SHORT TERM EVALUATIONS OF ALTERNATIVE INVESTMENT AND ESTATE PLANNING STRATEGIES ON PRIVATE NONINDUSTRIAL FORESTS

by

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(ABSTRACT)

The purpose of this study is to analyze the effects of selected tax provisions and management strategies on the profitability of the forest assets over a short time horizon. The subject matter is organized into three separate and independent analyses.

First, two major federal estate tax provisions, special use valuation and deferral and extension of estate tax payments are reviewed. Requirements are discussed and the economic implications of electing these options are modeled for a simulated forest estate over a 15 year period. The preferred choice when the estate is retained or sold by the heirs is with the election of a combination of special use valuation and deferral and extension.

In the second analysis, timber growth is simulated for loblolly management regimes to determine whether thinning is financially the preferred choice. Selected alternatives for stand thinning age and rotation age with two planting densities and site indices 60 and 70 are evaluated for row

and low thinning and for several assumptions on stumpage price responsiveness.

The final study again looks at estate tax implications for hypothetical forest estates and includes loblolly pine growth in the model. The objective is to evaluate the estate tax impacts at different stages of timber growth and to determine how to best incorporate estate planning The amount of tax depends on the valuation method and stage in growth. The greatest estate taxes are generally incurred when timber value is based on the capitalization of future income from the woodlands and with older stands. Marital deduction planning is dependent on the rate of timber value appreciation.

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Chapter I

INTRODUCTION

The opportunities and problems facing private nonindustrial forestland (PNIF) owners have been gaining considerable attention (Sedjo and Ostermeier 1978). These owners control a majority of the commercial timberland, and therefore management practices on their lands are an issue of public concern.

However, low productivity from PNIF lands could adversely affect future timber supplies. These lands have the potential to substantially increase their output of timber if PNIF owners can be encouraged to invest in forest management (NFPA 1980; USDA Forest Service 1980). Forest practices, particularly harvesting, though are often undertaken with little thought for reinvestment through reforestation. Other practices, such as thinning which offer the landowner opportunities for substantially improving returns and the value of the forest assets are frequently overlooked.

In order for PNIF owners to respond to forest management opportunities, these opportunities must compare favorably with other objectives. Also, owners average 60 years of age and have an expected tenure of 10 to 15 years (AFI 1972).

methods for evaluating the potential effects of a forest management investment should focus on outcomes in the short run.

Estate taxes can have a significant impact on forest investments. Many landowners who own forestland do so for the expressed purpose of building an estate and subsequently passing it on to their heirs (Fesco et al 1982). However, the preservation of managed woodlands in intergenerational transfers can be a difficult task due to a variety of problems which face forest estates. Some of the more serious difficulties encountered include liquidity for payment of death taxes and settlement costs, unavailability of credit due to the unimproved nature of the asset and inability to maintain management continuity (Olson, Haney and Siegel 1981; Siegel 1978; Sutherland 1978).

With the recent changes in the estate tax laws brought about by the Economic Recovery Tax Act of 1981 (ERTA), and the use of proper estate planning, forest estates of up to $1.2 million in value can escape taxation in 1987 and thereafter (USGAO 1981; Gingiss 1982). This could effectively eliminate a majority of estates from paying estate taxes. The actual acreage involved subject to estate taxes, however may still be substantial even though estate taxes will affect fewer estates, since these large-size

ownerships are controlled by a relatively few individuals[1] (Birch et al. 1982). Many of these ownerships have high estate values that will be liable for estate taxes at both the federal and state level. In addition, estate valued between $600,000 and $1.2 million may incur unnecessary estate taxes due to lack of proper planning[2].

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[1] Less than one percent of the private forest landowners own forestland greater than 500 acres. However they own 47.6 percent of the private forestland in the United States. Even though much of this acreage is controlled by non-family corporations there is still a significant amount that is owned by individuals.

[2] Ineffective use of the unified tax credit and marital deduction provisions can lead to additional estate taxes.

Chapter II

OBJECTIVES

The purpose of this study is to evaluate the effects of selected estate tax provisions and management strategies on the profitability of the forest assets over a short time horizon. The topics of discussion are organized in the following manner:

1. Examine the federal estate tax provisions, special use valuation (Section 2032A) and deferral and extensions of payment (Section 6166) and determine the preferred election of the two provisions under an inheritor's choice of retained ownership or sale of the property for a forest estate.
2. Evaluate selected management strategies for loblolly pine plantations with particular emphasis on the decision of whether to thin.
3. Look at the short term impacts of estate taxes on a forest estate at different stages in the growth of a loblolly pine plantation.

The intent is to first evaluate certain estate tax provisions in the context of a forest estate (Chapter III). In this analysis forest growth was assumed to be constant for the management regime employed. The fourth chapter

relaxes this assumption to examine loblolly pine management strategies and their impact on the value of the forest. In the fifth chapter the forest estate is again studied by simulating the growth of a loblolly plantation to determine the impacts of estate taxes and to develop procedures for integrating forest investments with estate planning.

The three chapters were originally written for journal submission and with modifications have been incorporated into the thesis. The first chapter is a revision of a portion of the thesis by Olson (1981) that was invalidated by the passage of ERTA. It also includes contributions from Dr. William C. Siegel.

Chapter III

PREFERRED ELECTION OF CERTAIN FEDERAL ESTATE TAX PROVISIONS

Certain estate provisions of the Federal 1976 Tax Reform Act were enacted to alleviate tax problems, specifically that of the illiquidity of the assets and forced sales to pay for estate taxes (USGAO 1981). These demand attention by private nonindustrial forest landowners who wish to have their woodland continue as a viable managed forest in future generations.

Special use valuation allows preferential treatment for estates whose primary resources are held in a farm or closely held business. If certain qualifying conditions are met, this provision permits the executor to value the estate on the basis of its "use" value rather than at fair market value (FMV) as determined by its highest and best use. Making the election will generally result in a reduced estate tax bill.

Another important provision permits deferral and extension (DAE) of payment of the estate tax attributable to the decedent's interest in a farm or closely held business[3]. If the qualifying conditions are met, these options can provide financial flexibility to qualifying estates and may

[3] IRC Section 6166

reduce the net present value of the estate tax.

The passage of the Economic Recovery Tax Act of 1981 (ERTA), resulted in the liberalization of some of the provisions in both the special use valuation (SUV) and DAE elections. In addition an executor is permitted to elect SUV for standing trees growing in a qualified woodland[4] (KIA 1981).

In most cases reduction and/or postponement of estate taxes will ease the transfer of forest property to the heirs. Savings can be substantial, particularly by reducing the estate's liquidity needs at the time of death. To obtain maximum tax savings, however, careful planning is required because of the restrictive legal requirements necessary to qualify for the two types of preferential treatment even though ERTA liberalized several of these provisions.

Certain adverse consequences may also arise with election of these provisions, either singly, or combined. The post mortem requirements for SUV are a particular problem. Sale of the estate to a non-family member or failure to manage the timberland in a qualified manner for 10 years following the decedent's death triggers the imposition of a recapture tax[5]. In the case of specially valued timber, no harvesting

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[4] IRC Section 2032(e)(13)

is allowed within ten years of death or an additional tax must be paid.

The SUV election may cause certain estates to lose their qualification for deferral and extension of tax payments. Election of these options requires that farm or closely held business assets comprise certain minimum percentages of the adjusted gross estate. The market value of the assets may satisfy the percentage requirements, but the lower special use value may not (Hjorth 1978).

Woodland owners and their prospective heirs are thus faced with a variety of financial considerations that may affect treatment and use of the inherited property. Clearly basic financial planning is required before and after the decedent's death to insure that the maximum tax advantage is achieved and the owner is able to pass the property to his heirs with his goals intact.

The objective of this study is to analyze the impacts on the forest estate of electing either special use valuation or deferral and extension of tax payments or both. Specific attention is focused on the inheritors' choice between retention or sale of the property within 15 years following

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[5] The act provides a special two year grace period immediately following the decedent's death in which failure by the qualified heir to use the property in the qualified use will not result in a recapture tax. IRC Section 2032(c)(7)(A)

the decedent's death.

SPECIAL USE VALUATION

Tax savings from election of special use valuation are permitted by decreasing qualified real property values to a maximum of $750,000[6]. For example, a qualifying taxable estate of $5,000,000 could be reduced to $4,250,000 which results in an estate tax reduction of $450,000 (in 1983). The tax savings can thus be substantial, but the requirements for qualification are strict (Table 1) and may often preclude the relief intended.

Prior to publication of the final treasury regulations governing special use valuation on July 31, 1980, it was unclear whether an election could be made to value less than all qualified real property in an estate. The issue is now clarified; such an election is permitted[7] provided that the 25 percent threshold requirement shown in Table 1 has been met by the property actually valued at use value. The election must be made not later than the time prescribed by law for filing the estate tax return including extensions thereof[8]. This is 9 months after the date of the decedent's

[6] Methods for determining special use values of farms and closely held business interests are defined in IRC Section 2032A(e)(7) and Section 2032(e).

[7] Treasury Regulation Section 20.2032-8(a)(2).

Table 1. Qualifications for federal estate tax special use valuation.*

1. Decedent must have been a U.S. citizen.
2. Property must be located in the United States.
3. Property must pass to a qualified heir (member of the family).**
4. Property must have been owned by the decedent and/or member of his family for at least five of the last eight years immediately before the decedent's death.
5. During at least five years of such ownership, the property must have been used for farming or a closely held business purpose, which includes timber growing, by the decedent or a member of his family.
6. The decedent and/or a family member must have materially participated in the operation of the business for at least five years of the last eight before the decedent's death, except that this requirement for retired and disabled decedents is measured during the eight years prior to the beginning of the disability or retirement.
7. All use valuations taken together (forest land and timber, farms and other qualifying property) cannot reduce the fair market value of the gross estate by more than $750,000.
8. The total property (both real and personal) qualifying for special use valuation must constitute, at fair market value, at least 50 percent of the decedent's adjusted gross estate (gross estate less debts and expenses).
9. The real property eligible for use valuation must constitute, at fair market value, at least 25 percent of the decedent's adjusted gross estate.
10. An agreement for use valuation must be signed by all persons who have inherited an interest in the forest land and filed with the estate tax return. The election can be made on a late return as long as it is the first return filed.
11. For the agreement to remain valid, the following requirements must be met for 10 years after the death of the decedent:
    a. Ownership must continue solely within the decedent's family.
    b. At least one member of the decedent's family must materially participate in management of the property during 5 of every 8 years. A less stringent "active management" test is substituted for "material participation" for surviving spouses and certain other clauses of heirs.
    c. During at least 5 of every 8 years, the property must be used and managed for special use.

*Section 2032A, Internal Revenue Code.

**(1) Ancestors of the decedent.

(2) Spouse of the decedent.

(3) Lineal descendents of the decedent, of the decedent's spouse, or of the decedent's parents.

(4) The spouse of any lineal descendent in (3) above.

death plus extensions granted by the Internal Revenue Service for periods up to 6 months[9]. However, under the provisions of ERTA, such an election may now be made on a late-filed return, as long as it is the first return filed[10].

Another requirement that is strictly construed is that the property must have been owned by the decedent or a member of his family and used for a qualifying purpose for at least 5 of the 8 years immediately preceding the decedent's death. In satisfying this requirement, tacking (aggregation) is permitted for replacement property acquired in like-kind exchanges and involuntary conversions[11]. However, proceeds from involuntary conversion must be reinvested in real property that is used for the same qualified use as was the original property[12]. Likewise, property received in a like-kind exchange must be employed in the same qualified use as was the property exchanged[13].

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[8] IRC Section 2032A(d).

[9] IRC Section 6075(a) and Section 6081.

[10] IRC Section 2032(d)(1).

[11] IRC Section 2032A(e)(14)(A).

[12] IRC Section 2032A(h)(1)(A).

[13] IRC Section 2032A(i)(1).

Particular problems have been encountered with respect to meeting the material participation requirement[14]. The timber example in the regulations suggests that the following activities are to be considered minimal to qualify for election:

1. Actively participating in management decisions such as where and when to conduct stand improvement operations.
2. Assuming financial responsibility for business expenses.
3. Reporting income from the tree farm business as earned income for purposes of computing the tax on self-employment income.
4. Retaining perogatives for approval of management plans submitted by consulting foresters.
5. Participating in the supervision of harvesting, marketing and replanting activities indicative of an ongoing business rather than of a passive investment.

Following the decedent's death, heirs are required to continue active operation of the property in its qualifying

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[14] IRC Section 2032(b)(1)(C)(ii) and Section 2032A(e)(6).

[15] The law was amended by the 1978 Revenue Act to provide that this requirement is not breached when property valued at special use is involuntarily converted. The proceeds from conversion, however, must be reinvested in

use for a period of 10 years[15]. Failure to do so[16] or disposition of any portion of the qualified real property (to anyone other than another family member) triggers the imposition of an "additional estate tax"[17]. This amounts to a recapture of the estate tax saved by special use valuation[18].

When special use valuation is elected, a federal tax lien arises on all qualified property to which the election applies[19]. The United States is secured during the 10 year period in which recapture-of-benefit taxes may be imposed by a first lien on the property in an amount equal to the potential additional tax liability. The estate may thus experience credit difficulties[20]. This situation was alleviated by the 1978 Revenue Act. The Secretary of the Treasury can now issue a certificate of subordination of the

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property that is used for the same purpose. IRC Section 2032A(h).

[16] Failure of the qualifying heir(s) to materially participate in management of the property, or actively manage it whichever may be required, for at least 5 years of any 8 year period following the decedent's death is also considered cessation of qualified use.

[17] IRC Section 2032A(c).

[18] IRC Section 2032A(c)(2).

[19] IRC Section 6324B.

[20] For instance, the Federal Land Bank System provides loans to woodland owners only where the property provides a first lien security.

government's lien if he determines that the interests of the United States are adequately protected thereunder[21]. Qualified heirs can avoid personal liability for recapture taxes imposed on their interests in the qualified property if they furnish a bond for the amount of additional taxes attributable to their proportion of ownership[22]. Government special valuation liens are automatically transferred to qualified replacement property when the special use assets are involuntarily converted and replaced with other property[23].

Prior to ERTA, the law included woodlands within the definition of qualifying property (see Utz, Siegel, and Gunter 1978), however, as Carter (1978) points out this was a Congressional afterthought. Thus a considerable lack of clarity existed with respect to application of special use valuation to forest property.

In an attempt to clarify the situation, Section 2032A was amended to provide special rules specifically for woodlands[24]. Timber may now be taken into account in determining whether the requirement that at least 25 percent

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[21] IRC Section 6325(d)(3).

[22] IRC Section 2032A(c)(5) and 2032A(e)(11).

[23] IRC Section 6324B.

[24] Section 2032A(c)(13) as added by Section 421(n).

of the estate's adjusted value consist of the adjusted value of real property qualifying for special use valuation (Condrell and Neidich 1982). However, if the timber is severed within 10 years of the election a recapture tax is imposed. On the other hand, if the special use election is not filed for timber, then the timber is treated as a crop and severence does not result in the extra tax (Hall 1982).

EXTENSIONS OF PAYMENT

Payment of the estate tax is generally due within 9 months of the decedent's date of death. Extensions of payment, however, can be obtained in certain situations (IRC Sections 6161, 6163 and 6166). Requirements for qualification among the various provisions vary considerably and not all estates can qualify for all options.

Reasonable Cause Extension

Section 6161 permits extensions for payment of estate tax for up to 10 years where "reasonable cause"[25] can be shown.

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[25] Reasonable cause is defined to include situations such as the following: (1) a significant portion of the estate is a farm or closely held business but does not qualify for a Section 6166 election (5 year deferral and 10 year extension) and there are insufficient funds to pay the tax, (2) the assets must be liquidated at a sacrifice price or in a depressed market, or (3) the estate does not have enough funds to pay the tax and provide dependent children without borrowing at an interest rate higher than generally available. Treasury Regulation

The extension may apply to part or all of the tax owed, or to any extended installment payment. Interest is charged at the regular rate[26].

Extension for Remainder Interests

Section 6163 permits an extension for payment of the estate tax due on reversionary or remainder interests in property. It cannot exceed 3 years and 6 months and also requires determination of reasonable cause[27].

Five Year Deferral and Ten Year Extension

Section 6166 permits an estate to elect to defer taxes attributable to a closely held business[28] for a period of 5

Section 20.6161-1.

[26] The rate is adjusted every year by October 15 to an amount equal to the average predominant prime rate quoted by commercial banks as determined by the Federal Reserve System, if the rate in effect the preceding September differs from the current prime rate by one percent or more. IRC Section 6621(b); Rev. Ruling 81-260, I.R.B. 1981-44.

[27] IRC Section 6163(b).

[28] For purposes of a Section 6166 election, an interest in a closely held business is defined as: an interest as a sole proprietorship; an interest in a partnership with 15 or fewer partners or in a partnership in which the decedent owned 20 percent or more of the business; or an interest as a stockholder in a corporation with 15 or fewer stockholders or in which the decedent owned 20 percent or more of the voting stock. IRC Section 6166(b)(1).

years to be followed by payments in a maximum of 10 equal annual installments. Interest must be paid during both periods. The rate is 4 percent on that portion of the tax attributable to the first one million dollars in value[29]. The regular rate is charged on the tax above this amount[30]. Interest is deductible as an administrative expense[31]. However, it may only be deducted as it accrues. Thus no deduction is allowable on the estate tax return for an estimate of interest expense to be included in the future[32]. This means that the entire estate tax will have to be recomputed after every payment if deductions are taken simultaneously.

To qualify for the Section 6166 election, 35 percent of the adjusted gross estate[33] must be comprised of a closely held business[34]. Farmhouses and related structures are includible to meet the 35 percent test for farms. It is not clear, however, that such structures may be included for

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[29] IRC Section 6601.

[30] See Footnote 26.

[31] IRC Section 2053(a)(2) as interpreted by Treasury Regulation Section 20.2053-3(a).

[32] Rev. Ruling 80-250.

[33] Gross estate less expenses, debts and administrative costs.

[34] IRC Section 6166(a)(1).

estates composed strictly of timberland.

Questions exist regarding the application of Section 6166 to woodland. It is not clear as to exactly what is meant by a "closely held business". For example, to what extent must business activity occur in a managed but otherwise inactive timber investment in order to qualify? Also, to what extent can timber lease arrangement qualify? One IRS ruling indicates that the mere leasing of farm land will not qualify as a business[35]. A later ruling, however, held that a sharecropping arrangement will qualify[36]. There is no indication, though, whether either applies to woodlands.

Termination of deferral and extension privileges occur and the remaining balance of the estate tax becomes payable immediately if any of the following situations occur:[37]

1. One half or more of the qualifying closely held business is sold, exchanged, or distributed.
2. One half or more of the assets of the business are withdrawn.
3. Any payment of interest or tax is not made within six months of its original due date[38].

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[35] Rev. Ruling 75-365, 1975-2 C.B. 471.

[36] Rev. Ruling 75-366, 1975-2 C.B. 472.

[37] IRC Section 6166(g)(1).

[38] A payment made within the six month "grace" period will not be eligible for the special 4 percent interest rate,

CHOICES AVAILABLE TO HEIRS OF FOREST LAND

Heirs to minimally planned estates have limited choices available. They can choose to retain and manage the property or they can sell or otherwise dispose of it. These basic choices are analyzed within the context of SUV and DAE for a hypothetical estate with a currently viable forestry business. After-tax (federal estate and income) estate values are computed to demonstrate how these two provisions might affect the heirs' financial decisions for forest assets. Four options incorporating SUV and DAE will be examined for each of the two choices of either selling or retaining the property. Accordingly heirs may elect: FMV, SUV, DAE, or SUV & DAE. These are considered for a 15 year period following the date of death in order to correspond to the statutory time requirements for SUV & DAE[39]. A simplified model of a closely held forestry business is used to illustrate the interaction of the 4 options.

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and a penalty of 5 percent per month of the amount of the payment will be imposed.

[39] The Economic Recovery Tax Act (ERTA) changed the recovery period of SUV from 15 to 10 years; DAE remains at 15 years (14 years 9 months).

Estate and Economic Assumptions

The assumptions applicable to the simulation are:

1. A decedent with a moderately large estate who dies in 1983 is the sole owner of the interests in property. No debts or liens exist against the estate and it is all transferred to the surviving spouse. However, the marital deduction is elected for half of the estate value allowing the other half to be taxed[40].
2. FMV of the gross estate is $3,000,000 composed of $1,200,000 in land, $1,000,000 in timber, $250,000 in principal residence and lot, $60,000 in personal property used in forestry operations and $490,000 in non-income producing other real and personal property.
3. Adjustments for SUV reduce the total gross estate value by $500,000 to $2,500,000[41]. This lowers the forestland value to $700,000 while other values remain the same. Timber is treated as a crop and is not specially valued.

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[40] The rational for electing 50 percent of the marital deduction is discussed later in the chapter.

[41] ERTA allows for up to a $750,000 reduction in estate value using special use valuation.

4. The proportion of estate assets that qualifies as a closely held business for deferral and extension is[42]:

a) FMV case

$$\frac{\text{Land + Timber + Business Property}}{\text{Adjusted Gross Estate}} = \text{Qualifying Percent (1)}$$

$$\frac{1{,}200{,}000 + 1{,}000{,}000 + 60{,}000}{2{,}907{,}000} = 78\%$$

b) SUV case

$$\frac{\text{Land + Timber + Business Property}}{\text{Adjusted Gross Estate}} = \text{Qualifying Percent (2)}$$

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[42] The respective percentages are used in determining qualification for election of DAE. The "adjusted gross estate" in equation (1) is the gross estate reduced by funeral and administrative costs, claims against the estate, and any indebtedness with respect to the decedent's property. A similar equation to (1) and (2), not shown here, is used to determine qualification for special use valuation. The "adjusted value of the gross estate, however, is defined to include only the of indebtedness against the estate. The qualifying property in this case is considered at its "most suitable use" value rather than at its "current use" value (West 1982).

$$\frac{700{,}000 + 1{,}000{,}000 + 60{,}000}{2{,}407{,}000} = 73\%$$

5. The federal estate tax is $395,081 and $304,511 for the FMV and SUV cases, respectively. Computations are summarized in Table 2.
6. A piggy-back state death tax[43] is assumed but state income taxes are not included in the analysis.
7. Average annual inflation of 7.8 percent for the 1970-80 decade will continue (U.S. Department of Labor, Bureau of Labor Statistics).
8. Average annual forest land appreciation includes a real price rise of 3 percent (Armstrong and Briggs 1979, USDA ERS 1977) and inflation of 7.8 percent.

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[43] This form of tax equals the maximum allowable credit for state death taxes against the federal estate tax. Under other state death tax forms, the combined federal-state levy may be greater (Olson, Haney and Siegel 1981), further reducing after-tax estate value. These include state estate taxes which are levied on the right to transmit property from the decedent's estate to the heirs and inheritance taxes which are levied on the right to receive property from the decedent's estate.

9. Average annual real timber value appreciation is 3 percent (USDA Forest Service 1973 1980). Average annual timber growth is 5 percent. Total current timber value growth is rounded to 17 percent[44].

10. No income to the decedent remains in the estate on the date of death. A current income of $50,000 from other sources, inflated annually, is available to the surviving spouse and one child for living expenses and payment of state and local taxes.

11. A selection silvicultural system on a 3 year cutting cycle incurs little or no regeneration cost but requires additional outlays necessary to maintain stocking levels[45]. These were established as a percent (1.6%) of the original growing stock value and appreciated annually at the rate of inflation.

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[44] Total current timber value growth = (1.05) (1.078) (1.03) = 1.1659.

[45] This is a conservative management plan under which inventory increases are in effect. Harvests were computed primarily on the basis of tax requirements. Although cutting growth or other alternatives may be more economically rational, the decision was postponed for the analysis period in order to isolate the legal and financial ramifications of estate elections.

Table 2. Federal estate tax calculation for the estate in 1983

Estate Assets	Market Value	Special Use Valuation
	($)	($)
Land	1,200,000	700,000
Timber	1,000,000	1,000,000
Miscellaneous Real and Personal Property	800,000	800,000
TOTAL GROSS ESTATE	3,000,000	2,500,000
Deductions		
Funeral Expenses	3,000	3,000
Administrative Costs	90,000	90,000
ADJUSTED GROSS ESTATE	2,907,000	2,407,000
Marital Deduction	1,453,500	1,203,500
TAXABLE ESTATE	1,453,500	1,203,500
Tentative Tax	535,905	429,235
Credits		
Unified Tax Credit	79,300	79,300
State Death Tax Credit	61,424	45,424
FEDERAL TAX	395,081	304,511

Model for Determining After-Tax Estate Values

The model used to compare the expected net estate value for the 4 options after harvesting timber to pay federal estate and income taxes utilizes the following computational steps:

1. Compute the estate tax payment due in each year[46].
2. Determine interest due on any extensions of payment. Rates of 4 and/or 20 percent are applied against the unpaid portion of estate tax remaining each year[47].
3. Determine the ordinary and necessary business expenses of the forestry operation.
4. Estimate the annual revenues required to pay the amounts in steps 1, 2, and 3. Determine the necessary harvest levels every third year to obtain the required annual revenues as well as the income tax on the harvest. The revenues from the harvest,

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[46] In year 1 this includes the minimum state death tax computed as the credit against the federal estate tax. For the FMV and SUV options, the entire estate tax levy is paid 9 months after death. For the DAE and SUV & DAE options, interest payments only are made for the first 5 years. Annual installments are then paid for the next 10 years.

[47] At the time of the analysis the interest rate charged on extension of tax payments for closely held business interests over $1,000,000 in value was 20 percent.

which are treated as installment sales, are received when required in intervening years[48].

5. Add the residual timber value to the current fair market value of personal property and land and deduct any outstanding estate tax debt to obtain the after-tax net value of the retained estate for the harvest years.

6. Adjust the current expected value and cost basis in land, timber and personal property for each time period.

An example of a retained estate value. To illustrate, the after-tax estate value for the SUV & DAE option in year 10 is calculated as follows: The preharvest expected value (current dollars) of the estate totals $8,242,956 which is comprised of $1,663,883, $3,329,485 and $3,249,588 in personal property, land and timber values, respectively. The estate tax installment payment ($22,266) is one tenth of the total extended tax ($222,658). The entire extension of the outstanding estate tax debt qualified for the 4 percent

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[48] The installment income from the harvest is added to the "other" assumed income. Income tax on that installment is therefore computed at the taxpayer's marginal tax rate. In harvest years the total harvest value is subtracted from the appreciated timber value to give the residual value. Although the marginal tax rate may not apply to the entire installment income depending upon total installment value and applicable tax bracket, it was used as a reasonable approximation.

interest rate ($5344). Assumed business expenses are $31,450.

The necessary revenues required to cover these payments are then calculated for year 10, the harvest year in the cutting, plus the required revenues determined for years 11 and 12. This total is used to compute a harvest level. This harvest is treated as an installment sale so that payments received in years 10, 11,and 12 cover the estate and business expenses. In year 10, the total harvest level required to meet these costs equals $187,637 in timber value. This includes the tax attributable to the capital gains and interest income on the installments ($6750, $2544 and $432 for years 10, 11 and 12 respectively)[49].

Residual timber value following the year 10 harvest shows $3,061,951 which is added to the current personal property and land values. After adjusting for the outstanding estate tax, an after-tax net estate value of $7,943,991 is obtained (Table 3).

Model adjustments for sale of the estate. For the sale option, a variation of the original model is used to determine the estate's net sale value[50] after paying federal

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[49] Income tax on installments were estimated using the surviving spouse's marginal tax rates of 35, 42, and 35 percent for the 10th, 11th and 12th years, respectively.

[50] The estate's net sale value is the appreciated value the heirs would expect to receive from the sale of the estate

Table 3. Expected net value of the retained estate after payment of federal estate and income tax on timber harvest.

Option election	1 ($000)	4 ($000)	7 ($000)	10 ($000)	13 ($000)
FMV	2,764	3,767	5,168	7,144	9,954
SUV	2,871	3,938	5,442	7,583	10,658
DAE	2,714	3,790	5,313	7,490	10,582
SUV & DAE	2,847	3,988	5,611	7,944	11,292

estate and income taxes. Sale values are calculated prior to cutting in the harvest years. Thus the entire estate is assumed to be sold with sale revenues considered taxable to the surviving spouse. The steps are as follows:

1. Determine the total estate value prior to harvest (Table 4A). It represents the appreciated fair market value of land, personal property and timber (less previous harvests).
2. Compute income tax attributable to the sale of the estate[51]. The taxable capital gain equals sale proceeds less adjusted basis of the assets, expense of sale (10 percent is assumed), and capital gains deduction. The gain is added to other income and total income taxes are computed. Subtracting the tax on other income results in the income tax attributable to the sale of the estate.
3. Calculate the cost of liquidating the entire estate (Table 4B) which represents the sum of: income taxes attributable to the sale, outstanding estate tax, recapture tax if special use valuation had been elected, and actual expenses of sale (attorney and

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assets after tax.

[51] Neither income averaging nor installment payments are utilized for this part of the analysis. Their inclusion would generally reduce the applicable income tax bracket.

real estate fees, etc.). When subtracted from the preharvest estate value, it produces the net sale value of the estate after payment of federal estate and income taxes (Table 4C).

An example of selling the estate. Continuing with the year 10 SUV & DAE example, the preharvest estate value is $8,242,956. Subtracting the total adjusted basis of $2,521,177 produces a capital gain of $5,721,779. Reducing the gain by the expenses of sale ($824,296) and the capital gains deduction ($2,938,490) results in a taxable capital gain of $1,958,993. Adding other income ($98,300) and subtracting deductions and exemptions ($38,146) gives a total income tax levy of $984,244.

The cost of liquidating the estate ($2,025,960) is comprised of income tax attributable to the sale (total tax less tax on other income or $972,156), interest due on the Section 6166 extension in year 10 ($5,344), outstanding estate tax ($133,594), recapture tax ($90,570) and expenses of sale ($824,296). The income tax alone represents 48 percent of the total cost (Table 4B). Subtracting the transfer cost from the preharvest estate value produces the estate's net value after taxes and liquidation costs ($6,216,996) (4C).

Table 4A. Expected values for selling the estate prior to scheduled timber harvests in the year of sale.

Option election	Year 1 ($000)	4 ($000)	7 ($000)	10 ($000)	13 ($000)
FMV	3,269	3,830	5,250	7,248	10,086
SUV	3,269	4,001	5,524	7,687	10,790
DAE	3,269	4,241	5,778	7,874	10,887
SUV & DAE	3,269	4,319	5,960	8,243	11,546

Table 4B. Cost of selling the estate

Option election	Year 1 ($000)	Y*	4 ($000)	Y*	7 ($000)	Y*	10 ($000)	Y*	13 ($000)	Y*
FMV	783	0	569	33	978	46	1,553	53	2,367	57
SUV	783	0	686	28	1,094	44	1.745	51	2,542	58
DAE	783	0	959	22	1,384	37	1,914	49	2,715	56
SUV & DAE	783	0	966	22	1,423	37	2,026	48	2,825	57

* Percent of the estate sale cost attributable to federal income taxes on the transfer.

Table 4C. Net sale value of the estate after payment of federal estate and income taxes.

Option election	Year 1 ($000)	4 ($000)	7 ($000)	10 ($000)	13 ($000)
FMV	2,486	3,261	4,271	5,695	7,720
SUV	2,486	3,314	4,429	5,942	8,248
DAE	2,486	3,285	4,397	5,960	8,172
SUV & DAE	2,486	3,353	4,537	6,217	8,721

Examining Selected Choices

Projected after tax[52] values for the assumed estate under the 2 landowner choices for each of the 4 estate tax options described above are summarized in Tables 3 and 4C. In Addition, Table 4B shows the transfer cost, if the heirs switch from their choice of retaining to selling the estate. The respective values are shown for 5 time periods[53] during the 15 years following the date of death.

When the estate is retained for periods longer than one year, its net expected value is greatest with election of the combination of SUV & DAE. Next in declining order of estate value is the SUV, DAE, and FMV elections. This order remains the same throughout the rest of the analysis (Figure 1). The SUV & DAE election provides the highest value since the taxable estate is not only smaller, but the actual tax payments are also deferred. The SUV option results in a slightly greater estate value than the DAE option because a lower initial tax bill outweighs deferred payments. This is the case due to the proportion of the deferred estate tax

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[52] Federal estate and income taxes.

[53] Five periods of 9 months, 3 years and 9 months, 6 years and 9 months, 9 years and 9 months, and 12 years and 9 months were chosen for the analysis to correspond to the timing of the harvest. Although computations were made for the specified periods, results are displayed in the tables and discussed as 1, 4, 7, 10 and 13 years, respectively, for simplicity.

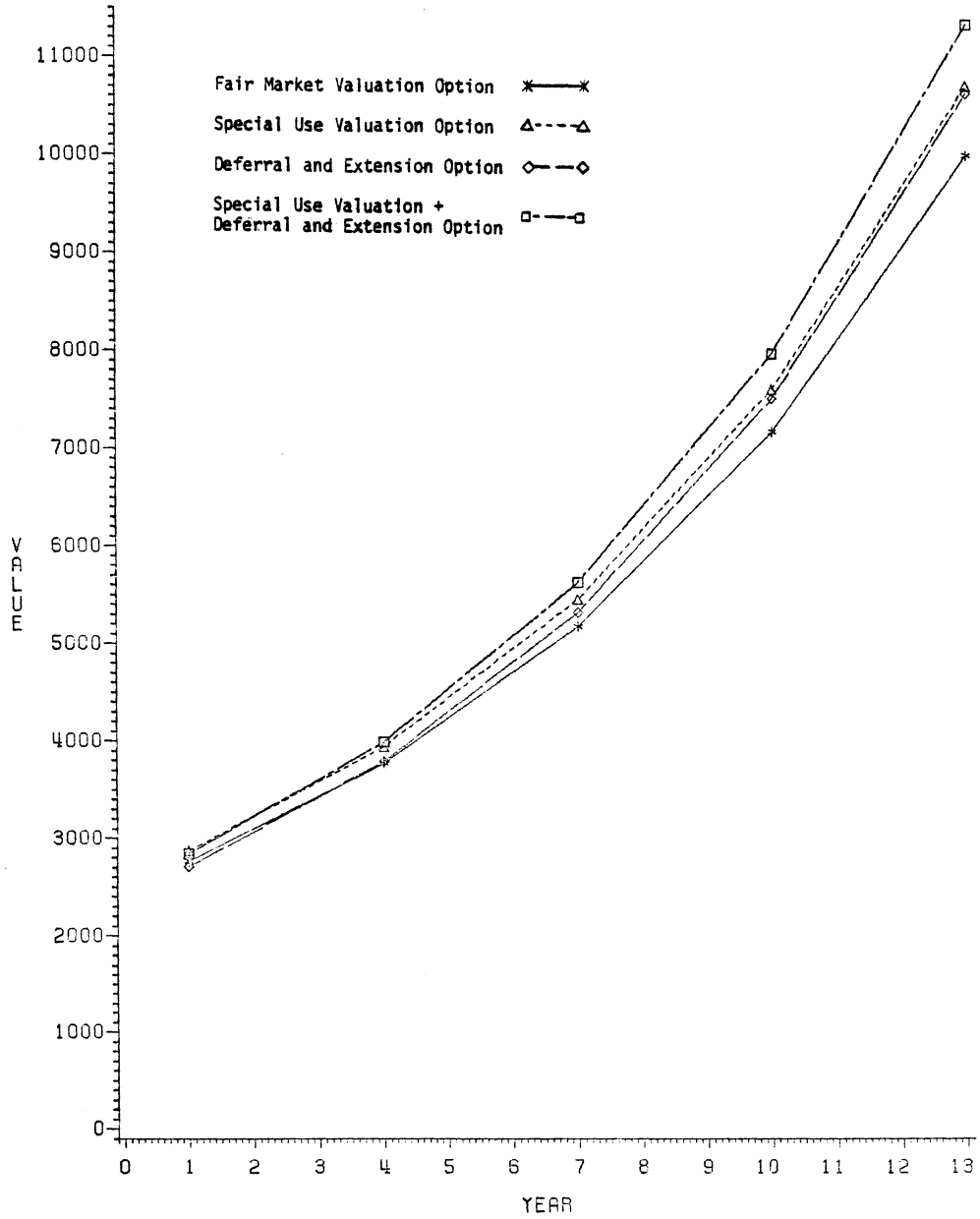

Figure 1. Expected net value of the retained estate

that incurs an interest charge of 20 percent[54]. Should the value attributable to a closely held business be below $1,000,000 and thus be charged interest at a 4 percent rate, then it is conceivable that the DAE option would have a higher estate value. Similarly, a lower regular rate may increase the financial attractiveness of the DAE relative to the SUV option.

These results differ marginally from Olson's (1981), using the same options and simulated estate, but analyzed before the passage of ERTA[55]. In that study the DAE election had the second highest estate value after year 4 followed by the SUV case. The difference is attributable to the higher interest rates that apply in the current analysis to deferred taxes on that portion of a closely held business interest that exceeds $1,000,000 in value when electing DAE.

Olson (1981) also discovered that the net estate value relative to the options increased over time[56]. However, the

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[54] Four percent interest rate applies to deferred tax on first $1,000,000 of closely held business interests. Regular interest rate (20 percent at the time of the analysis) applies to balance of deferred tax.

[55] The estate simulation by Scott Olson (1981) is exactly the same except that harvests were conducted annually to pay for estate tax, income tax, and business expenses as opposed to every third year with installment payments in intervening years.

[56] The time periods differ slightly, but the methodology and trends are the same. For Olson the time period was from 5 to 15 years; for this study it is between 4 and 13

rate of increase is not so pronounced after ERTA. For instance, the advantage of electing DAE over FMV now rises from 1 to 6 percent whereas, Olson found an increase from 6 to 13 percent for the same option. The benefits of electing SUV & DAE over FMV in the current study increase from 3 to 13 percent compared to an increase of from 4 to 17 percent found by the previous study. This further reflects the dampening effect of the higher interest rate on the DAE options after ERTA, whereas the SUV option is unaffected.

The results show that qualifying estates will preserve the greatest net estate value with the SUV & DAE option. The relative advantage of the other options will depend on the size of the closely held business interest and applicable interest rates on deferred estate taxes.

Cost of Selling the Estate

The heirs of an estate who are initially committed to its retention and management, may, due to changed circumstances, consider selling at some point. When this is the case, the type of option chosen will have a large bearing on the net revenues from the sale. These results reflect a disposal of the entire estate holding.

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years.

Table 4A displays the expected sale values of the estate for each of options prior to harvesting for the five periods (years 1, 4, 7, 10 and 13). The highest estate sale value is with the combination of SUV & DAE followed by DAE, SUV, and FMV. These rankings are consistent for the 15 year period .

However, the cost of liquidation is also greatest when electing SUV & DAE. The sale cost of the other options ranks in the same order as sale value. SUV & DAE have the highest costs due to the additional expenses incurred during the sale when compared to the other options. The cost of the sale includes interest charges on deferred payments, payment of unpaid installments, recapture of taxes from special use valuation, income taxes and expenses of the sale. The DAE election does not include any recapture of taxes in the liquidation costs, but does include the other costs. The SUV option requires a recapture of taxes from special use valuation, but does not incur costs from extensions of payments. The sale costs for the FMV option include only income taxes and expenses of the sale.

The relative difference in liquidation costs for the four options may be shown with the year 10 example. The cost of selling the estate with the FMV election is $1,552,919. The SUV & DAE option costs $2,025,960, 30 percent greater than

with FMV. For the DAE and SUV elections, the cost of selling the estate are $1,914,158 and $1,745,051, respectively (23 percent and 12 percent greater than FMV).

The time of sale also changes the relative difference in sale costs between the various options. For instance, the relative cost when electing DAE over FMV is much greater in year 4 (68 percent) than in year 10 (23 percent). This can be attributed to the reduced interest payment, lower amount of unpaid estate taxes and lesser impact of future payments in times of inflation. The relative liquidation cost of electing SUV over FMV is also larger in year 4 (20 percent) than in year 10 (12 percent). The difference is again due to the lesser impact of future expenses (in this case the recapture tax) during inflationary periods. The relative cost between the two options declines even further in year 13 (7 percent) when the recapture period for special use valuation has expired.

Choice of Options When Selling

Should the heirs choose to sell, their problem becomes one of choosing the option that will provide the greatest net value from sale of the estate after the payment of federal estate and income taxes. To compute these values, the cost of selling the estate (Table 4B) was subtracted

from the estate sale values (Table 4A). The net sale values of the estate for the four options are shown in Table 4C graphed in Figure 2.

The election of SUV & DAE provides the greatest net sale value throughout the 15 year period. The second highest values are found with either the SUV or DAE options which track closely. The difference between them is negligible (less than 1 percent) and they flip-flop between years 10 and 13. DAE has the higher value in year 10 and SUV looks better in year 13. The FMV option has the lowest net sale value throughout.

The hierarchy of options giving the highest net sale values are considerably different after ERTA than under the prior regulations. In Olson's study the options ranked as follows:

1 to 5 years - - DAE, SUV & DAE, FMV, SUV

Year 10 - - DAE, SUV & DAE, SUV, FMV

Year 15 - - SUV & DAE, DAE, SUV, FMV

There were two primary reasons for these rankings and the changes in their order over time. Under the prior regulations SUV cases received a lower, use value basis in calculating the capital gain when selling the estate, that resulted in a higher tax. This disadvantage reduced the relative value of the SUV options. With appreciating assets

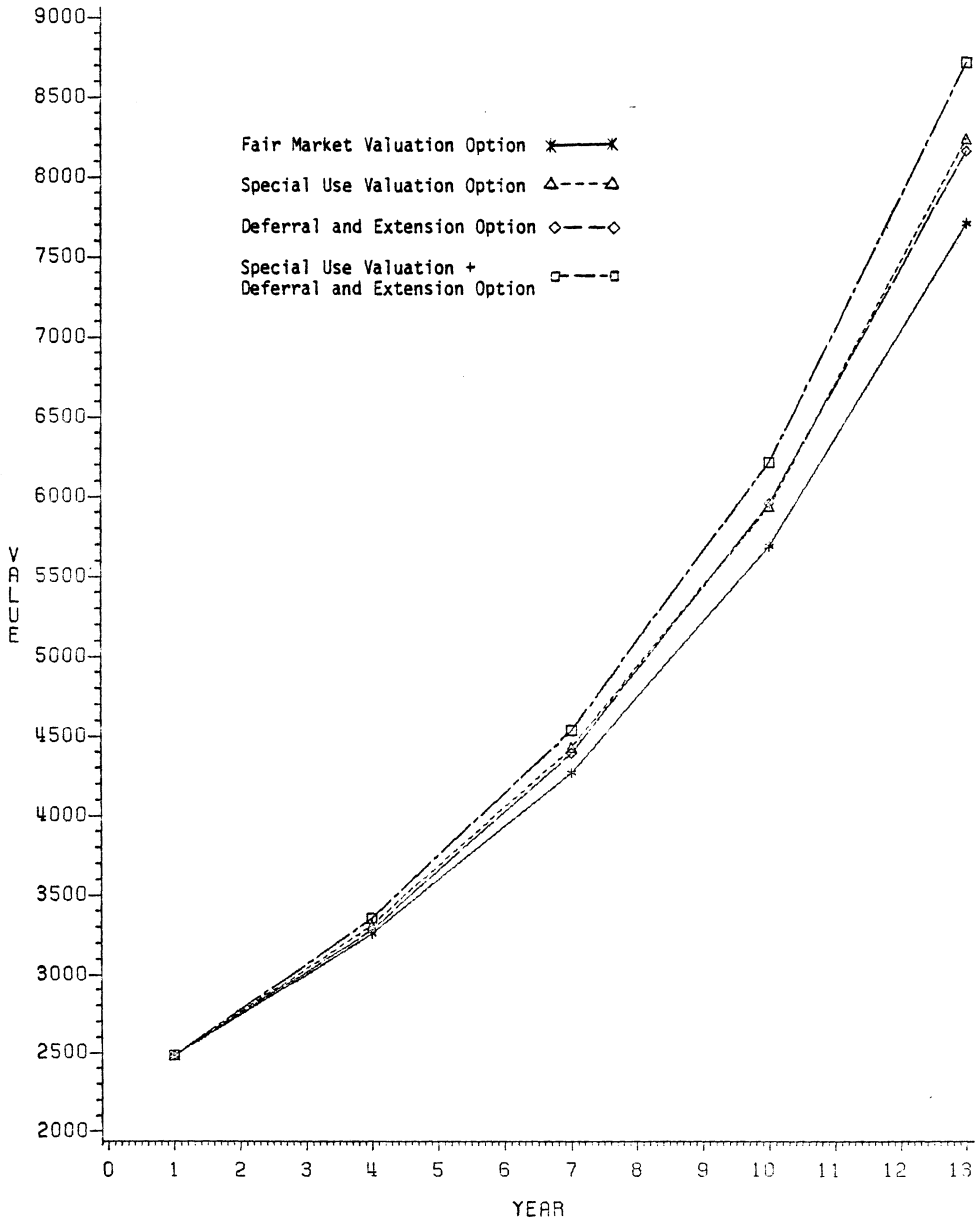

Figure 2. Projected net sale value of the estate

the effect of the lower basis in later years was negligible and the SUV options became relatively more favorable. The same was true for the SUV & DAE option which took on the higher value over DAE in year 15. The DAE options had provided greater net estate values throughout the analysis because of the favorable 4 percent interest rate.

With ERTA, the basis may be increased to the fair market value as of the date of the decedents death if the recapture tax is paid. Thus, the prior penalty, imposed by a lower basis and higher taxes, is eliminated. This is reflected in the higher rankings for the SUV cases. The higher interest rate for DAE cases with closely held business interests above $1,000,000 (12% before ERTA, 20% after) reduces the relative value of the DAE option (ranked third). It does not, however, effect the SUV & DAE option because the deferred tax falls under the 4 percent rate.

The relative variations in the net sale value of the estate for the various options increases over time. For instance in year 4 the SUV & DAE option has a net sale value 3 percent greater than the FMV option. In year 13 it is 13 percent greater (Figure 2). A similar trend holds true for the SUV and DAE cases when compared to FMV. However, the elections of SUV and DAE do not diverge over time. In fact throughout the analysis there is little difference in the

net sale value for the two options. A different result is probable if either all of the deferred estate payments qualified under the 4 percent rate or a substantial portion exceeded the cutoff for 4 percent interest and was charged at 20 percent interest. The increasing relative value of the SUV & DAE election points out the advantage of preserving assets (timber and land) that are appreciating at a faster rate than inflation.

Present Value Analysis for the Four Options

Should the heirs decide to sell the estate, the question becomes what is the best time for the sale. Present value analysis provides a reliable method for comparing the sale values for different years. Calculations are based on the investor's alternative rate of return. Given the present value and market conditions, the heirs are able to decide on the optimal time to sell the estate. The choice of option will affect the present value and may also have a bearing on the timing.

The present values for the four options were calculated in the five time periods with after-tax current alternative rates of return of 8, 10 and 12 percent. The results are shown in Table 5.

Table 5. Net present values for the estate in selected years.

After tax alternative rate of return (percent)	Option election	Year 1 ($000)	3 ($000)	7 ($000)	10 ($000)	13 ($000)
8	FMV	2,347	2,443	2,541	2,689	2,894
	SUV	2,347	2,483	2,634	2,806	3,092
	DAE	2,347	2,458	2,614	2,814	3,063
	SUV & DAE	2,347	2,512	2,699	2,936	3,269
10	FMV	2,314	2,281	2,245	2,249	2,290
	SUV	2,314	2,318	2,328	2,340	2,447
	DAE	2,314	2,295	2,310	2,353	2,424
	SUV & DAE	2,314	2,345	2,384	2,456	2,587
12	FMV	2,283	2,132	1,988	1,886	1,820
	SUV	2,283	2,167	2,061	1,968	1,945
	DAE	2,283	2,145	2,045	1,974	1,927
	SUV & DAE	2,283	2,192	2,111	2,059	2,056

For an 8 percent RORat the individual options each reach the maximum NPV in year 13. This indicates that the assumed forestry business is earning a greater RORat than 8 percent. When ranking the various options according to maximum NPV, the results show that in year 13 SUV & DAE is the best option followed by SUV, DAE, and FMV. It is interesting to note that the NPV of the SUV & DAE option in year 10 is greater than the NPV for the FMV option in year 13.

If the heirs' RORat is 10 percent, the highest NPV is in year 13 for the SUV & DAE, SUV, and DAE cases. However, if the FMV option is elected, then a sale in the first year gives the maximum value. Ranking all of the options shows SUV & DAE in year 13 to be the best option followed by SUV & DAE in year 10, SUV in year 13 and DAE in year 13. The FMV option for all time periods ranks at or near the bottom.

At a 12 percent RORat the best alternative for each option is to sell in year 1. In other words the assumed forestry business is earning less than could be obtained elsewhere; therefore, it should be liquidated immediately if financial considerations are the sole decision criteria.

Throughout the analysis a constant rate of forest value growth[57] has been assumed in order to illustrate the effects of the 2 estate tax provisions. However, interactions of

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[57] This is a realistic assumption for a regulated forest under either a selection or clearcut harvesting regime.

forest value growth and estate tax elections for either immature or overmature forests must be considered. Growth rates exceed the average in the former situation and are less than the average in the latter. At the margin when value growth rates approximate the RORat, as in the 10 percent case above, this interaction may affect the heirs' optimal choice.

Some Consequences of an Unlimited Marital Deduction Formula

In the analysis the marital deduction was used for 50 percent of the adjusted gross estate. With ERTA, however, all of the estate may be passed to a surviving spouse tax free. If such is the case, the consequences could be devastating for the forest enterprise when paying for the estate taxes at the death of the second spouse.

Consider the information in our example where the entire simulated estate, less the unified credit[58], passes to the surviving spouse at the decedent's death in 1983. The second spouse dies six years later in 1989[59] again subjecting the entire estate, less the unified credit to taxation. Between 1983 and 1989 harvests are conducted

[58] It is assumed that the marital deduction is reduced to the minimum amount such that the taxable estate is covered by the unified credit.

[59] Generally wives outlive their husband by seven years; ERTA credits are fully phased in at this time.

every third year in order to cover business expenses and the income taxes incurred on the harvest. The harvest level is determined by the amount needed for the year of the harvest and intervening years[60]. This income is received in an installment payment as it is required. Estate tax calculations were computed for the DAE option following the death of the second spouse.

At the second death the federal estate tax amounts to $1,742,278. An election of the DAE option would require the removal of 61 percent of the timber value in order to cover the estate tax, interest on extension and business expenses for the first three years. A harvest of this magnitude would reduce the growing stock so that continued management for sustained yield would be severely disrupted.

Returning to the original simulation with a 50 percent marital deduction, if the surviving spouse were to die in 1989 the estate tax on the surviving spouse's estate would be $660,888. Using the DAE option, a harvest in 1990 to cover both the deferred estate taxes for the first death and estate taxes for the second spouse as well as business expenses for the initial three years would remove 38 percent of the entire value in timber. Although this harvest would

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[60] Harvest levels could also have included net growth, but it was added to the growing stock of the forest in this case.

also substantially reduce the growing stock, it would be much less severe than in the unlimited marital deduction case.

In conclusion, if the forest enterprise is required to supply the funds to cover estate taxes then careful planning as to the consequences of using the unlimited marital deduction is necessary.

Many estate planning options[61] are available to provide relief from estate taxes and to provide the liquidity to pay death expenses and taxes. This later example shows the necessity of planning carefully for the deferral of taxes plus the liquidity to pay death tax levies without disrupting a managed forestry business. Under some circumstances it may be advantageous to liquidate mature forest stands to pay taxes, if the opportunity cost of deferral (e.g., 20 percent on amounts over $1,000,000) exceeds the returns from timber management.

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[61] Trusts, insurance, ing, dividing the estate assets, etc.

CONCLUSION

Federal estate taxes, although mitigated by the 1976 Tax Reform Act and further eased by ERTA, still impose a considerable burden on the intergenerational transfer of forest property. The need for cash or readily marketable assets at the time death is a problem faced by all types of estates. It is the peculiar nature of forestry assets in the estate that compounds this problem. The values from expected future harvests are illiquid and subject to heavy discounts in cases where they are disposed of prematurely. Timber investments are typically long term and usually yield only periodic incomes. If funds are not available to pay the death taxes and various costs associated with estate administration, harvest of immature timber or forced sale of the land may be necessary.

The analysis has shown that significant tax savings are possible with the election of special use valuation, deferral and extension of payment or both. With the new regulations resulting from the Economic Recovery Tax Act of 1981 these options are more easily available for large estates.

For the simulated estate under an assumption of continued ownership by the heirs for at least 15 years following death, estate tax relief is greatest with the combined

election. The next most advantageous election is special use valuation followed closely by deferral and extension. Of course, estate tax costs are greatest with fair market valuation.

If the heirs decide to sell the estate during the 15 year period, the analysis shows the ranking of options providing the highest net estate value is similar to that for the value of the retained estate. However, for this particular simulation the difference in value between the SUV and DAE options is negligible. The relative values and rank of the two options may change depending on the portion of the estate which qualifies for the lower 4 percent rate in the DAE option.

Special use valuation and deferral and extension are elected by the executor on behalf of the decedent's heirs. The election is made after the date of death. Advance planning is necessary, however, for the estate to meet the requirements for qualification. Potential tax savings are evident, but evaluation of the consequences of the various elections is required in order to select the optimal financial choice that is consistent with the heirs' objectives. Integration of the heirs' management goals with estate planning options such as these can often ease the costly transfer of forest estates and maintain a productive enterprise.

Chapter IV

ECONOMIC ANALYSIS OF THINNING LOBLOLLY PINE PLANTATIONS

Loblolly pine (Pinus taeda L.) is the most important commercial species in the South. Considerable attention has been focused on the management of loblolly plantations, especially in the area of growth and yield predictions. However, few economic analyses have been formulated to evaluate the efficiency of alternative loblolly management regimes (Broderick et al, 1982) due to data limitations. To meet future timber demands from both corporate and nonindustrial forest lands, it is essential that management regimes are identified that can compete for limited investment funds.

Thinning is an important practice that should be considered when choosing among management alternatives for loblolly plantations. Past experience indicates that the initial commercial thinning in these plantations might occur at a stand age of 15 to 20 years. Of the 22 million acres of pine plantations in the South, approximately 36 percent are in this age group (Knight and Sheffield 1980; Thomas and Hedlund 1980). Thus many forest landowners are confronted with deciding whether it is to their advantage to thin in the near future.

Thinning can provide a number of benefits for the landowner. The most obvious advantages are improved stand quality by concentrating growth on larger, more valuable trees and early returns from thinning revenue. In addition, thinning salvages trees that will be lost to natural mortality, it enhances wildlife habitat and it creates lanes for the control of wildfires in the case of row thinning. Reduction of stand densities through thinnings lowers the risk from certain insect pests such as the southern pine beetle.

Thinning may also have several disadvantages. Specifically, the costs for marking and harvesting small stems could be prohibitive. Attracting loggers to thinning jobs can be difficult when more profitable clearcutting operations are readily available. Stand aesthetics may also be temporarily affected by tops and logging debris left in the woods. Finally, thinning can invite insects or disease into an otherwise healthy stand.

This study will present a framework for making decisions concerning thinning in loblolly plantations. It considers two alternative thinning strategies for various stand conditions, stumpage price functions, and product mixes. With these results a landowner has solid economic information on which to base thinning decisions that apply to their particular situation.

A FRAMEWORK FOR THINNING DECISIONS

In the analysis selected management regimes for a single thinning were evaluated for "thin" versus "no thin" options based on after-tax financial returns. Thinning and final harvest volume yields and stand characteristics were projected using a stand model (WTHIN) for determining diameter distributions and yields of thinned loblolly pine plantations (Cao et al 1982). It was developed using sample plot data from the Virginia Piedmont and Coastal Plain. The model provides detailed information for analyzing several thinning methods. In this particular case row and low thinning methods were examined. A low thin, or thinning from below refers to the removal of all trees below a specified diameter at breast height (dbh), simulating the removal of suppressed trees. In a row thinning it is assumed that selected rows are removed and that the total number of trees is reduced proportionally without changing the diameter distribution.

Thinning Alternatives

Single thinning management alternatives were selected according to the factors for which the landowner has control at the time of thinning. Thinnings at 15 or 20 years and rotation ages of 30 and 35 years were chosen as a representation of the choices available (Table 6).

Table 6. Alternative thinning regimes

Management Alternative	Timing of cutting operations	
	Thinning Age	Rotation Age
1	15	30
2	15	35
3	20	30
4	20	35

Approximately 30 percent of the volume was removed in simulations of row thinning and low thinnings[62] for each alternative. Thinning was considered infeasible unless a minimum of 5 cords of merchantable volume could be removed per acre. Each management alternative was simulated for site indices 60 and 70 and planting densities of 700 and 900 per acre[63].

Economic Factors

Net present value (NPV) was chosen as the economic criterion for evaluating the thin versus no thin options. When considering mutually exclusive projects, the alternative with the highest NPV will maximize forest value. The NPV was calculated on an after-tax basis[64] using real discount rates of 3 and 5 percent. These alternative rates of return (ARR) were assumed to represent reasonable landowner opportunities for use of their capital net of

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[62] Low thinning alternatives were programmed in WIHIN as a combination of 20 percent row thinning to simulate the removal of rows of trees for access and 80 percent low thinning.

[63] The two planting densities were chosen to represent the approximate range of trees that were planted across the South (Moak et al 1982).

[64] After-tax cash flows were computed for the nonindustrial landowner situation. However, the results with minor adjustments are applicable for corporate decisions concerning thinning .

inflation or real price appreciation[65]. An ARR is the interest rate the owner can receive in his best investment alternative with a risk similar to that in forestry. Actual calculations were made with NCRETURN, a computer program for analyzing long-term investments (Schweitzer et al 1967).

Stumpage Price

One of the most important factors affecting decisions about thinning is the stumpage price received for harvested timber. Stumpage prices vary according to the product mix and price differences among products can be significant. In this analysis pulpwood, sawlogs and peelers were included. In general, prices are dependent on the state of the economy at the time of sale, and are specifically influenced by the competitiveness of markets in the region where the timber is sold. These possibilities were taken into account in examining a high, medium, and low sensitivity (responsiveness) of stumpage price to product category (Table 7).

Highly responsive stumpage prices mean substantially greater returns for higher quality products. Sawtimber at $30 per 100 cubic feet has three times the value of pulpwood

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[65] Omitting real price appreciation may understate the value of thinning since sawtimber has historically appreciated at a faster rate than pulpwood.

Table 7. Stumpage price by product and price responsiveness categories.

Product category	Stumpage price		
	Highly responsive	Moderately responsive	Slightly responsive
	Dollars per 100 cubic feet		
Pulpwood	10	10	10
Sawlogs	30	25	20
Peelers	60	40	30

at $10 per 100 cubic feet. Similarly peelers bring six times as many dollars as pulpwood at $60 per 100 cubic feet. By contrast, slightly responsive stumpage prices show a much smaller difference in value between products. Sawtimber and peeler stumpage prices are only two and three times greater, respectively, than the $10 per 100 cubic feet for pulpwood.

Lower stumpage prices for low thinnings as opposed to row thinnings were also taken into account in the analysis. The stumpage price for low thinnings was assumed to be 80 percent of the final harvest stumpage price. Row thinning income was calculated with the same stumpage prices as for the final harvest.

Product Mix

The product mix obtained in the final harvest for a particular thinning alternative is dependent on the thinning method. For a row thin, the product mix as shown in Table 8 is based on data from Broderick et al (1982). By comparison, all residual trees in the low thin examples, that met the minimum diameter limit for a particular product category[66] were assumed to be in that category in the

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[66] Minimum diameter limits for product categories were assumed to be; 5 inches dbh and larger to a 4-inch top for pulpwood; 8 inches dbh and larger to a 6-inch dbh for sawtimber; and 11 inches dbh and larger to an 8-inch top for peelers.

Table 8. Product categories by tree diameter class.

DBH	Pulpwood	Sawtimber	Peelers
Inches		Percent	
5-7	100	0	0
8	68	32	0
9	47	53	0
10	7	93	0
11	2	49	49
12	0	50	50
13	0	42.5	57.5
14	0	35	65
15	0	30	70
16	0	25	75
>16	0	25	75

Source: Broderick et al. 1982

final harvest. These relationships were based on the assumption that stems of varying quality are removed in row thinning, whereas low thinning improves the stand by removing trees of poor quality and those in the lower diameter classes.

Additional Factors

Additional inputs included annual management costs and property taxes of $5.00 per acre and a reforestation cost of $120 per acre. Landowners were assumed to be in a 50 percent marginal tax bracket although the tax rate has no effect on the decision of whether or not to thin.

RESULTS OF THE THINNING ANALYSIS

The results are presented as the ratio of the NPV of the unthinned regime (NPVu) to the NPV of the thinned regime (NPVt). For example, a ratio of greater than one shows that the unthinned regime is preferred such as the cases with high and moderately responsive stumpage prices and a 3 percent discount rate (Table 9). The ratios are less than 1 for the remaining situations in indicating that these stands should be thinned. When these results are displayed graphically as in Figure 3, the two ratios above the 1.0 reference line show the unthinned stand to be preferred.

Table 9. Net present value ratio analysis for alternative 4 with row thinning on site index 70 with 900 trees planted per acre.

Discount rate	Stumpage price responsiveness	NPV (thin)	NPV (unthinned)	NPVu/ NPVt
(%)		($)	($)	
3	High	776	810	1.04
	Moderate	588	596	1.01
	Slight	465	451	0.97
5	High	279	273	0.98
	Moderate	201	186	0.93
	Slight	146	128	0.88

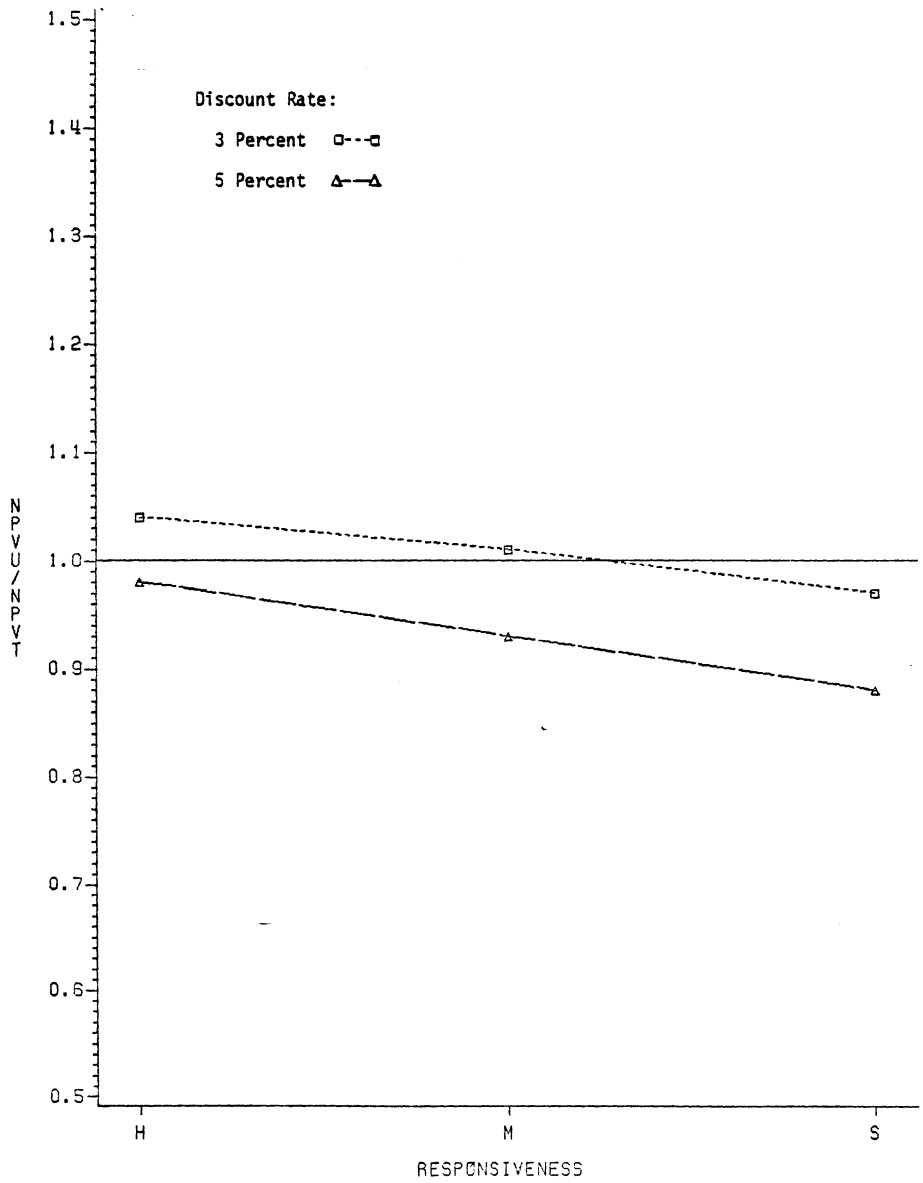

Figure 3. Thinning analysis of alternative 4 with a row thin and 900 trees planted on site index 70

Conversely, ratios below the line (less than one) show the thinned regime to be the better alternative.

This analysis provides information for making marginal decisions about thinning. It is also convenient for examining the effects of thinning method, site index, planting density and pricing structures on the decision to thin. Clutter (1982) used a similar method in analyzing slash pine thinning alternatives[67]. The examination of ratios is only adequate for marginal decisions involving a single alternative and is not designed for comparisons between alternatives.

All four thinning alternatives were compared to their unthinned counterparts for site indices 60 and 70, two planting densities, three price structures, 3 and 5 percent real discount rates and row and low thinning methods. The results for the 192 combinations (ratio NPVu/NPVt) are displayed graphically in the appendix. The effects of these variables on thinning recommendations are discussed below with particular emphasis on comparisons between the two thinning methods.

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[67] Clutter's analysis included the effects of logging cost on thinning. We have assumed that harvesting differentials will be reflected in the stumpage price.

The Effects of Low Thinning

Low thinning consistently ranks as a desirable practice over all no-thin regimes. This holds across all selected thinning alternatives and price sensitivities for both planting densities and site indices 60 and 70. The NPVu/NPVt ratio is also well below 1.0 for the 3 and 5 percent discount rates.

The magnitude of benefits from low thinning is best shown by looking at the difference in NPV between thinned and unthinned regimes. For a site index 70 with a 3 percent discount rate, the thinned regime provided increases in NPV that ranged from $38 to $97 per acre for slightly responsive stumpage prices and from $175 to $275 per acre for highly responsive stumpage prices.

The primary reason for the financial attractiveness of low thinning is that it promotes the production of higher valued products. In all of the alternatives, low thinning more than doubled the volume in the peeler class over the unthinned counterpart at the final harvest.

Generally, most of the results show that thinning is more economically attractive as stumpage prices become more responsive to product category. For example, the ratios for alternative 4 decline with both discount rates as stumpage prices change from slightly responsive to highly responsive

for a low thin on site index 70 and a planting density of 900 trees per acre, (Appendix page 113). Since a large proportion of the volume is concentrated in the peeler classes, financial returns are most sensitive to changes in its stumpage price. Thus, as stumpage prices become more responsive (peeler prices increase from $30 to $60 per 100 cubic feet) thinning becomes more attractive.

Exceptions to this trend do occur. For instance, with a 5 percent discount rate for alternatives 3 and 4 on site index 60 thinning is more favorable with nearly constant stumpage prices. This is shown for alternative 4 on page 117 of the appendix where with a 5 percent discount rate the NPVu/NPVt ratio declines as stumpage prices change from highly responsive to slightly responsive. The apparent paradox may be resolved by considering the time value of money. Higher discount rates cause earlier cash flows from thinning to have a larger impact on present value dollar for dollar than final harvest income. The change from highly to slightly responsive stumpage prices also reduces the value of the final harvest for both thinned and unthinned regimes while thinning is only partially affected due to unchanging pulpwood prices. Combined, these factors give thinned stands a greater advantage over unthinned stands as stumpage prices approach constant levels.

The Effects of Row Thinning

The row thinning examples are less consistent than those for low thinning. For instance, on site index 70, row thinning is favored for a thin at age 20 with the final harvest at 35 (alternative 4) if 700 trees are planted per acre. Row thinnings are generally not preferred when the thin occurs at a stand age of 15 (alternatives 1 with both planting densities and 2 with 900 trees planted per acre). In the other situations, the decision to thin is dependent on the discount rate and/or the stumpage price structure.

The effect of stumpage price structure is shown in alternative 4 with 900 trees planted per acre and a 3 percent discount rate. Row thinning is not recommended with either highly or moderately responsive stumpage prices but is recommended if stumpage prices are only slightly responsive (See Appendix, page 111).

Discount rate also plays a key role in deciding whether to row thin. As discount rates increase, row thinning generally becomes more attractive. At a 3 percent discount rate, thinning is the best choice with alternative 4 and 700 trees planted per acre on site index 70. When the discount rate is increased from 3 to 5 percent, thinning is recommended for all price sensitivities on alternative 4 with both planting densities and for most cases (moderate

and slightly responsive stumpage prices) on alternatives 2 and 3 with 700 trees planted per acre.

For site index 60, row thinning is the best choice in all situations except one (alternative 1 with a planting density of 900 trees per acre, highly responsive stumpage prices and a 3 percent discount rate). The advantage of thinning on the lower site can again be explained by the income benefits obtained from early thinning as final harvest income is reduced.

The effects of site index are shown in Table 10 where actual incomes of the thin and no thin options for alternative 2 are shown. As the site index is lowered from 70 to 60 the final harvest income for both options decreases $441 and $788 per acre for the thinned and unthinned options, respectively. In fact, the decline is much greater for the unthinned stand. The thinning income falls only $35 per acre. These results suggest that, at least with row thinning, sites of lower quality (e.g. site index 60) will most likely favor thinning.

All ratios for the row thinning alternatives show that it is more desirable as stumpage prices become more constant (i.e. a downward trend as stumpage prices change from highly responsive to more nearly constant levels). The reason is again attributed to the early cash flow and reduced final harvest income.

Table 10. Income from alternative 2 for row thinning, highly responsive stumpage prices and a planting density of 900 trees per acre on two site indices.

Site index	Thin	Income ($ per acre)	
		Harvest after thinning	Harvest with no thinning
60	41	987	985
70	76	1428	1773

Preferred Thinning Regimes for the Selected Alternatives

The best choices of the thinning alternatives evaluated for a planting density of 700 trees per acre are given in Tables 11 and 12. Results are based on present value analysis for infinite series of rotations. Forestry is the assumed highest and best use of the land.

In all cases, low thinning is the preferred thinning technique with consistently higher NPV's for each category of stumpage price responsiveness. For example, comparing the best regimes for row and low thinning with a 3 percent discount rate and site index 70 shows low thinning with the greater NPV's by $247, $129 and $75 per acre for high, moderate and slight stumpage prices, respectively. By investing in low thinning over row thinning, one is in effect earning these extra dollars in present value.

With two exceptions, the better time to thin appears to be at age 20 (alternatives 3 and 4 call for thinning at 20). The better rotation age results are not quite as consistent and are dependent on the site index and discount rate. As the discount rate increases from 3 to 5 percent, the harvest age shifts from 35 to 30 years. For example, of the 12 alternatives selected as having the highest NPV's for a 3 percent discount rate (Table 11), 10 have a rotation age of 35 (alternative 4). With a 5 percent discount rate (Table

Table 11. Best thinning regimes for selected loblolly plantation alternatives with a 3 percent discount rate and 700 trees per acre planting density.

Site index	Thinning technique	Stumpage price responsiveness	Thinning alternative	Net present value
				($ per acre)
70	Row	High	4	808
		Moderate	4	598
		Slight	4	455
	Low	High	4	1067
		Moderate	3	714
		Slight	3	531
60	Row	High	2 or 4	465
		Moderate	4	343
		Slight	4	256
	Low	High	4	669
		Moderate	4	439
		Slight	4	312

Table 12. Best thinning regimes (5 percent discount rate).

Site index	Thinning technique	Stumpage price Responsiveness	Thinning Alternative	Net present value
				($ per acre)
70	Row	High	3	293
		Moderate	3	214
		Slight	3	155
	Low	High	1 or 3	404
		Moderate	3	264
		Slight	3	185
60	Row	High	4	145
		Moderate	4	95
		Slight	4	59
	Low	High	4	221
		Moderate	4	128
		Slight	3	78

12), 7 of the 12 alternatives call for a final harvest at age 30 (alternatives 1 and 3).

An increase in site quality also causes a slight shift to shorter rotations. With a 5 percent discount rate and site index of 60, five of the six alternatives with the highest NPV's had a final harvest at 35. However, with a site index of 70, all of the thinning alternatives called for a rotation age of 30. A similar though not as pronounced relationship holds for a 3 percent discount rate. These factors affecting rotation length are consistent with that found in earlier studies (Broderick et al 1982; Pearse 1967).

The best choices for a planting density of 900 trees per acre are the same with one exception; a 5 percent discount rate and site index of 60. A majority of the alternatives in this case have the highest NPV's with a final harvest at 30 years (alternative 3) instead of at 35 years as found with a 700 trees per acre planting density.

SENSITIVITY OF PRICES ON THE DECISION TO THIN

To study the effects of varying levels of returns from thinnings, stumpage prices for products harvested in the thinnings were set at 80, 50, and 0 percent of final harvest stumpage prices. Values were calculated for thinning

alternative 3 with 900 trees planted per acre and alternative 4 with a planting density of 700 trees per acre on site index 70 assuming both low and row thinning. The present value ratios for the various stumpage price sensitivities using a 3 percent discount rate and alternative 4 are displayed in Figures 4 and 5.

For the row thin case, the decision whether to thin depends on both stumpage price sensitivity and thinning price. The stand should not be thinned if stumpage for wood cut in thinnings is 50 percent or less than final harvest stumpage. When the thinning price is 80 percent of final harvest price, thinning is recommended as the best practice with moderately and slightly sensitive prices. With highly sensitive stumpage prices thinning is not recommended.

With no thinning income, the case for not row thinning becomes stronger as stumpage prices are more constant (i.e. the NPVu/NPVt ratio becomes larger as the stumpage price sensitivity changes from highly to slightly responsive). But as thinning prices are increased, the relationship is reversed so that thinning is more favorable as stumpage price sensitivities are reduced. The same is true for the row thinning example with thinning alternative 3 although leaving the stand unthinned is recommended for all or all cases.

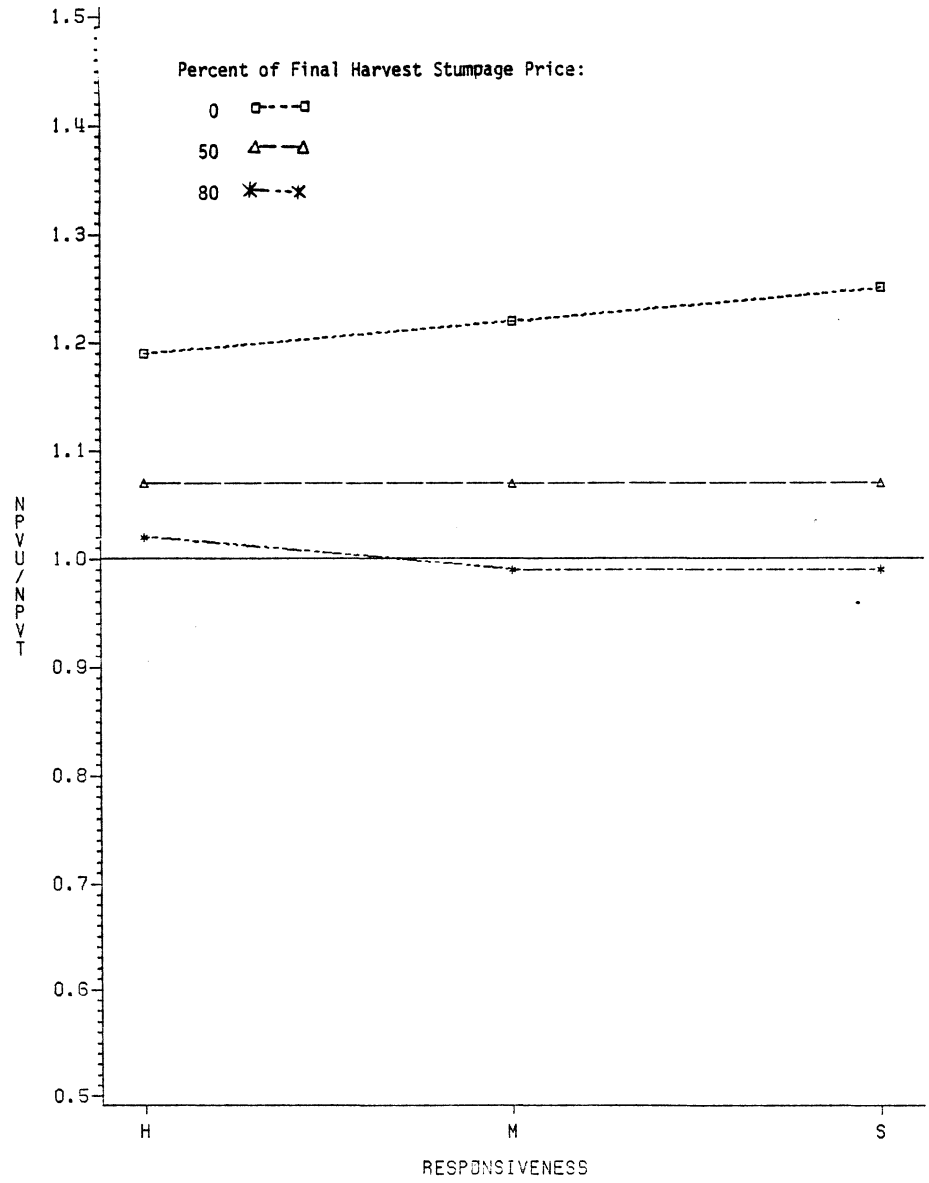

Figure 4. Thinning analysis of alternative 4 with row thinning and different thinning incomes

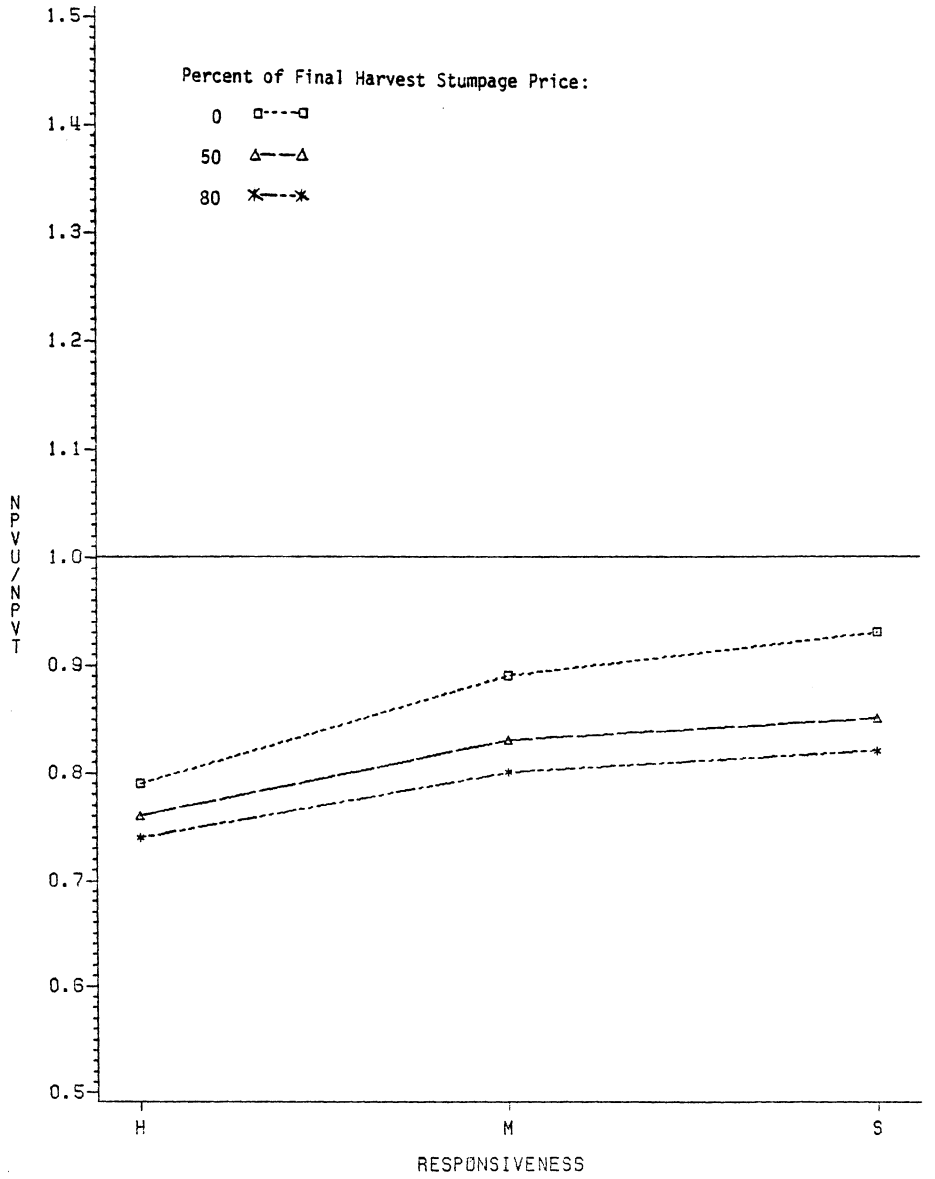

Figure 5. Thinning analysis of alternative 4 with low thinning and different thinning incomes

For the low thinning example, thinning remains the best choice for alternative 4 under all price assumptions. This is true even if no thinning income is received. For example, without any thinning income, the thinned option had greater NPV's by $208, $75, and $34 per acre over the unthinned option for high, moderate, and slightly responsive stumpage prices, respectively. With alternative 3 thinning is recommended except when there is no thinning income and stumpage prices are only slightly responsive. These results show that in many instances landowners can achieve better financial returns even if they have to accept reduced stumpage prices for volume removed in thinnings.

CONCLUSIONS

Low thinnings appear to be consistently an attractive option, even when intermediate stumpage values are reduced. The decision whether to row thin is dependent on site quality, stumpage prices and the landowners alternative rate of return. Row thinning was shown to be the better choice on the lower site index (site index 60). Row thinning is also more desirable as the stumpage prices for individual forest products approach constant levels. A landowner with a higher alternative rate of return (5 percent as opposed to a 3 percent discount) is more inclined to row thin. Results

indicate that of the selected thinning ages, 20 years is the better choice over all site indices, planting densities and thinning methods.

The analysis demonstrates the possible effects of economic uncertainty im making decisions that reap benefits in the future. In many of the alternatives, the decision to thin is not clear-cut, but is dependent on what the future holds in the way of stumpage prices. On the other hand, a landowner can feel fairly safe in the decision if for all perceived stumpage price possibilities, the answer is consistently to thin.

Thinning has often been promoted largely because of the benefits derived from the final harvest (i.e. increased volumes of higher quality forest products). These benefits account primarily for the attractiveness of low thinning. However, it is mainly the early income that is the reason row thinning is often recommended over no thinning.

Although this analysis covers only a limited number of the possibilities that exist in making decisions concerning thinning, it provides a framework for analyzing other choices. In terms of thinning technique, the two extremes of low and row thinning were examined. There are infinite combinations of these two techniques. The thinning decision for the specific combination will probably fall somewhere between the benchmarks set out in the analysis.

Chapter V

ESTATE TAX IMPLICATIONS FOR VARIOUS STAGES IN FOREST GROWTH

An important goal of many forestland owners is to transfer their estate to the heirs with a minimal impact from death taxes. Most are also interested in the efficient and continued management of their woodlands after death.

Acheivement of these purposes may be difficult, especially with minimally planned estates. One of the most serious problems is the illiquidity of the timber asset. Forested estates are characterized by long investment periods and sporadic income (Olson 1981). Generally the rotation length is longer than the landowner's expected tenure. The result is that in most cases the timber will not be financially mature when estate taxes are incurred. In addition, it is difficult to obtain credit due to the unimproved nature of the asset. Distress sales of immature timber to finance death taxes can not only break up efficient management units, but also reduce the cash flow and value of the forest estate. Such forced sales usually mean the estate will have to accept lower stumpage prices.

For these reasons, it becomes essential that forestland owners integrate their forest management program and estate plans such that the burden of estate taxes is minimized and the viability of forest resource management is preserved.

The objective of this analysis is to evaluate alternative investment and estate planning strategies on selected examples of forested estates. Specifically, the interactions of forest value growth and estate tax consequences over short periods of time will be examined. Estate values, including timberland values, for three different sized estates were simulated over the death of both spouses during a ten year period for various stages in the timber stand growth. Estate tax impacts and estate planning alternatives were analyzed for each growing period. This information will aid forest landowners in making estate planning decisions based on the condition of their particular forest resource.

COMPARISON OF DEATH TAXES AT DIFFERENT STAGES OF STAND GROWTH

In order to examine estate tax impacts on forest estates, selected examples were chosen for evaluation.

Estate and Economic Assumptions

1. Three estates were evaluated in the simulation. The estates were assumed to be forested with a single stand of loblolly pine. The small, medium, and large-sized estate contain 400, 750, and 1500 acres of timberland respectively.

2. In each simulation the first to die was the sole owner of the estate. Death was assumed to occur in the first year with the surviving spouse dying ten years later.
3. The ten year period between the two deaths was simulated for three stages in the growth of the loblolly pine plantation. In the first stage the stand was grown from age 5 to 15 years. The next stage runs from a stand age of 15 to 25 years. In the third stage, a stand of 25 year old loblolly pine was simulated over ten years to an age of 35 years. The stand was assumed to be financially mature at 35 years of age.
4. A piggy-back state death tax was assumed to be equal to the maximum allowable credit for state death taxes.
5. The analysis used an inflation rate of 5 percent. Calculations of timber liquidation values were based on a real price appreciation of 2 percent for both sawtimber and peelers and 0 percent for pulpwood.
6. Estate assets included timber, land and miscellaneous real and personal property. Timber values were based on the valuation procedures to be discussed below. Land values were assumed to start at $400 per acre.

Property values were $213,233, $400,000, and $800,000 for the small, medium and large-sized estate respectively. Land and property values were assumed to rise with the inflation rate over the ten year period. Annual expenses and taxes were paid with current income and interest. No income or expenses of the decendent remained in the estate on the date of either death.

7. Financial calculations were on an after-tax basis assuming a marginal tax rate of 50 percent

In the analysis, the first death occurs in the initial year for each stage of forest growth. That is, the first death is examined for an estate having a timber stand age of 5, 15 or 25 years. The gross estate value and estate taxes are calculated. The estate value is then simulated for ten years into the future when the surviving spouse dies. The estate value and taxes are again calculated and evaluated. The procedure is carried out for the three different sized estates.

Timberland Valuation Methods

Fundemental to the determination of estate values for forest properties is the method in which woodlands are valued. The Tax Reform Act of 1976 allowed for the

valuation of certain real property according to its "current" use as opposed to its "highest and best" use, if certain qualifications were met. One of the requirements was that at least 25 percent of the adjusted value of the estate consist of the adjusted value of real property qualifying for current use treatment. Timber was treated as other growing crops and thus the value of timber could not be included in calculating the percentage. The result was that many forest estates could not qualify for current use valuation (Condrell and Neidich 1982). The Economic Recovery Act of 1981 (ERTA) amended the rules with an election that timber could be included as an interest in real property. However, if the election was made to specially value the timber, then timber could not be severed within ten years of the decedent's death[68]. In the analysis, it was assumed that the timberland qualified for current use valuation without the need to specially value standing timber at the first death.

The Internal Revenue Code states that special use valuation for land plus timber or just timberland must be in accordance with the provisions of paragraphs (7) and (8) of section 2032(e). Paragraph (7) gives the "farm method" of

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[68] For estates with stands of all ages this causes an unnecessarily restrictive impediment to management flexibility to meet changing market and family economic conditions.

valuation whereby property is valued on the basis of gross annual cash rental for comparable land. This method was amended by ERTA such that the value may be determined using net share rentals of comparable land (Goggans and Cantrell 1982). However, in the case of forestlands there is rarely any comparable land on which to base the valuation (Condrell and Neidich 1982). Therefore the five factors for valuation in paragraph (8) must provide the method for forestland valuation. These factors include:

> (A) The capitalization of income which the property can be expected to yield for farming...purposes over a reasonable period of time under prudent management using traditional cropping patterns for the area, taking into account soil capacity, terrain configuration, and similar factors,
>
> (B) The capitalization of the fair rental value of the land for farmland...,
>
> (C) Assessed values in State which provides a differential or use value assessment law for farmland...,
>
> (D) Comparable sales of other farm...land in the same geographical area far enough removed from a metropolitan or resort area so that nonagricultural use is not a significant factor in the sale price, and

(E) Any other factor which fairly values the farm... value of the property.

The law is vague and does not state how the factors are to be applied and what weights are assigned to each factor. In fact, Condrell and Neidich (1982) state that "when applied to standing timber, it potentially may produce a value below the fair market value of the standing timber".

It appears that the most common practice for valuing timberland for estate purposes in the South is to capitalize the rental value for forestland based on forest industry land leases[69]. The method relies on the availability of industry leases in the area. In several locations, lease values may be rare or nonexistent. Lease values may also be highly variable and are dependent on the means in which they were calculated. The lack of a consistent valuation procedure hinders the ability to develop an effective estate plan.

In an attempt to cover the possible range in timberland values, the analysis considers three different methods for valuation (Figure 6). One method is based on factor (A) of paragraph (8) and involves the capitalization of future

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[69] The valuation procedure was determined in a phone survey of several estate tax experts on June 15, 1983.

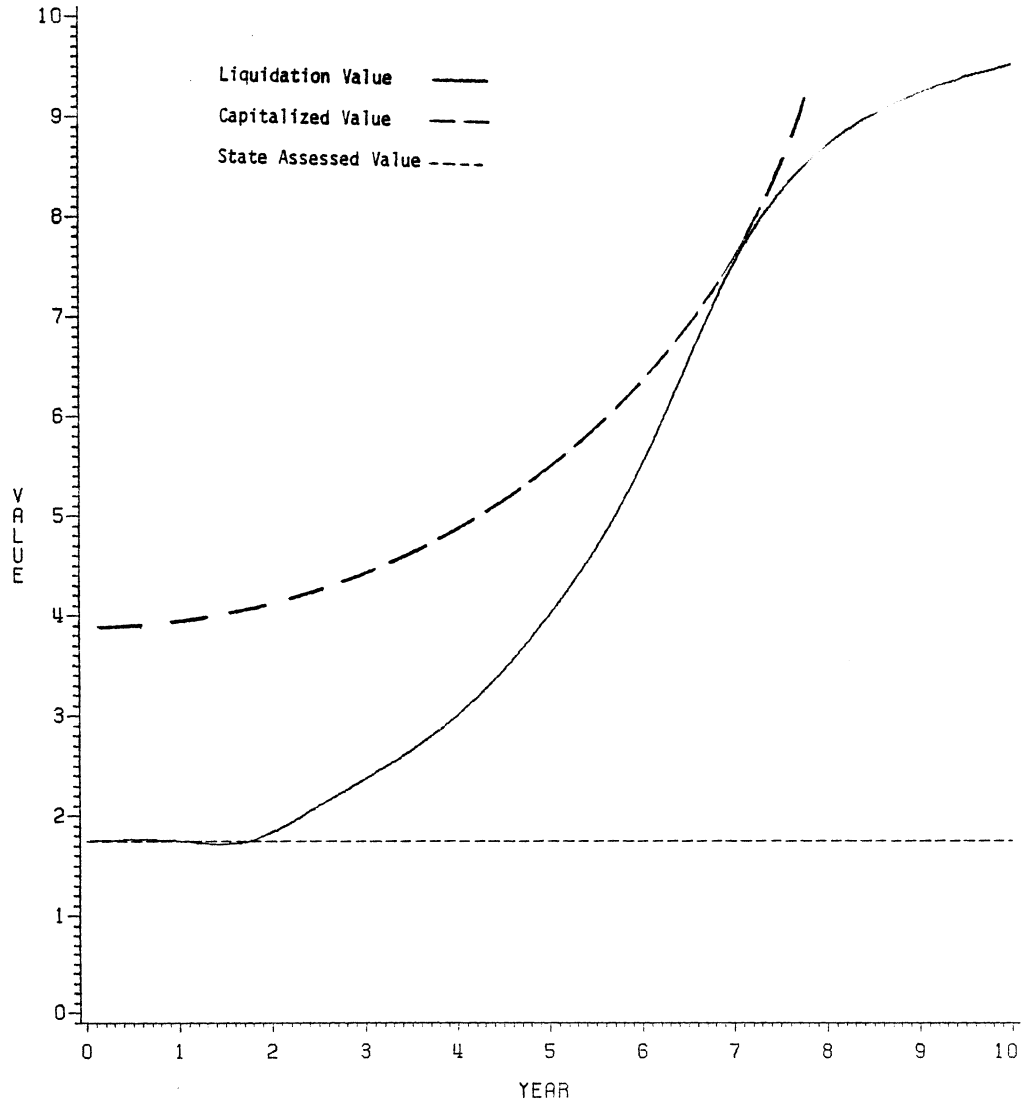

Figure 6. Forest valuation methods

income[70]. In Figure 6 this is the upper line showing the discounted value of the harvest income after taxes at a stand age of 35. The provisions call for using a capitalization rate equal to the average annual effective interest rate for all new Federal Land Bank loans which is assumed to be 10 percent. The second valuation method used in the simulation follows factor (C) and is denoted in Figure 6 by the lower line. An assessed value for high quality timberland in Virginia was used. Assessed values by counties in Virginia were determined by first calculating the net income per acre based on average yields for 35 to 45 year old pine multiplied by current average stumpage prices minus land management expenses. The net income is divided by the maximum economic rotation age to obtain an annual net income per acre which is divided by a capitalization rate (SLEAC 1982). The result is the current value per acre for forest use. A timberland value of $400 per acre was used for all the examples[71]. Finally, timberland values were

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[70] The income is capitalized for one rotation as opposed to infinite series of rotations as in land expectation or land and timber values. The results are comparable, however, because the length of the investment periods are equal and the scale of the investment is approximately equal.

[71] The timberland value is similar to forest land use values for excellent sites in several counties of Virginia such as Accomack, Dinwiddie and Prince George counties.

calculated by adding the liquidation value[72] for the timber to the bare land value (sigmoid curve in Figure 6). These methods for timberland valuation will be refered to as the income, assessed and liquidation methods, respectively.

Examining Alternative Marital Deductions

Probably the most important change in estate tax laws made by ERTA was the amendment permitting an unlimited marital deduction. The new provisions allow for the deferment of all estate taxes at the first death when full advantage is taken of the unlimited marital deduction. In other words, the full value of the estate (after taking into account the unified credit) may be passed to the surviving spouse free of estate taxes. The major portion of the estate is taxed at the second death.

There are several advantages of tax deferral by making full use of the unlimited marital deduction. First, couples with large estates will benefit from the lower maximum estate tax rate of 50 percent effective after 1985. Second, the increasing unified tax credit will shield $600,000 of estate value from taxation after 1987 (Garlock 1982).

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[72] Liquidation value is the amount of money received by the estate after taxes if the timber is harvested. It is calculated with stumpage prices of $10, $25 and $40 per 100 cubic feet for pulpwood, sawtimber and peelers respectively.

Third, it also allows additional estate planning by the surviving spouse such as continuing to make tax free gifts to children and grandchildren of up to $10,000 per beneficiary each year.

There are also circumstances under which it will not in the best interest of the estate to use the unlimited marital deduction. For example, in states with substantial state death taxes, deferment of estate taxes can lead to the mismatching of state death taxes and the state death tax credit. Thus a portion of the state death tax credit will be wasted (Garlock 1982). Full use of the unlimited marital deduction for an estate with rapidly appreciating assets will result in a much larger estate that is taxed in the death of the surviving spouse.

The study looked at the two extreme cases of marital deduction planning for each estate simulation. In one case, 50 percent of the estate was passed to the surviving spouse at the first death and the remainder was placed in a trust. For the other situation, the entire estate less the unified credit went to the surviving spouse. The two marital deduction strategies will be refered to as the 50-50 strategy and the formula will.

EXAMPLE OF ESTATE SIMULATION

The procedure may be illustrated with a medium-sized estate and the income method of valuation for both marital deduction strategies and a ten year horizon with an initial stand age of 15 years. Land and property values in the first year (first death) are $300,000 and $400,000 respectively. The timber value of $568,500 is calculated by discounting the after-tax harvest value for a 35 year old stand, 20 years to the present at a 10 percent discount rate. The total gross estate is $1,268,000 and the adjusted gross estate is $1,225,000 after payment of funeral expenses and administrative costs. Estate tax calculations for both marital deduction strategies are shown in Table 13. The estate tax at the first death using a 50-50 marital deduction is $118,125. There is no tax when full advantage of the unlimited marital deduction is taken. The estate value is then calculated for 10 years in the future at the death of the surviving spouse. The gross estate value is $1,213,069 for the 50-50 marital deduction with an estate tax of $240,358. For the formula will, the value of the estate is $1,951,116 with an estate tax of $536,803 at the second death.

In the same example if valuation is based on the liquidation value for timber, then the timber value is

Table 13. Federal estate calculations for a medium-sized estate and two marital deduction strategies

Estate Assets	Marital Deduction Strategy: 50-50 1st Death*	50-50 2nd Death*	Formula 1st Death*	Formula 2nd Death*
	(dollars 000)		(dollars 000)	
Timber	568.5		568.5	
Land	300.0		300.0	
Miscellaneous Real and Personal Property	400.0		400.0	
TOTAL GROSS ESTATE	1,268.0	1,258.0	1,268.0	1,951.1
Deductions				
Funeral expenses	3.0	4.9	3.0	4.9
Administrative costs	40.0	40.0	40.0	60.0
ADJUSTED GROSS ESTATE	1,225.0	1,213.1	1,225.0	1,886.2
Marital Deduction	612.5		950.0	
TAXABLE ESTATE	612.5	1,213.1	275.0	1,886.2
Tentative Tax	197.4	433.2	79.3	729.6
Unified Tax Credit	79.3	192.8	79.3	192.8
FEDERAL TAX	118.1	240.4	0	536.8

*The 1st death is in 1983 with a stand age of 15. The second death is in 1993.

$165,318 or about a third of what it was with the income method. For the 50-50 marital deduction, estate taxes are $48,844 and $185,527 for the first and second deaths respectively. If estate taxes are deferred, the tax at the second death is $342,955.

With assessed values for timberland, the combined timber and land value is $300,000. Estate taxes amount to $21,590 at the first death and no tax at the second death when the 50-50 marital deduction is used. Incorporating the formula will results in a tax of $33,813 at the second death.

RESULTS OF THE ESTATE SIMULATIONS

Gross estate values at the first and second deaths for each simulation of valuation method, estate size, marital deduction strategy and stand growth stage are given in Table 14. With the income method of valuation and a small estate, gross estate values range from $601,333 to $775,333 at the first death (first death occurs with stand ages of 5, 15 or 25). The initial gross estate value for the medium estate is between $1,127,500 and $1,453,750 depending on stand age. Large estate values begin at between $2,255,000 and $2,907,500. With the liquidation valuation method, gross estate values for the first death are between $373,333 and $697,493 for the small estate, $700,000 and $1,307,800 for

Table 14. Total estate value for each valuation method based on estate size, marital deduction strategy, and stand age at time of death

A. Capitalization of Income Valuation

Estate Size	Marital Deduction	Stand age at time of death (Years)					
		5	15	15	25	25	35
		(dollars 000)					
Small	50-50	601	577	676	671	775	796
	Formula	601	605	676	777	775	1,006
Medium	50-50	1,128	1,086	1,268	1,258	1,454	1,496
	Formula	1,128	1,624	1,268	1,951	1,454	2,408
Large	50-50	2,255	2.176	2,537	2,524	2,908	2,996
	Formula	2,255	3,803	2,537	4,484	2,908	5,407

B. Liquidation Valuation

Estate Size	Marital Deduction	Stand age at time of death (Years)					
		5	15	15	25	25	35
		(dollars 000)					
Small	50-50	373	367	462	593	697	798
	Formula	373	174	462	450	697	946
Medium	50-50	700	689	865	1,119	1,308	1,497
	Formula	700	816	865	1,503	1,308	1,497
Large	50-50	1,400	1,381	1,731	2,227	2,616	2,997
	Formula	1,400	2,202	1,731	3,724	2.616	5,343

C. Assessed Valuation

Estate Size	Marital Deduction	Stand age at time of death (Years)					
		5	15	15	25	25	35
		(dollars 000)					
Small	50-50	373	279	373	279	373	279
	Formula	373	132	373	132	373	132
Medium	50-50	700	603	700	603	700	603
	Formula	700	716	700	716	700	716
Large	50-50	1,400	1,169	1,400	1,169	1,400	1,169
	Formula	1,400	1,863	1,400	1,863	1,400	1,868

the medium estate and $1,400,000 and $2,615,600 for the large estate. Estate values using the assessed method are $373,000, $700,000 and $1,400,000 for the small, medium and large estates respectively.

Gross estate values at the second death are dependent on the valuation method, stage in stand growth and marital deduction strategy. Values are least with the assessed valuation method and a formula will for all stages in stand growth and greatest with the income method of valuation , a formula will and a stand age of 35. Gross estate values at the second death are generally greater when full use is taken of the unlimited marital deduction because of the large proportion of the estate that is deferred from taxation until the second death.

The estate taxes that are incurred at each death for all the simulations are displayed in Table 15. Estate taxes over all estate sizes are least when timber valuation is based on state assessed values for timberland. Assessed values do not take into account an increase in value according to stand age. Therefore, taxes are the same for the three stages in stand growth.

Estate taxes are greatest with the income method of valuation when the two deaths occur during the periods of stand growth of 5 to 15 and 15 to 25 years. In the case of

Table 15. Estate taxes for each valuation method based on estate size, marital deduction strategy and stand age at time of death

A. Capitalization of Income Valuation

Estate Size	Marital Deduction	Stand age at time of death (Years) 5	15	15	25	25	35
				(dollars 000)			
Small	50-50	4.8	0	17.6	17.0	33.5	61.6
	Formula	0	0	0	54.4	0	141.6
Medium	50-50	93.0	172.1	118.1	240.3	151.6	336.1
	Formula	0	285.4	0	536.8	0	751.0
Large	50-50	303.8	640.0	360.6	805.7	436.6	1,033.6
	Formula	0	1,424.8	0	1,754.9	0	2,204.2

B. Liquidation Valuation

Estate Size	Marital Deduction	Stand age at time of death (Years) 5	15	15	25	25	35
				(dollars 000)			
Small	50-50	0	0	0	0	21.2	62.6
	Formula	0	0	0	0	0	118.1
Medium	50-50	21.6	23.7	48.8	185.5	125.5	340.2
	Formula	0	69.6	0	343.0	0	719.2
Large	50-50	142.5	290.8	203.6	665.0	376.0	1,034.1
	Formula	0	652.8	0	1,387.4	0	2,172.1

C. Assessed Valuation

Estate Size	Marital Deduction	Stand age at time of death (Years) 5	15	15	25	25	35
				(dollars 000)			
Small	50-50	0	0	0	0	0	0
	Formula	0	0	0	0	0	0
Medium	50-50	21.6	0	21.6	0	21.6	0
	Formula	0	33.8	0	33.8	0	33.8
Large	50-50	142.5	222.3	142.5	222.3	142.5	222.3
	Formula	0	526.3	0	526.3	0	526.3

the first death at a stand age of 25 years and the death of the surviving spouse at a stand age of 35, the valuation method with the highest estate tax is dependent on the marital deduction strategy. With full use of the unlimited marital deduction, estate taxes are higher under the income method. If the 50-50 marital deduction strategy is used, the liquidation method has the higher estate taxes.

The amount of estate tax in relation to the period of stand growth follows a similar trend to the timber value based on valuation method for each stage (See Figure 6). Estate taxes increase at a steady rate over the three periods with the income method. For example, with a medium-sized estate and a formula will, the total estate taxes are $285,420 for the period of stand growth, 5 to 15, $536,803 for 15 to 25, and $750,988 for 25 to 35. Total estate taxes for the liquidation method start out lower in the 5 to 15 year stage, but increase substantially with the older stages to a level similar to that for the income method at a stand age of 35. With assessed values for timberland, estate taxes are constant over the three ten year periods in stand growth.

In all but one case, total estate taxes are greater when full use is taken of the unlimited marital deduction. However, financial comparisons of the relative advantages of

the two marital deduction strategies are best examined using present value analysis. The strategy with the lower present value of estate taxes is the better choice because more of the estate value is preserved. Table 16 displays present values calculated with a 10 percent alternative rate of return for each of the simulations. The better choice of marital deduction strategy to use in the first death is dependent upon valuation method, estate size and stage in stand growth. For the income valuation method and a small estate, the best choice is to fully use the unlimited marital deduction no matter what the stand age. The formula will is best with the medium-sized estate for the two younger growth periods, however, the 50-50 strategy is better with the growth period of 25 to 35. Finally, with a large estate, the 50-50 strategy has the lower present value of estate costs for the two older stand growth stages.

With the liquidation valuation method and the small estate, the 50-50 marital deduction strategy is slightly better in the last stage of stand growth (the only period in which estate taxes are incurred). For the medium and large estates, the lower present values of estate taxes are with the 50-50 strategy in the periods 15 to 25 and 25 to 35. The formula will is always the best choice with assessed valuation of timberlands.

Table 16. Present values of estate taxes at a 10 percent discount rate

A. Capitalization of Income Valuation

Estate Size	Marital Deduction	Stand age at time of death: 5-15	Years 15-25 (dollars 000)	25-35
Small	50-50	4.8	24.2	57.3
	Formula	0	21.0	54.6
Medium	50-50	159.4	210.8	281.1
	Formula	110.0	207.0	289.5
Large	50-50	550.5	671.2	835.1
	Formula	249.3	676.6	849.8

B. Liquidation Valuation

Estate Size	Marital Deduction	Stage in stand growth at time of death: 5-15	Years 15-25 (dollars 000)	25-35
Small	50-50	0	0	45.3
	Formula	0	0	45.6
Medium	50-50	30.7	120.4	256.6
	Formula	26.8	132.2	277.3
Large	50-50	254.6	460.0	774.7
	Formula	251.7	534.9	837.4

C. Assessed Valuation

Estate Size	Marital Deduction	Stand age at time of death: 5-15	Years 15-25 (dollars 000)	25-35
Small	50-50	0	0	0
	Formula	0	0	0
Medium	50-50	21.6	21.6	21.6
	Formula	13.0	13.0	13.0
Large	50-50	228.2	228.2	228.2
	Formula	202.9	202.9	202.9

Another way of examining the choice of marital deduction strategy is to determine the alternative rate of return at which one would be indifferent between using the 50-50 marital deduction or formula will. The alternative rates of return for each simulation are displayed in Table 17. For the income valuation method, the small and medium estates require increasingly higher alternative rates of return with older stands for the estate to be indifferent between the two strategies. The discount rate for the large estate falls slightly when comparing the growth periods 15 to 25 and 25 to 35. This is attributed to the fact that a large proportion of the estate that was shielded by the unlimited marital deduction in the first death has reached the maximum tax rate of 50 percent at the second death. The estate does not suffer from an escalating tax rate due to the deferral of estate taxes.

For liquidation valuation of timberlands, a medium and large-sized estate requires the highest alternative rate of return for the stage in stand growth of 15 to 25 years. This is the period in which the stand is achieving the greatest appreciation in value. The portion of the estate that is deferred from taxation in the first death receives a much higher value and estate tax at the second death. The required alternative rate of return with assessed valuation is constant for the three growth periods.

Table 17. Alternative rates of return at which the landowner is indifferent between the 50-50 and unlimited marital deduction formula

A. Capitalization of Income Valuation

Estate Size	Stage in stand growth at time of deaths		
	5-15	15-25	25-35
		percent	
Small	0	7.8	9.1
Medium	2	9.6	10.6
Large	9.9	10.6	10.4

B. Liquidation Valuation

Estate Size	Stage in stand growth at time of deaths		
	5-15	15-25	25-35
		percent	
Small	0	0	10.1
Medium	7.8	12.4	11.7
Large	9.8	13.5	11.7

C. Assessed Valuation

Estate Size	Stage in stand growth at time of deaths		
	5-15	15-25	25-35
		percent	
Small	0	0	0
Medium	4.6	4.6	4.6
Large	7.9	7.9	7.9

ESTATE PLANNING CONSIDERATIONS

It has been shown that in spite of the recent changes in estate tax laws brought about by ERTA, owners of large unplanned estates face heavy burdens imposed by estate taxation.

Without proper planning, the payment of estate taxes can be devastating for a forest estate, especially if a portion of the timber must be liquidated. For example, consider the case of the medium-sized estate with a 15 year old loblolly pine stand. At the first death, using the 50-50 marital deduction strategy, it would require the harvest of 37 percent of the timberland to pay the tax (includes capital gains tax on timber) if the timber is valued by the liquidation method[73]. Using the formula will would result in the harvest of 36 percent of the timber to pay the estate tax at the second death. The amounts that must be harvested are substantially greater with the income valuation method. The early liquidation of timber to pay estate taxes not only disrupts the management program, but results in low revenues from sale of small timber. This is also the period of greatest timber value growth (21.6 percent). Harvesting timber to pay estate taxes is not as disrupting for an estate with timber approaching maturity (25 to 35 year old

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[73] Does not include additional tax incurred at second death.

stand example). The estate generally does not face as severe a liquidity problem as in the earlier stages. Also, the timber is reaching financial maturity.

However, there may be another problem these estates face if they must liquidate timber to pay the estate taxes at the second death. At the first death, is is not necessary to include timber as real property in meeting the requirement that at least 25 percent of the estate's adjusted value consist of the adjusted value of real property qualifying for special use valuation. By not including timber, the estate avoided incurring a recapture tax, if timber is harvested within ten years following death. At the second death, though, the timber value has appreciated significantly[74] and, therefore, must be a part of real property to meet the percentage requirement. Thus, an estate that must harvest timber within ten years of the second death, will be subject to the added tax. The alternative is to compute the estate tax based on the fair market value of the real property.

These are a few of the implications of funding estate taxes from the harvest of timber. Proper estate planning is necessary to insure that timber management is not disrupted or is the least cost alternative faced by the estate.

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[74] This is the case for the income and liquidation valuation methods.

Estate planning will reduce taxes as well as alleviate the sudden need for funds.

Marital deduction planning has been shown to be one way of reducing estate taxes. Estate taxes may also be lowered by giving gifts of up to $10,000 per year, free of gift taxes[75]. an estate with rapidly appreciating assets such as land and timber (Dennis 1981). In order to preserve the integrity of the forest estate gifts may be in the form of shares in a corporation or partnership. Various types of trusts tailored to the needs of the individual may also reduce taxes.

Forest estates must make sure that there is an adequate source of funds to pay estate taxes. This is most important for estates with immature or rapidly growing stand of trees particularly if timber is valued according to the capitalization of future income. Insurance on the life of the estate owner, held by an heir, is one method of financing the tax. Qualifying for deferral and extension of estate taxes will spread payment of the tax and eliminate forced sales of timber.

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[75] An annual gift tax exclusion is allowed such that a donor can give gifts of up to $10,000 per donee each year without any gift tax cost (Code Sec. 2503(b) as amended by '81 Act Section 441(a)). Spouses using the gift-splitting provisions can transfer up to $20,000 per donee. Gifting will especially benefit

EXAMPLE OF AN ESTATE WITH A THINNED STAND

A thinning at age 20 was incorporated in the example for a medium-sized estate to study impacts of thinning on estate taxes and marital deduction planning. It is assumed that income from the thinning is invested at a return of 10 percent and included in the estates of the decedents.

With the liquidation method for valuing timber, the estate taxes increase slightly over the unthinned example at the second death with a stand age of 25. Estate taxes are much higher for the 25 to 35 year stage (estate tax of $409,246 at the second death when the stand is 35 as opposed to $340,157 for the unthinned example). The income method of valuation imposed much higher estate taxes with the 15 to 25 year growth stage ($326,968 in estate taxes for the thinned example with the second death at a stand age of 25; $240,358 for the unthinned case). Taxes for the oldest stage are similar to that with the liquidation valuation method.

With a 10 percent alternative rate of return, thinning causes a shift from the formula will to the 50-50 marital deduction as having the lower present value of estate taxes during the 15 to 25 year stage for the income valuation method. It becomes more desirable to tax a greater proportion of the estate at the first death and not be

subject to a much larger tax resulting from the increase in the value appreciation for timber brought about by the thinning. There is no shift for the liquidation valuation method because thinning actually reduces the immediate harvest value for several years.

CONCLUSIONS

It is essential that estates consisting primarily of forestland, consider estate planning in their forest management program. Estate taxes can be especially burdensome for a capital intensive forested estate. For the unplanned estate, the problem of funding taxes becomes very serious due to the illiquidity of timber assets.

The amount of estate tax has been shown to vary with the stage in the growth of the timber stand. These taxes increased for two of the three timber valuation methods as the stand approached maturity. The ability to pay for the taxes from the timber harvest revenues without severe disruption of the forest management plan improves with the age of the stand. Thus with young and medium aged stands, having other means for funding the tax is extremely important.

Exactly how much estate tax must be paid is highly dependent on the method used for timberland valuation. The

law is vague as to the procedure for valuing timberland. In many cases, timberland values are based on capitalized forest industry lease values when they are available.

In the valuation methods examined, forest estates with younger stands suffer least from estate taxation when valuation is primarily based on the timber's liquidation value or state assessed values for timberland. The assessed valuation method results in the least amount of tax for all stages in stand growth. For medium aged stands, the capitalization of income method produced the highest estate taxes whereas the liquidation method resulted in the highest taxes with stands approaching maturity.

Planning the appropriate level of marital deduction is important for reducing estate taxes. In cases where timber values rapidly appreciate between the two deaths, there is a greater benefit in allowing more of the estate to be taxed early (i.e. 50-50 marital deduction strategy). However, the rate of appreciation is dependent on the timberland valuation method, stage in growth of the stand and cultural practices such as thinning.

Forest estates face a unique problem in qualifying for special use valuation. Rapidly appreciating timber values may make it necessary that timber be included as an interest in real property in order to meet the requirements for

special use valuation. Thus, the timber that is approaching maturity cannot be harvested in the normal course of management without incurring a recapture tax.

The analysis examined simplified examples of forest estates. The intent was not to model actual situations, but to consider the broad implications of forest management investments under the impact of estate taxation over a short time horizon. It will provide forest estates with a framework for tackling the complexities of estate planning for their particular situation.

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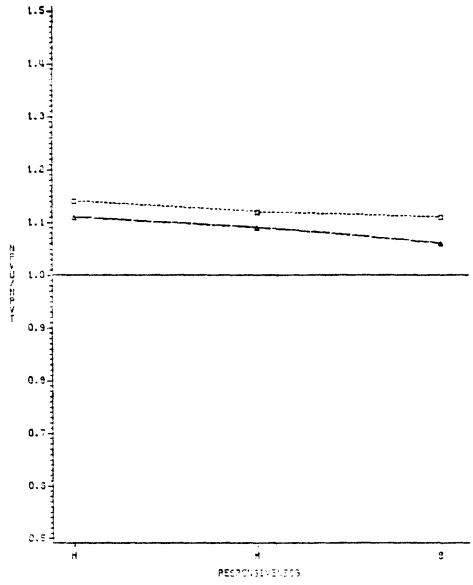
Appendix A

NPVu/NPVt TO STUMPAGE PRICE RESPONSIVENESS RELATIONSHIPS FOR LOBLOLLY PINE PLANTATIONS

Site index 70
Row thin and 700 planted trees per acre

ALTERNATIVE 1



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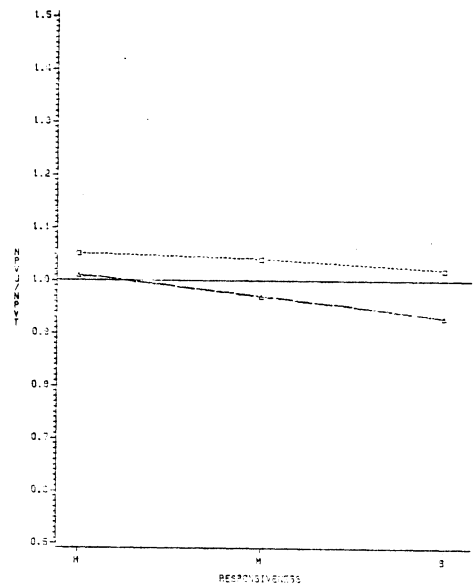

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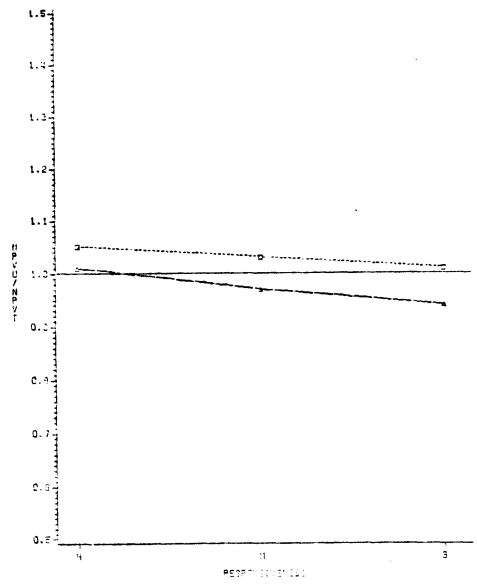

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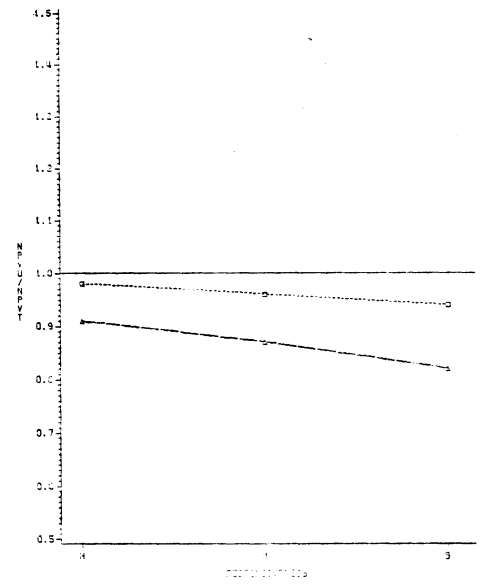
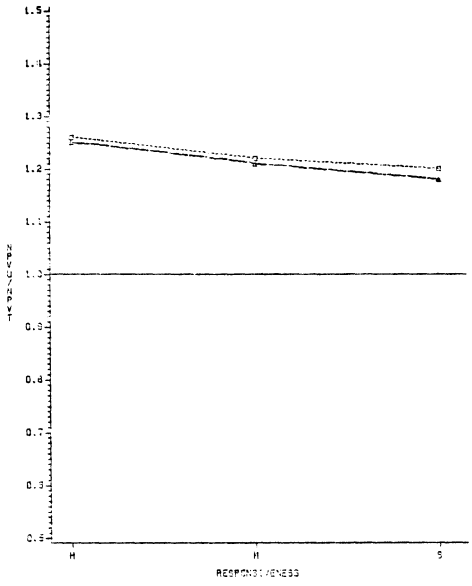


Site index 70
Row thin and 900 trees planted per acre

ALTERNATIVE 1



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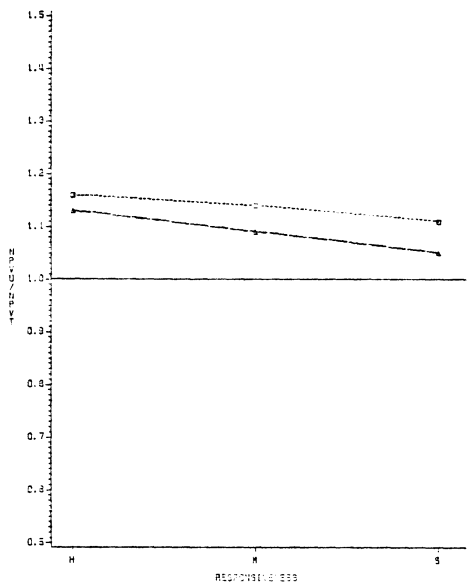

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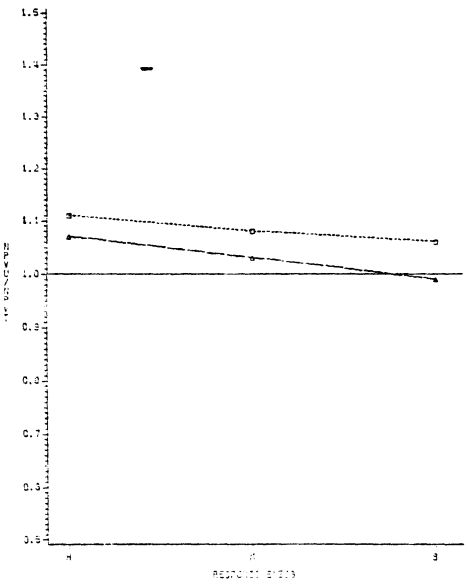

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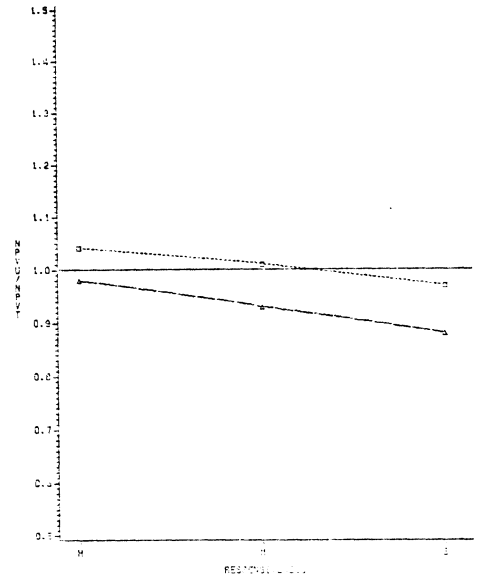
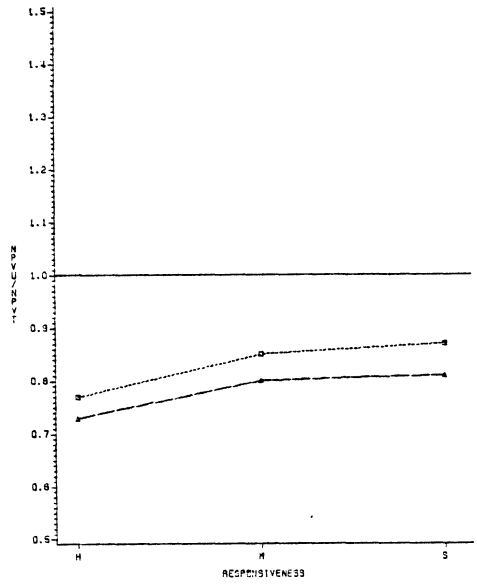


Site index 70
Low thin and 700 planted trees per acre

ALTERNATIVE 1



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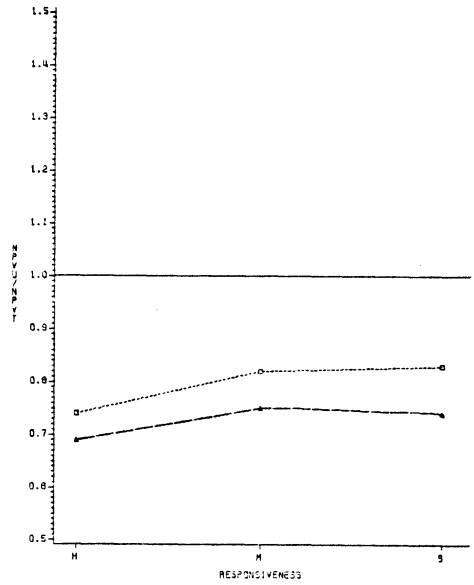

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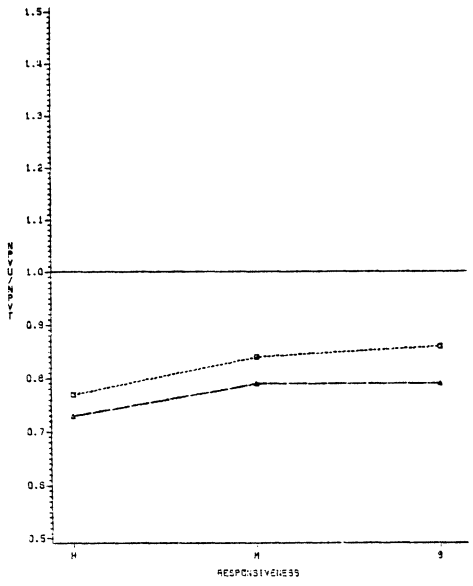

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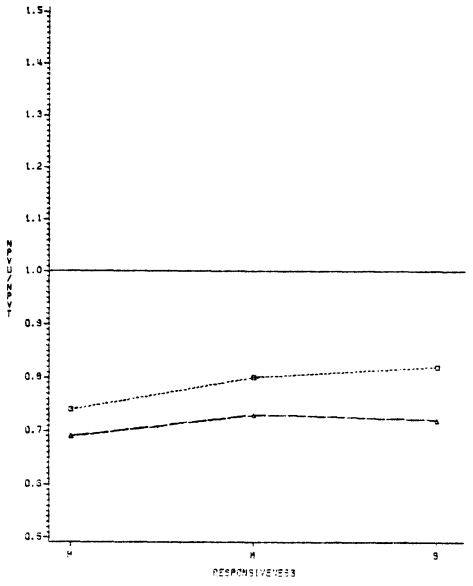
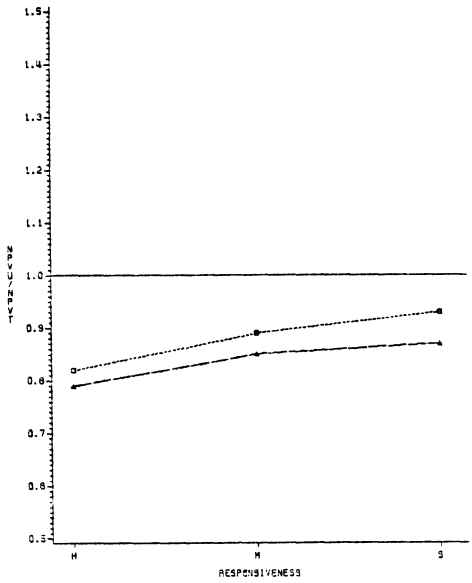


Site index 70
Low thin and 900 planted trees per acre

ALTERNATIVE 1



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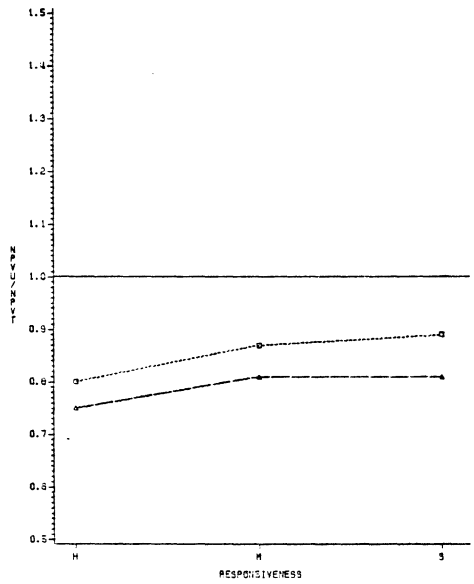

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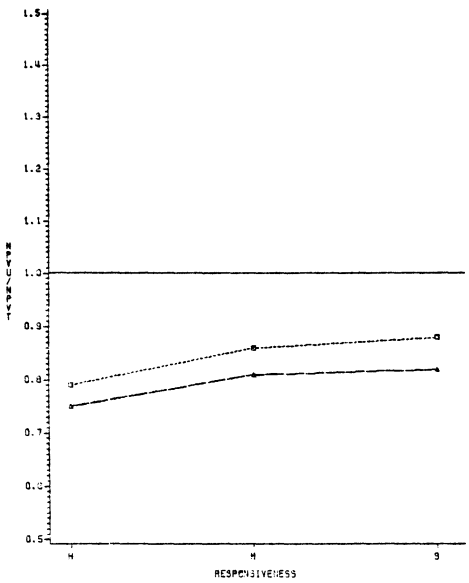

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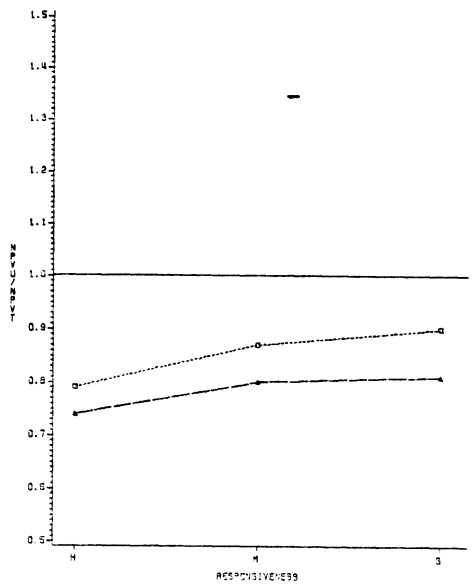
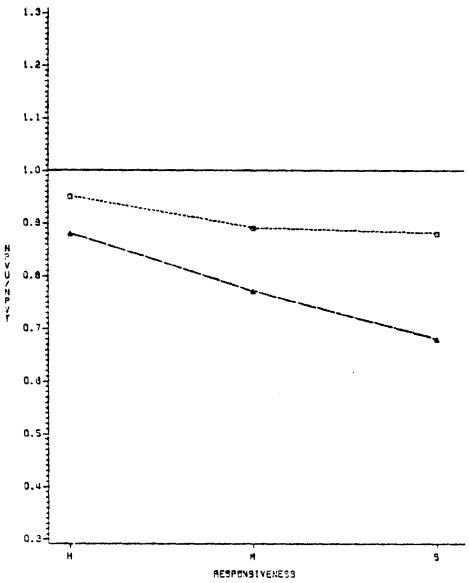


Site index 60
Row thin and 700 trees planted per acre

ALTERNATIVE 1



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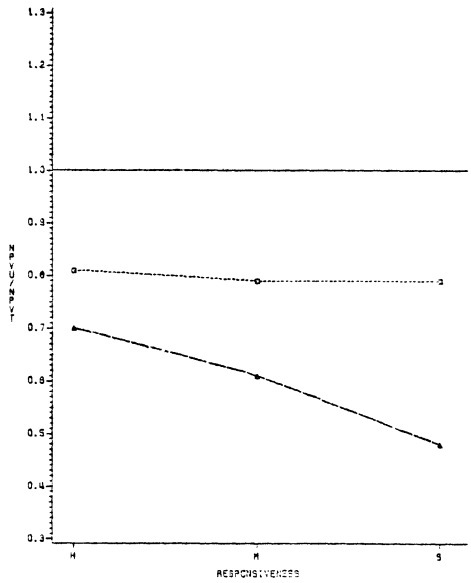

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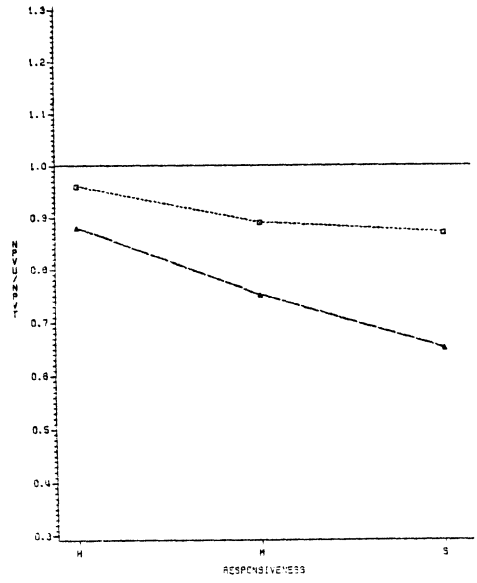

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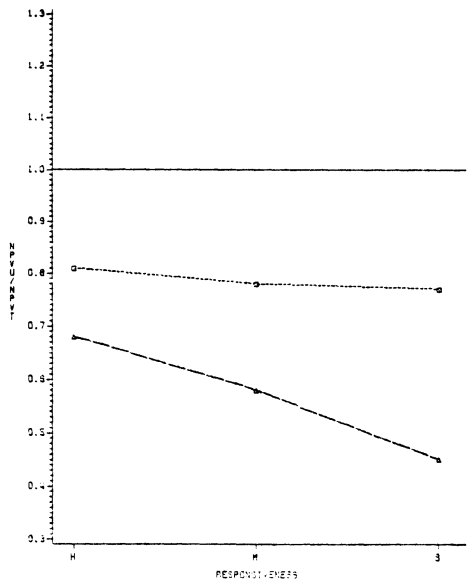
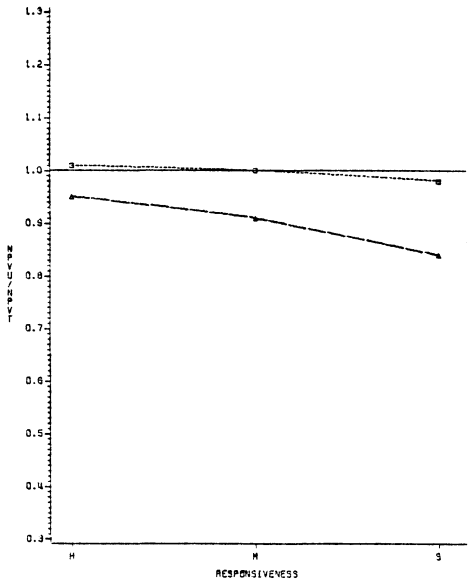


Site index 60
Row thin and 900 trees planted per acre

ALTERNATIVE 1



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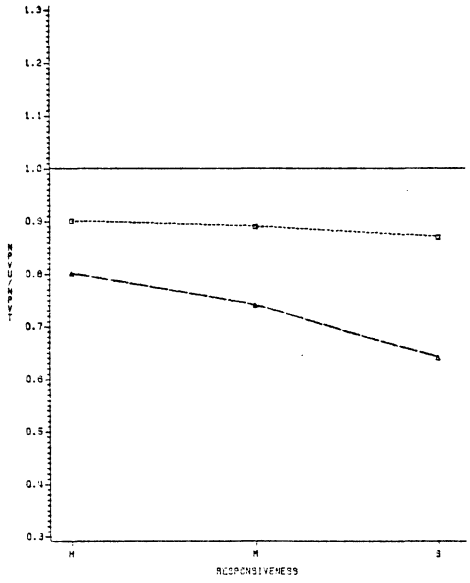
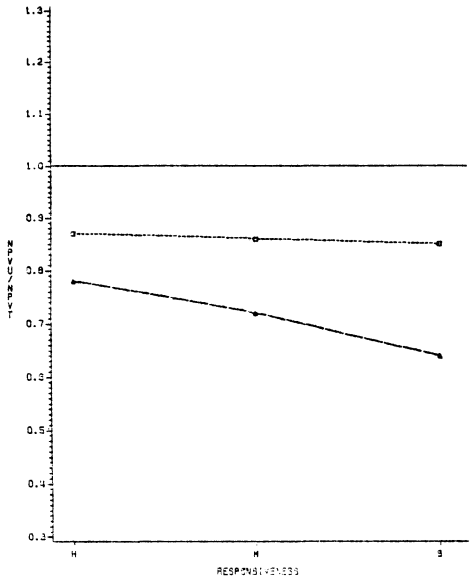


ALTERNATIVE 3



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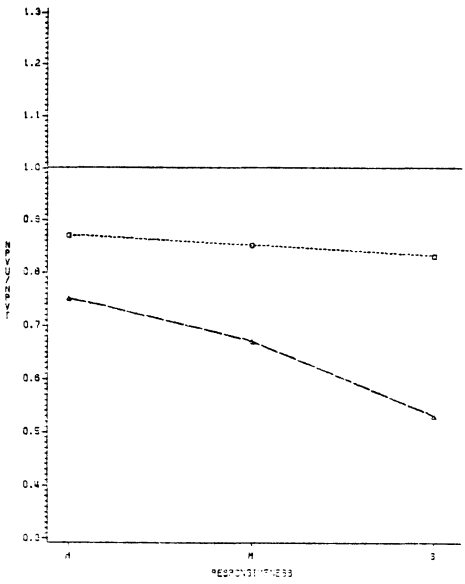
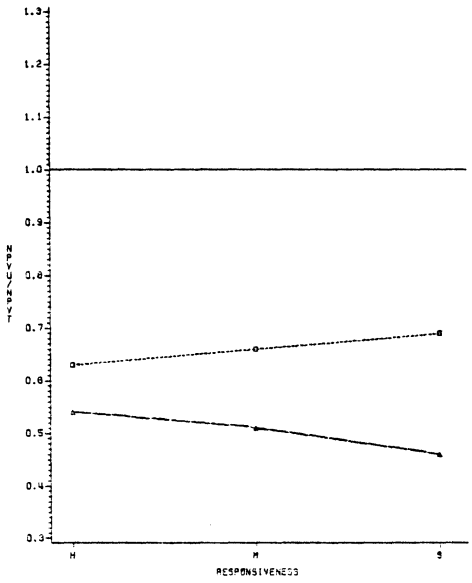


Site index 60
Low thin and 700 trees planted per acre

ALTERNATIVE 3



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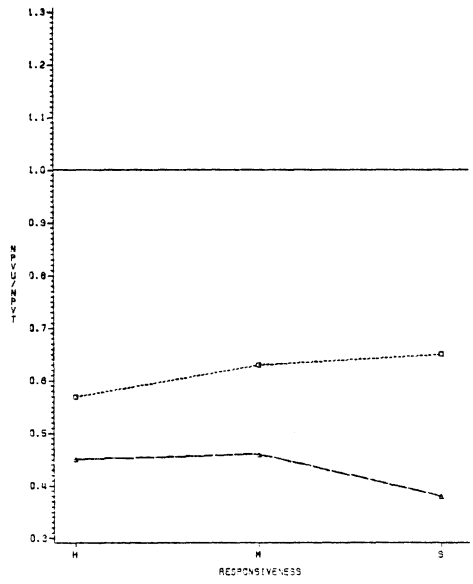
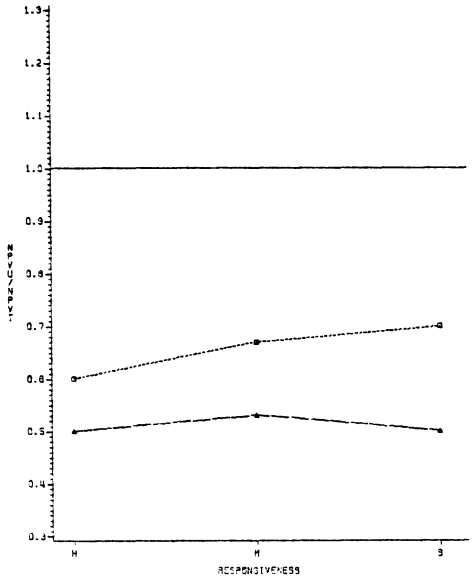


Site index 60
Low thin and 900 trees planted per acre

ALTERNATIVE 3



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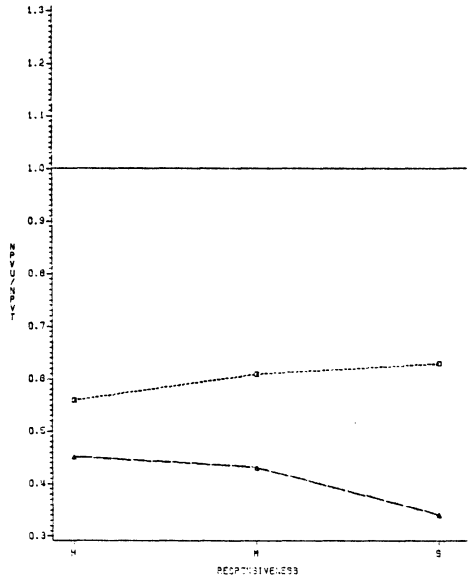

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