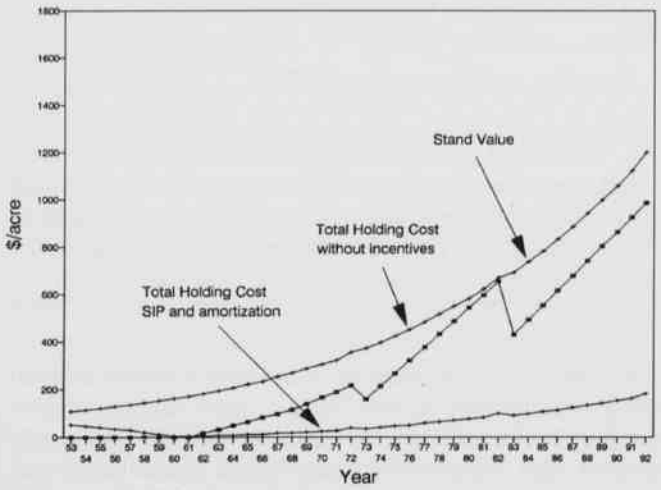

Fig. 8. Simulated stand value, and total owning and holding cost based on constant dollar average stumpage prices with and without investment and tax incentives for SI 70, after tax basis using 6% real alternative interest rates, 1953-1992.

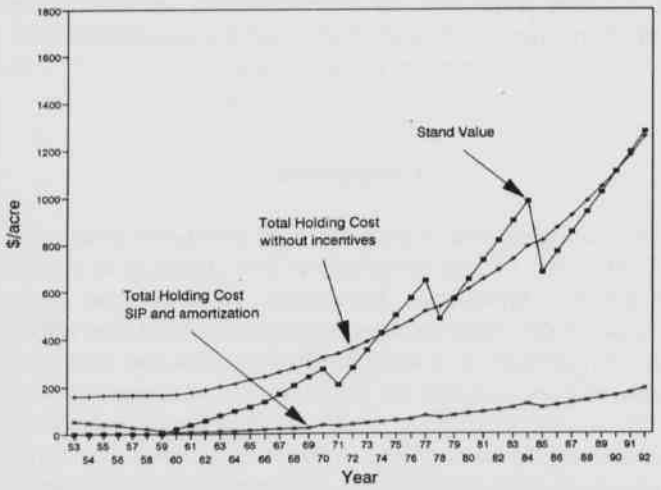

Fig. 9. Simulated stand value, and total owning and holding cost based on constant dollar average stumpage prices with and without investment and tax incentives for SI 80, after tax basis using 6% real alternative interest rates, 1953-1992.

Literature Cited

Arkansas Department of Revenue. 1993. Arkansas 1993 individual income tax booklet. State Income Tax. Little Rock, Arkansas.

Arkansas Forestry Commission. 1990. The Arkansas forest stewardship program. Pamphlet (no series number).

Arkansas Game & Fish Commission. 1986. Wildlife habitat improvements through the conservation reserve program. Pamphlet (no series number).

Belli, M.L., T.J. Straka, M. Dubois, and **W.F. Watson.** 1993. Costs and trends for forestry practices in the south. Forest Farmer. 52:25-31.

Buongiorno, J. and **J.K. Gilless.** 1987. Forest management and economics. MacMillian Publishing. New York, NY.

Church, G.J. 1986. The making of a miracle. Time. August 25, 1986, p 12-18.

Data Resources Inc. 1986. Stumpage prices for pine sawlogs and pine pulpwood in Arkansas. Timber Mart-South, 1984 yearbook. Lexington, MA.

Greene, J.L. and **K.A. Blatner.** 1987. Woodland owner characteristics associated with timber management. Arkansas Farm Research. 36:11.

Haney, H.L. 1993. Should you tailor forest management to current tax law?. Forest Farmer. 52:15-17.

Pearse, P.H. 1967. The optimum forest rotations. Forestry Chronicle. June, pp. 178-195.

U.S. Department of Agriculture. 1981. Forestry as an investment in the South. Forest Service. General Report SA-GR 20. Washington, D.C.: Government Printing Office.

U.S. Department of Agriculture. 1988. The south's fourth forest: Alternatives for the future. Forest Service. Forest Resource Report No. 24. Washington, D.C.: Government Printing Office.

U.S. Department of Agriculture. 1990. U.S. timber production, trade, consumption, and price statistics 1960-88. Forest Service. Misc. Publication No. 1486. Washington, D.C.: Government Printing Office.

U.S. Department of Agriculture. 1992a. Forest resources of Arkansas. Forest Service. Resource Bulletin SO-169. New Orleans, Louisiana. Southern Forest Experiment Station.

U.S. Department of Agriculture. 1992b. Stewardship incentives program - Arkansas. Soil Conservation Service. Amendment 3, Paragraph 21, p. 16-17. Washington, D.C.: Government Printing Office.

U.S. Federal Reserve Bank, Dallas, TX. 1994a. Long-term U.S. Treasury Bond rates time series. A dial-in computer bulletin board for statistical series.

U.S. Federal Reserve Bank, St. Louis, MO. 1994b. Long-term consumer price index time series. A dial-in com-

puter bulletin board for statistical series.

Weih, R.C., Jr. and **J.A. Scrivani.** 1990. PC THIN, a growth and yield simulator of loblolly pine. Virginia Polytechnic Institute and State University. School of Forest and Wildlife Resources.