Potential Impacts of Various Capital Gains Tax Structures on Forest Investments

by

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(ABSTRACT)

The objective of the study was to determine how various capital gains tax structures affect decisions to invest in new forest investments. These effects were measured by changes in the after-tax present values of bare land under each tax structure. The three capital gains tax structures modeled were: the current federal income tax law without basis indexing, the current federal income tax law with basis indexing, and the accrued income tax with indexing. Other things equal, the direction of effects on present values of bare land of capital gains tax structures and the other factors in the model was the same for White pine Christmas trees and Douglas fir timber. Highest present values occurred with basis indexing and lowest present values were with the accrued income tax structure, in all possible combinations of the above variables. Higher present values with basis indexing were due to tax savings. Tax saving from basis indexing per dollar of cost basis increases, reaches a maximum, then decreases as the payoff period lengthens, at a given inflation rate, with all other things equal. The payoff period that maximizes tax savings per dollar of cost basis decreases, as real interest rates increase. When the capital gains tax rate is 34% and inflation rate is 5%, and when real interest rates range from 3% to 9%, the payoff period with maximum tax savings ranges from 20 to 10 years. Since most forest investments have rotations longer than 20 years, this result implies that basis indexing will probably not affect decisions about new forest investments very much. It will also not affect the timing of gains realization for capital assets, not necessarily forestry in nature only, that had already been held for longer than 20 years.

Two equity criteria were considered in the study. The first criterion requires the tax to be neutral with respect to allocation of land to different uses. The second criterion requires capital gains recipients to pay, at investment maturity and with other things equal, taxes equal to the sum of annual taxes on increases in asset value (accrued income) accumulated with interest.

The study showed that, without inflation, the realized income tax (the current federal income tax) is neutral with respect to allocation of land to uses with different rotations because the tax reduces the bid prices for land uses with different rotations by equal percentages, other things equal. However, with inflation, the results suggest that basis indexing is needed in order to maintain the tax's neutrality with respect to allocation of land to uses with different rotations.

Under the second criterion, a forestry example was compared with a bank account, both with equal value growth rates. It showed that taxes paid on realized capital gains at investment maturity are lower than the sum of annual taxes on accrued income accumulated with interest, given the same tax rate. Thus, the current federal income tax, which taxes capital gains upon realization, does not meet the second equity criterion. Based on this criterion, the tax favors assets that yield capital gains over assets with annual incomes.

In order to meet the second equity criterion, realized capital gains should pay taxes at the ERITAX rate. The ERITAX rate, when applied to realized capital gains, gives tax revenues equal to accrued income taxes accumulated with interest to investment maturity. However, when the annual accrued income tax rate is high, or when the rotation is long, or when the timber value growth rate is low relative to the interest rate, the ERITAX rate can exceed 100% of the capital gains, thus driving some bare land values below values in alternative uses. This result is consistent with the finding that the accrued income tax is non-neutral with respect to allocation of land to different uses and is biased against land uses with long payoff periods, given the same establishment costs. Thus, when the second equity criterion is met, the tax becomes biased against land uses with long rotations.

These results indicate that none of the taxes modeled can meet the two equity criteria simultaneously. Even so, among forest investments, the current federal income tax with basis indexing is the most desirable because it is least likely to distort allocation of land to forestry.

Dedication

To Roberto, for all what might have been, and to Nene Girl and Nonoy Boy, for all the missed and outgrown bedtime stories.

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CHAPTER I

INTRODUCTION

Authors may disagree as to whether something is a capital asset, but they more or less agree on the definition of capital gains. It is a gain (or loss) derived from the sale or exchange of a capital asset. A capital asset is property held for investment. This property is contrasted to goods and services which are normally offered for sale by the trader in the course of his daily business and which are termed normal stocks of trade. A capital asset, when sold, gives rise to capital gains (or losses) while normal stocks of trade result in ordinary income (or losses).

Standing timber has been recognized as a capital asset, ever since capital income taxation started in 1913 when the federal income tax was enacted (Condrell, 1970; Siegel, 1977; GAO, 1981; Boyd and Daniels, 1985). When capital gains were given preferential treatment in 1922, timber capital was able to avail itself of such treatment. Prior to 1986, this was a desirable distinction because capital gains were given preferential tax treatment. The forest industry worked hard to ensure that timber was always classified as a capital asset and that the preferential treatment of capital gains over ordinary income was maintained.

In 1986, there was a major change in capital gains taxation. The Tax Reform Act of 1986 repealed the 60% exclusion for individuals and removed the preferential treatment of capital gains, including those for timber. These provisions fully took effect after a phase-in period from 1986 to 1987. Currently, individuals pay a top rate of 28% for both ordinary and capital gains income. Corporations pay a top rate of 34% for both income types. In 1987, there still was a differential between capital gains and ordinary income tax rates because ordinary income tax rates were still higher than the capital gains tax rates. For that year, the top ordinary income tax rate was 38.5% for individuals and 40% for most corporations. Capital gains tax rates for the two groups of tax-payers were 28% and 34% respectively.

The new law taxes the full amount of capital gains at ordinary income rates. Many articles have already been written about possible effects of this new measure (Aten, 1988; Auerbach, 1988, 1989; Auten *et al*, 1989; Darby *et al*, 1989; Herber, 1988; Howitt and Sinn, 1989; Minarik, 1986; Kopcke, 1989; Lindsey, 1987a, 1987b; McConaghy, 1986; McLure, Jr., 1988; McLure, Jr. and Zodrow, 1987; Pechman, 1987b, 1990; Rose and Milliken, 1986; Condrell, 1986; Dangerfield, Jr. and Gunter, 1986; Siegel, 1986; Klemperer, 1987; Hoover, 1986; Hyde *et al*, 1987). Some of them predict that the tax reform will result in decreased investments in forestry.

1. Justification for the study

The forest industry is particularly concerned about the possible effects of the 1986 tax reform (FICTVT, 1985). Several works have indicated the possible effects, good and bad, of the tax reform on forest investments. However, they were preliminary and general in nature. Moreover, they dealt only with the projected effects of a higher capital gains tax rate on forest investments. The potential effects on forest investments of different capital gains tax structures in combination with various inflation rates, discount rates and cost and price configurations have not been reported. Although attention has been called to possible advantages of indexing the cost basis [1] to the inflation rate in order to alleviate the negative effects of inflation upon capital gains recipients, there is no reported study specifically dealing with inflation rates in connection with forest investments and capital gains tax systems.

Tax reform proposals and studies are always forthcoming in the desire to achieve efficiency and equity in taxation. This is especially true with capital gains taxes. Lawmakers have constantly adjusted either the tax rate, the holding period [2] or the composition of the tax deductible cost basis. It is not far-fetched to assume that in the future, preferential tax rates will again be allowed for long term capital gains. Alternatively, indexing of the cost basis to inflation may be allowed if the current capital gains tax rates continue to be in effect. Inflation rates, discount rates and price of timber are likely to change. Expenses that currently must be capitalized may in the future have to be expensed and vice versa.

Because of the above possibilities, this study focuses on the potential effects of different capital gains tax structures, when coupled with the foregoing possible scenarios, on decisions to invest in new forest investments. The forest investment considered in the study is an acre of bare land which may be planted with White pine for Christmas trees or Douglas fir for timber production. The potential impacts of the various capital gains tax structures modeled are measured by changes in the net present values of bare land when the capital gains tax structure changes while the other factors are held constant. Results of such a study would be useful to private forest landowners who were estimated to own over 345 million acres of forest lands in the United States (USFS, 1982). For example, the results could guide them in deciding whether to invest in a new plantation or to fertilize existing ones, if they know the capital gains tax structure that will most likely be in effect at the time of future harvests.

The Forest Service may also benefit from the results of the study. Because of the vast acreage under private forest ownership, if changes in capital gains tax structures do affect forest investment and management decisions such as rotation lengths, management intensity and harvest levels, then

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[1] See Appendix G.

[2] See Appendix G.

timber supply questions arise. The Forest Service (1982) has mapped out the timber supply situation in the United States in connection with projected timber demand well into the next century. This timber supply outlook could differ if capital gains tax structures were changed sufficiently so that the Forest Service's expected private forest investments and management decisions fail to materialize.

The study also focuses on aspects having policy implications of interest to Congress. For example, indexing the cost basis to inflation has been proposed several times but has never been approved. Policy analysts may be interested in possible effects of basis indexing on present values of a forest investment under different scenarios.

The manner in which certain costs are treated by law is another point of potential interest to Congress. At present, some costs are expensed while others are capitalized. This study compares the present values of the same forest investment when fertilization cost is expensed to the case when fertilization cost is amortized or capitalized, while holding all other things equal.

2. Objectives

The primary objective of this study is to determine the potential effects of various capital gains tax structures on decisions to invest in new forest investments. These potential effects can be identified by measuring and comparing after-tax present values of a forest investment under these capital gains tax structures. These tax structures are the current federal income tax structure without basis indexing, the current tax structure with basis indexing, and the accrued income tax with basis indexing. To contrast tax impacts on short and long term forestry investments, empirical examples are plantations of White pine Christmas trees or Douglas fir for timber production. The secondary objective is to determine how these present values of bare land under each capital gains tax structure are affected by capital gains tax rates, interest rates, inflation rates, payoff periods, and tax treatment of fertilization costs. Fertilization costs are either expensed, amortized or capitalized.

CHAPTER II

REVIEW OF LITERATURE

A brief review of any subset of the numerous articles on taxation will show that the issue of capital income taxation is almost always coupled with complaints about inequity and inefficiency. Examples are articles by Stiglitz (1983), Diamond (1975), Brinner (1973), Feldstein (1976), Smith (1961), Andrews (1974), Gravelle (1983), Break and Pechman (1975), Gann (1985), Gravelle and Kotlikoff (1989), Kay and Keen (1989), Poterba (1987a, 1987b, 1988), Protopapadakis (1983), and Halperin (1971). Public economics literature points out that non-uniform taxation of anything causes inequity and inefficiency. From the volume of complaints against capital gains taxation, it seems that this particular section of the tax code causes much inequity and inefficiency.

Accordingly, capital gains taxation has growth as well as efficiency effects (David, 1968; Boskin, 1988; Head, 1963; 1987; Pechman, 1987a; 1987b; Stiglitz, 1969; 1983). It affects the rate of economic growth because it affects the level of real investment. It influences the demand for investments as well as the supply of financial securities. Its efficiency effects derive from tax-induced changes in the relative yields of alternative investments. Those with preferential capital gains treatment have higher after-tax yields (David, 1968; Gravelle, 1983; Poterba, 1987a; 1987b). Due to these factors, almost all authors who write about the subject propose reforms (Sunley, 1972; Andrews, 1974; Gravelle, 1983; Feldstein, 1976; Minarik, 1984, 1981; Dworsky, 1986; Helliwell, 1969; Diamond, 1975; Conda, 1986; Break and Pechman, 1975). All of them agree that the capital gains provisions influence investment behavior but that in some instances, the resultant behavior may not be the intended outcome of the tax provisions. Hence, the constant reappraisal and tax reform studies (Siegel, 1977; Minarik, 1981; U.S. Treasury, 1969; GAO, 1981; Herber, 1988; Pechman, 1987b; 1990).

1. A Brief History of Timber Capital Gains Taxation in the United States

Capital income taxation started in 1913 when the federal income tax was enacted (Minarik, 1981; Condrell, 1970; Boyd and Daniels, 1985). Until 1921, capital gains was treated as ordinary income. Capital losses were not deductible in 1913-1915, deductible only from capital gains in 1916-1917, and deductible in full from any income in 1918-1921. In 1922, special lower rates were adopted for capital gains. From that time up to 1986, capital gains were taxed at a lower rate than ordinary income. There were tax changes made, but they dealt with the holding period and the rate and not with eliminating the disparity of treatment between the two kinds of income.

Standing timber has always been classed as a capital asset (Condrell, 1970; Siegel, 1977; GAO, 1981; Boyd and Daniels, 1985). In 1919, a legislative action provided specifically for timber depletion although since 1913, timber depletion had been allowed as a matter of procedure (Condrell, 1970; Siegel, 1977). When capital gains were given preferential rates in 1922, the provisions applied to timber capital as well. Up to 1943, however, these special rates were allowed only for lump sum sales of timber because only lump sum transactions were considered as disposal of a capital asset at that time, provided that the timber owner's normal business was not selling timber to customers and the holding period was satisfied. If landowners cut their own timber either for sale as logs or for use in their own sawmills, they had to pay taxes at ordinary income rates. Also, if they sold their timber at an agreed price per unit of measure or if they marked only the trees they wanted cut under a cutting contract because they were practicing good forest management principles, they had to pay at ordinary income tax rates even though the buyer did the cutting. This disparity of treatment between the two methods of disposal of timber was claimed by some authors to have discouraged sustained yield forest management and reforestation (Condrell, 1970; Fortson and Hargreaves, 1972; Forest Industries Committee, 1985).

When tax rates began to rise, the capital gains treatment of timber income became very attractive. Clamors for equity began, and in 1943, Section 117(k) of the Internal Revenue Code allowed the capital gains provisions also for timber owners who cut and process their own timber. The reasons for passing these provisions were to stimulate development of forest resources through better management, to correct the inequity due to taxation of bunched income under the progressive personal income tax, and to provide the same treatment to all kinds of timber owners (Mead, 1959; Condrell, 1970).

The provisions did not change substantially even with eight revenue rulings pertaining to timber between 1943 and 1953. Section 117(k) was reenacted almost intact as Section 631 of the new Internal Revenue Code of 1954. Even with tax reform studies in 1954, 1959, 1963, 1969, 1971, 1973 and 1976, capital gains provisions for timber were reviewed and were left substantially unchanged. The industry claims that this was proof that the studies have reaffirmed again and again the value of these provisions in terms of taxation equity and economic benefits (Condrell, 1970). Other experts say, however, that the timber capital gains provisions were so little understood that they have escaped the scrutiny they needed to get repealed (Sunley 1972; GAO, 1981).

Since 1969, timber capital gains have continued to be under scrutiny. Some bills in the House and the Congress (e.g., Mills-Mansfield Bill of 1972, Corman Bill of 1973) would have had Section 631 repealed. Congressional hearings on tax reform measures proposed a sharp reduction in deductible expenses for timber growing. Section 631 was not repealed but changes were made in the provisions. The holding period was changed three times, to nine months in 1977, to one year in 1978 and to six months in 1984. For individuals, until 1978, the maximum capital gains tax rate was 49% for those in the highest tax bracket. This was cut to 28% in 1978 and to 20% in 1981.

The exclusion proportion up to 1986 was 60%. For corporations, the capital gains tax rate from 1981 to 1986 was 28%.

In 1983, Senate Bill 1714 proposed the elimination of the preferential treatment of timber capital gains. The bill did not succeed. But, by 1985, numerous congressional groups became opposed to timber capital gains provisions. Foremost of these were the authors of the Bradley-Gephart and the Kemp-Kasten tax simplification plans.

The Tax Reform Act of 1986 left the determination of the cost basis unchanged; that is, costs for site preparation, seedlings, planting and early stand development are still to be capitalized and deducted from harvest revenue. Management and protection costs incurred during the first two years after establishment are deductible from ordinary income. Carrying costs such as property taxes, interest and administrative costs may be deducted currently or may be added to the basis in the timber. Reforestation costs up to $10,000 incurred in each tax year may be amortized over a seven-year period. Furthermore, a 10% tax credit up to $1,000 for reforestation costs is allowed. These provisions were carried over from the 1981 Economic Recovery Tax Act and apply only to individuals. Many articles have been written about the possible effects of these new measures (Conda, 1986; Dworsky, 1986; Bartlett, 1986; Gubernik, 1986; Jonas, 1986; Saunders, 1986; Ruhm, 1986; Auerbach, 1989; Auten *et al*, 1989; Darby *et al*, 1989; Guertin and Rideout, 1987; Herber, 1988).

More recently (Murray, 1989), more capital gains bills were introduced in Congress. In particular, Morrison's bill, (HR 1029), provides for a sliding scale of capital gains tax rates. Assets held over from 1 to 3 years would enjoy 40% exclusion of capital gains. Those held from 3 to 5 years would have 60% exclusion. A 100% exclusion would be applied to assets held for 5 or more years. These provisions would apply to all capital assets including timber.

2. Timber Capital Gains Taxation in Other Countries

The capital gains taxation system for forest land in eleven other countries was reported by Andersen and Co. (1985). The report showed that capital gains are explicitly distinguished from ordinary income in Brazil, Canada, Australia, Sweden, Japan, Finland, France, New Zealand, Norway, Germany and the United Kingdom. However, provisions for taxation of these gains differ (Andersen, 1985).

In Australia, capital gains from the sale of forest land may or may not be taxed, depending on the original intent of the purchaser of the asset. If the asset sold was purchased originally with the intention of reselling it for a profit, the gain is taxed as ordinary income. Otherwise, there is no tax on capital gains. Timber capital gains are taxed at ordinary income tax rates. Due to administrative difficulties in ascertaining intent, Australia recently introduced a capital gains tax with these features: the cost basis for capital gains calculation is adjusted for inflation if the asset was held for more than a year, otherwise no adjustment is allowed. In both cases, taxable gains are taxed at regular income tax rates. Also, both individuals and corporations have the same top rates of 49%.

Brazil has no special rates for capital gains from selling forest or timber land, but it taxes timber capital gains at special low rates and allows a special deduction of up to 80% of taxable income. Furthermore, the cost basis for timber is indexed for inflation. Both individuals and corporations pay at the same tax rate of 60%.

Canada taxes half of capital gains from the sale of forest land at ordinary income tax rates and excludes the other half from taxation. Timber capital gains are taxed fully at ordinary income tax rates. Virtually all forestry operations in Canada are carried out by corporations, and they pay a tax rate of 50% for timber capital gains. In Finland, capital gains from forest land are not taxed if the asset had been held for more than 10 years. Otherwise, the capital gains are taxed at ordinary income tax rates. Capital gains from timber are taxed under the ordinary tax rate system. Corporations pay at a rate of 43%, while individuals pay up to 51%.

In France, special treatment is given to capital gains in the form of exemptions from taxation or lower tax rates, depending on income levels, holding period and the purpose for which the asset was held. Capital gains taxes are based on the "rental" value of the land as determined by local authorities and, as such, vary from one owner to another. Generally, there is a 20% exclusion. In Germany, full capital gains from forest land are taxed at half the regular rates. Timber capital gains are taxed at reduced rates. In Japan, forest land capital gains are taxed at preferential rates. Timber capital gains are allowed special deductions but are taxed at ordinary income tax rates. New Zealand's system is similar to the old system of Australia, where capital gains from forest land are not taxed unless the original intent was to resell for profit later. Capital gains from timber are taxed at ordinary income rates.

Capital gains are taxed as ordinary income in Norway except for forest lands which are taxed at a lower flat rate of 31.9%, depending on the holding period. Timber capital gains are taxed as ordinary income at 63% for individuals and 50% for corporations. Sweden taxes all income from all sources as ordinary income. Individuals pay at the rate of 50%, while corporations pay at 52%. All gains are indexed for inflation when the holding period exceeds four years. The United Kingdom applies a capital gains tax of 30% on gains from sale of forest land. This applies to both individuals and corporations. Timber capital gains are taxed preferentially, but the rates vary from owner to owner.

3. Major Issues Concerning Capital Gains Taxation

Preferential Tax Treatment

A. Arguments for preferential capital gains taxes in general

Dan Throop Smith (1961) notes three views affecting the mode of taxing capital gains. The first view is that capital gain is simply another form of income and thus should be included fully in taxable income. The second view is that it is completely different from any other income and so, should be ignored. The third view is that capital gain is not exactly like ordinary income but it has a definite tax-paying capacity which should be taxed on different terms and rates. Smith says that this third view is the most accepted concept which explains in part why most tax structures give preferential treatment to capital gains.

Taxable personal income should equal the sum of personal consumption and accumulation (Andrews, 1974). The difficulty in measuring this accumulation leads to inequity, distortion and complexity in taxation (Andrews, 1974). According to Andrews (1974), these problems will persist for as long as capital gains are taxed only upon realization. An example is the inequity in taxing realized gains and cash savings while not taxing unrealized gains. Also, if the holding period is sufficiently long, and tax rates progressive, bunched gains could move an individual into a tax bracket much higher than would occur if taxes were paid annually on accrued income. Bunching, however, does not affect corporations paying fixed tax rates. In addition, if inflation is high enough relative to nominal gains, taxes are paid on real losses (Feldstein, 1983; Feldstein and Slemrod, 1978).

For the above reasons, some authors (Smith, 1961; Feldstein, 1983; Conda, 1986; Andrews, 1974) justify the preferential treatment of capital gains. Specifically, they cite the following reasons:

1. The preferential treatment provided incentive for socially productive investments.

2. It alleviated the effects of bunching of gains.
3. It served as a crude adjustment for inflation.
4. It was a reward for risk investment.
5. It was an incentive for reinvestment of gains.

Risk investment is important for economic growth (David, 1968; Conda, 1986; Smith, 1961; Break and Pechman, 1975; Stiglitz, 1969, 1983). Smith in particular believes that the special tax rates increased the total amount of capital, encouraged the use of capital in new risky investments and prevented successful investments from being locked into their existing forms.

B. Arguments for preferential timber capital gains taxes

Proponents and defenders of the capital gains provisions for timber cited more explicit reasons for the preferential treatment of timber capital gains (Condrell, 1970; Fortson and Hargreaves, 1972; Forest Industries Committee, 1985). They say that the preferential treatment:

1. was a reward to those who chose to invest rather than to consume their income;
2. was little enough compensation for the long exposure to risk due to the long investment period required in timber growing;
3. gave the timber industry the same tax treatment that was given to other natural resource industries;
4. was an incentive to keep capital in forestry which requires one of the highest levels of investment but which historically gives a low rate of return ranging from 15 to 20% below the average of other industries.

These proponents also argued that the longer exposure to risk exacerbated by the nonavailability of commercial insurance against losses due to fire and pests makes the tax provisions necessary. They have claimed further that these provisions were instrumental in infusing capital investment in forestry, in inducing a high rate of reinvestment of revenues from timber harvesting into regeneration, in encouraging intensive management of forests, in promoting planting and wise use of timber and in encouraging the reforestation of cut-over lands and afforestation of marginal agricultural lands (Condrell, 1970; Forest Industries Committee, 1985). It is claimed that after the 1943 bill, the wide-scale reforestation efforts on industry lands were largely due to the capital gains incentive.

C. Objections to preferential capital gains taxes in general

Authors who present arguments against preferential capital gains tax rates include Smith (1969), Longo (1983), Feldstein (1976), Minarik (1981), Andrews (1974), Balcer (1983), Kovenock and Rothschild (1983), and Break and Pechman (1975). Their arguments stem mainly from the mechanics of capital gains taxation. Because taxes were not paid until gains were realized, the deferred taxes constituted a tax-free loan from the government which favored the gains recipient over those who received ordinary income (Balcer, 1983; Brinner, 1973; Folsom, 1978; Halperin, 1971). Equity and efficiency concerns arose when we taxed as ordinary income other recurrent capital income such as interest, rents, royalties and cash dividends while capital gains were taxed at preferential rates. The lower capital gains tax rates encouraged substitution of capital gains for ordinary income and thus distorted the choice of assets and timing of their sales (Balcer, 1983; Longo, 1983; Feldstein, 1976).

Others oppose the implementation details of the tax. They argue that if the preferential rate was intended to relieve bunching problems, then the holding period should be at least one year. Also, there was no need to set a bottom rate for capital gains because relief from bunching is needed only when tax rate progression sets in (Smith, 1961; Minarik, 1981). Andrews (1974) further noted that there is no evidence that capital gain incomes fluctuate widely for many taxpayers. In fact, the timing of realization of these assets can be controlled more than the timing of other incomes. Minarik (1981) suggested that bunching can be remedied through other means, not by using a lower tax rate. According to Minarik, some experts contend that bunching is the result of the privilege to defer realization of gains until the time of a taxpayer's choosing. The deferral of taxes already benefitted the gains recipient. Additional relief from lower capital gains tax rates is unnecessary.

Andrews (1974) noted that using a lower tax rate in order to offset the effects of inflation is not justified. He noted further that there is no high correlation between the amount of gain and the burden of inflation. Two people with equal wealth over the same period will experience the same inflation rate even if one of them has capital gains and the other has none. This means that inflation will impact on their original investments the same way if they started with equal investments. Therefore, both of them should be given relief by authorizing adjustments proportional to their original investments, and not on their gains (Andrews, 1974).

Smith (1961) shares this view with some qualifications. He says that inflation gives additional justification for the special rates. However, it should not be the major reason, unless general adjustments in the law are made to offset the inequities against bonds, insurance policies, and salaries which lag behind the inflation rates (Smith, 1961).

D. Objections to preferential timber capital gains taxes

Opponents of the timber capital gains provisions were more specific in their objections. First, they believe that neither the long investment period for timber nor the traditionally lower-than-average rate of return to forestry investments justifies the preferential treatment timber income enjoyed. Long investment periods and the concomitant greater exposure to risk are not unique to timber-growing. If timber qualified because of this factor, then so should have other businesses that take at least two years to grow (Smith, 1961; Boyd and Daniels, 1985; Sunley, 1972). It should be pointed out that some long-term investments do not qualify for capital gains treatment because their assets constitute inventories which are held for the explicit purpose of reselling for profit in the normal course of their business. Smith (1961) then noted that the long investment period for timber should be considered as part of its inherent cost of doing business. This cost should just be reflected in the price of the timber and not be mitigated indirectly by preferential tax rates applied to timber income.

Efficiency arguments suggest that a low rate of return in any industry should be the market signal to produce less in that industry. The government should not view the low rate of return in the industry as a signal to decrease taxes in that sector. When the tax system counteracts price signals, inefficiency in capital allocation between investments with low and high rates of return occurs.

Others claim that there is no clear evidence that the preferential tax rate really caused timber supply to increase through reforestation and better forest conservation and management (Sunley, 1972; Boyd and Daniels, 1985; GAO, 1981; Hadd, 1982;, Chang, 1983). Their argument is that the capital gains provisions did not constitute a direct incentive to sustained yield forestry because even those who clearcut and never replanted their timberlands still qualified for the preferential treatment.

As for reforestation, the increase in plantings might have been due to other causes such as a response to sharp increases in stumpage prices and reduction in inventories due to depletion of old-growth timber. Besides, before 1983, according to this opposing group, no empirical basis for judging the effect of the tax on reforestation existed. Sunley (1972) said that even if the tax provisions did affect reforestation rates positively, the magnitude of the impact as measured in quantity of additional timber and price effects does not justify the magnitude of the subsidy; however, no quantitative evidence was offered.

Along this line, Chang (1983) examined the empirical relationship between capital gains taxes and reforestation investment for 13 southern states. Chang's basic conclusion was that changes in top capital gains tax rates did not change either the industrial or nonindustrial reforestation investments. Chang further stated that it is probably safe to conclude that preferential capital gains tax rates do not increase reforestation investment by the industry. However, Chang says that the results of the same study were not as conclusive in connection with nonindustrial reforestation investments.

The third argument is that if the preferential rate was needed in order to achieve more intensive forest management, then the incentive caused inefficiency. No one else directly benefits more from intensive forest management than the profit-seeking forest owner. If the forest owner needs the incentive to engage in these practices, intensive forest management must be unprofitable to begin with.

The tax authorities raised other concerns. These are:

1. The preferential treatment was a subsidy to the timber industry. It constituted a tax expenditure the effectiveness and benefit distribution of which cannot be determined satisfactorily (Mead, 1965; Sunley, 1972; GAO, 1981; Treasury, 1969; Trestrail, 1969). The subsidy increased profitability of investing in timber although these investments might not be largely composed of conservation practices.
2. The preferential provisions caused a significant revenue loss to the Treasury due to the lower tax rate and the mismatching of expense and income. Payment of capital gains taxes on timber income was deferred and deduction of expenses against current income taxed at ordinary rates was allowed (Sunley, 1972; Mead, 1965; Boyd, 1986). The revenue loss to the Treasury was more than just the simple difference between capital gains and ordinary income tax rates. This is because the profit was taxed at the capital gains rates and the associated expenses were deducted from ordinary income (Mead, 1965).
3. There is difficulty in determining the fair market value when the timber owners log and process their timber. Although there is no evidence showing the practice, there was an incentive to manipulate timber valuations so that proportionately more income would be taxed as capital gains (Mead, 1965; Sunley, 1972; Treasury, 1969).
4. It provided incentive for income shifting (Sunley, 1972; Mead, 1965; Treasury, 1969; Whitaker, 1977). Because expenses that caused capital gains were deductible from income from any other source, it is argued that a tax shelter can be created which effectively converts ordinary income to capital gains (Sunley, 1972; Treasury, 1969;

Mead, 1965; Whitaker, 1977). This observation is consistent with the remarks by Whitaker (1977) which essentially showed that the forest industries were indeed aware of this potential for a tax shelter.

5. Sunley (1972) and Mead (1965) maintain that due to the incentive for income shifting, there was a tendency for a shift in forest land ownership from small holdings to large integrated timber companies. The industry justifies this trend by saying that this is a natural result since industrial ownerships are more responsive to the incentive to re-forest. Also, they claim that these woodland investments are necessary in order for the industry to obtain capital at reasonable rates (Fortson and Hargreaves, 1972; Condrell, 1970). Accordingly, these investments show proof of stability of operations to sources of capital. They claim that evolving into a large and integrated timber company is a proof of stability of operations. Stable operations can more easily find sources of capital. The opposing view claims that industrial owners acquired these lands and integrated vertically so that they could more conveniently shift income. It is claimed that all benefits from the preferential tax provisions went to these integrated companies because they have other income from which to deduct the costs of producing capital gains. They also have mills which could benefit if market value of timber was set too high. Added to this is the fact that the nonindustrial owners usually have lower incomes which put them in low ordinary income tax brackets anyway. Thus, it would appear, according to this opposing view, that most benefits of the preferential tax rates went to the industrial forest owners. The preferential tax then failed to give equity to all kinds of timber owners.

6. The General Accounting Office (1981) is particularly concerned about the misalignment between timber production and the distribution of capital gains taxation's benefits. Based on their data, industrial owners accounted for the majority of benefits from capital gains (about 76%) from 1976 to 1980, yet the major portion of private timber supplies during that period for roundwood and sawtimber came from nonindustrial

forest lands. This discrepancy can be explained in part by the higher average quality and value of industrial harvests.

7. Another concern is that preferential treatment was also allowed for gains derived from cutting timber from public forests even when there are no data to show that increased long-term investments in the land or in replacement stands were made. In order to qualify for capital gains treatment under the previous law, timber companies needed only to have owned for the specified holding period of six months a contract right to cut timber from public lands controlled by the Forest Service, the Bureau of Land Management or the Department of Defense. Under this scheme, there was no reforestation investment required nor were the companies required to replace cut-over stands. Yet, when the cut timber was sold, timber income was taxed at preferential capital gains tax rates (GAO, 1981; Sunley, 1972).

Theoretically, however, it could be argued that the preferential treatment allowed for timber capital gains from public forests did not constitute a loss to the U. S. Treasury. If they had to pay higher timber capital gains taxes, the timber companies would have bid less for public timber.

It has been pointed out that concerns 3 and 4 worked together to reduce tax revenues. The higher the market value of the timber, the higher was the income subject to lower tax rates. Since this timber value is a cost in manufacturing, it reduced further the ordinary income taxable at regular rates.

To all these concerns, the forest industry pointed out that as early as 1973 (Glascock, 1973), they have been suggesting that research be conducted in order to determine the following: portion of capital gains money being reinvested in forestry, the actual effect of timber capital gains taxes on the cutting rate and degree of utilization of private timber, the effect of capital gains provisions on various forestry practices, and whether without preferential capital gains treatment, the industry will abandon some desirable silvicultural practices.

The General Accounting Office (GAO, 1981) wants to explore these areas and is interested in the relationship between capital gains treatment and the overall timber production and reforestation efforts of the private sector. The Office is also interested in knowing the production potential of nonindustrial private forest lands and the cost in terms of tax expenditures for alternatives to the capital gains preferential tax rates in aiding the realization of this potential (GAO, 1981; Hadd, 1982).

Implications of Taxing Capital Gains at Realization

Equity suggests that capital gains be treated in exactly the same way as other kinds of income. This will eliminate the incentive to convert ordinary income into capital gains. However, in order to do this, accrued capital gains will have to be valued annually. This is a difficult undertaking. Some assets are valued by their owners more highly than by the open market, while other assets are not traded frequently in the open market at all (Break and Pechman, 1975).

These difficulties are solved by taxing capital gains when realized. In doing so, however, other problems are created. Taxation of capital gains on realization causes inequity due to deferral of taxes and inefficiency due to locking-in of investments (Break and Pechman, 1975; Helliwell, 1969; Brinner, 1973; Balcer, 1983).

A. Lock-in Effects

The tax on the sale of the asset discourages transactions especially if gains are considerable. This lengthens the holding period which then effectively makes the capital less mobile (Kovenock and Rothschild, 1983; Break and Pechman, 1975). This was shown empirically by Feldstein, Slemrod and Yitzhaki (1980) in their study with corporate stock gains realization. They found that reduced tax rates lead to a substantial increase in corporate stock capital gains realization. Their study was the first econometric analysis of the effect of taxation on the realization of capital gains. Their results indicated that reducing the tax on capital gains would not only encourage a more active market in corporate stock but would also increase tax revenue due to increased realization of gains.

Since Feldstein *et al*'s (1980) study, however, several more recent results on gains realization and capital gains tax rate reduction have been reported (Lindsey, 1987a; 1987b; Auerbach, 1988; 1989; Danthine and Donaldson, 1985; Auten *et al*, 1989; Darby *et al* , 1989). Danthine and Donaldson (1985) reported that a lower capital gains tax rate leads to higher average gains realization but also to a higher variability in the distribution of capital stock and gains realization. Auerbach (1988) and Auten *et al* (1989) do not believe that there is a strong permanent relationship between tax rates and gains realization.

A study by Kovenock and Rothschild (1983) showed that under a capital gains structure where taxes are paid upon realization, the tax becomes a kind of turnover tax. Their model showed that in this case, it is never profitable to sell an asset that grows in value with time to an intermediate producer because the asking price will tend to exceed the bid price. Thus, this tax structure promotes vertical integration in industries with assets that grow in value through time.

B. Tax Deferral Effects

Capital gains taxation upon realization effectively gives the gains recipient an interest-free loan from the government equal to the deferred taxes (Brinner, 1973; Halperin, 1971; Break and Pechman, 1975; Diamond, 1975). It also allows investors to use capital losses to offset taxes currently due on other kinds of income while deferring the payment of taxes on accrued capital gains (Minarik, 1981; Break and Pechman, 1975).

As noted previously, the deferral of taxes benefits the gains recipient. This benefit, however, is mitigated by the effects of inflation because inflation distorts the measurement of capital gains (Brinner, 1973; Folsom, 1978; Diamond, 1975; Feldstein, 1983; Feldstein and Slemrod, 1978; Alm and Zubrow, 1987; Bossons, 1985; Gravelle, 1980; Edwards and Keen, 1985; Kopcke, 1981). Feldstein and Slemrod (1978) showed that this distortion caused excess taxation of corporate stock capital gains by nearly $500 million in 1973. The distortion was greatest for middle-income sellers. If the costs of the share were adjusted for inflation, the $4.5 billion nominal gains in corporate stock would have become a real capital loss of almost one billion dollars.

The tax deferral aspect of capital gains taxation has been studied by Brinner (1973), Balcer (1983), Diamond (1975), Andrews (1974) and others. These authors say that postponing taxes on the accrued yearly income benefits only those investments with deferred income. Diamond (1975) has shown that in the case where capital gains taxes are computed as they accrue annually, the value of deferral to the recipient first increases and then decreases with the tax rate. With a zero tax rate, deferral has no value because there is no tax payment to defer. With 100% taxation, deferral again has no value because the interest gained from deferred taxes is taxed in full.

Brinner (1973), Diamond (1975), Folsom (1978) and Helliwell (1972), among other authors, suggest that an equitable capital gains tax embodies simultaneous adjustments for inflation and deferral of tax payments. Brinner (1973), Diamond (1975) and Folsom (1978) agree that the asset's cost basis should be adjusted for inflation before capital gains are calculated. These authors also agree that adjustment for the deferral benefits is needed for equity. Brinner (1973) suggests inclusion of the adjusted gain in taxable income at a multiple determined by the length of the deferral period, the average real rate of capital appreciation and the average marginal income tax rate of the investor over the deferral period.

Helliwell (1969) suggests taxing capital gains at realization but at rates which effectively charge interest on the deferred taxes. Further, he suggests basing the tax calculations on inflation-adjusted gains. Diamond (1975) suggests another method. For a given investor, after-tax wealth positions are found when capital gains are taxed on accrual and upon realization. A tax rate on realized income can be found which will make the after-tax wealth equal to that when capital gains are taxed on accrual. This tax rate for that investor adjusts for the benefits of deferral of taxes. For a more detailed illustration of this proposal, see Diamond (1975).

When inflation is considered, Diamond (1975) suggests that the cost basis be adjusted for inflation. However, since inflation tends to penalize while deferral tends to benefit the gains recipients (Brinner, 1973; Diamond, 1975; Helliwell, 1969), Diamond notes that it is desirable to adjust for both effects simultaneously. He suggests that after-tax wealth positions based on accrual and realization taxation be found. The accrual case should allow for full inflation adjustment while the realization case should be allowed only a fraction of the inflation adjustment. This provision is to offset the beneficial effects of deferring taxes. When both after-tax wealth positions are set equal to each other, a fraction of the full inflation adjustment factor, say F, can be solved for. This is the fraction of the full inflation adjustment factor that should be allowed for the realization method. This will make the after-tax wealth positions of accrual and realization methods equal. Diamond (1975) showed that if asset growth rate is greater than the inflation rate and that if both values are positive, F increases with the asset growth rate and the tax rate and decreases with the inflation rate and the holding period.

The difficulties and distortions arising from taxing realized income are the most nearly acceptable explanation for preferential treatment of capital gains (Break and Pechman, 1975; Andrews, 1974). Andrews (1974) argues that preferential treatment of capital gains mitigates the disparity of treatment between unrealized gains and gains that are realized, recognized and reinvested. He maintains that in a world made up only of capital gains recipients, it is unfair to impose a tax at regular rates on taxpayers with realized but reinvested gains while unrealized gains are allowed to accumulate tax-free. As an incentive for savings and capital formation, therefore, preferential rates were allowed. It is hoped that this incentive will encourage gains realization and reinvestment in possibly more profitable ventures. However, according to Andrews (1974), this explanation presupposes reinvestment and saving. Yet, there was nothing in the law that confined preferential treatment to reinvested gains alone. And even if capital gains were saved, since there are taxpayers who do not have capital assets at all, but who may have bank deposits or savings accounts, there is no justification for distinguishing between capital gains and other forms of saving or investment. Where this group of taxpayers is concerned, preferential capital gains tax rates for capital gains recipients who pay taxes only upon realization creates even more inequity.

4. Tax Reform Proposals

Reform Proposals for Capital Gains Taxation in General

Proposals to correct the problems associated with taxation of capital gains upon gain realization abound. The more popular ones are shifting to a true accretion-type or pure consumption-type tax, taxing full capital gains at ordinary income rates, taxing capital gains upon accrual, indexing the cost basis for inflation, reducing the tax rates applied to capital gains as holding periods increase, and totally eliminating the capital gains tax.

A. Accrual type tax

1. Without preferential treatment of capital gains

Andrews (1974) and Balcer (1983) argue that there is no need for preferential treatment of capital gains in order to solve equity problems caused by taxation only upon realization if there is a true accrual-type personal income tax. This is also known as the comprehensive tax base (Diamond, 1975). In this tax scheme, appreciation in value is measured and taxed yearly. Accumulation by simple appreciation in value, as in growing trees for example, would be taxed in the same way and at the same rate as accumulation in savings accounts.

2. With preferential treatment of capital gains

Within the framework of a preferential treatment of capital gains, Brinner (1973) and Balcer (1983) suggest that ideally capital gains should be taxed upon accrual by annual inclusion of unrealized gains and losses in taxable income. Aside from the valuation problem, some see a difficulty in deciding whether an increase in value is still part of the capital or whether it is income. Smith (1961) maintains that if it is income, it should be taxed as such. If it is capital, it should not be taxed at all, at least until it is withdrawn or sold. On the other hand, according to the Haig-Simons definition of income, any increase in wealth is income and should be taxed as such.

Both proposals on accrued income taxation suffer from the valuation difficulty. They are exactly alike in principle except that with preferential treatment, capital gains are taxed at a lower rate.

B. Pure consumption-type tax

Similarly, Andrews (1974), Aaron and Galper (1985), Smith (1961), Feldstein (1976), and Gravelle (1983) claim that by changing to a pure consumption-type tax, the preferential treatment will become unnecessary. In the consumption-type tax, which Smith calls the tax-free roll-over of investments, and Aaron and Galper call cash flow income tax, any reinvested or resaved gains or income will not be taxed. All cash receipts and all withdrawal from capital gains or from savings used to finance consumption will be taxed at ordinary income tax rates. Actually, all tax rates in this instance are ordinary income tax rates.

C. Tax capital gains at ordinary income tax rates

Another proposal is to reduce the regular top-bracket tax rates, adopt year-to-year averaging of income and tax full capital gains at ordinary income tax rates (Break and Pechman, 1975). This proposal is rejected by Feldstein, Slemrod and Yitzhaki (1980), and Conda (1986) who note that high taxes on capital gains will reduce the mobility of capital due to lock-in effects and thus harm the allocative efficiency of the capital market. They claim that the proposal will harm promising growth companies and ventures by withholding venture capital from them. These authors also raise the possibility of this proposal's adverse effects on tax revenues. Feldstein, Slemrod and Yitzhaki (1980) specifically point out that based on their study a more active market or a higher volume of capital gains realization is encouraged by reduced capital gains tax rates. They showed that this increase in gains realization increases tax revenues. Minarik (1984) and Stiglitz (1983) agree, but they would not expect the increase in tax revenue to continue in the long run. They believe that the initial increase in tax revenue due to a reduction in capital gains tax rates is due only to a change in timing of realizations while investors are readjusting their portfolios.

Smith (1961) also rejected the proposal. Smith believes that there are no nonpecuniary incentives for investment. Therefore, the tax on capital gains is a more serious disincentive to investment than the ordinary income is to activity. By activity, Smith is referring to other income-generating acts such as the practice of a profession where one is presumed to be deriving nonmonetary satisfaction in addition to the monetary income. Smith cited cash and near-cash assets (checking and savings accounts) and risk-free securities as ever-available substitutes to investment of available funds.

D. Index the cost basis for inflation

Another popular reform proposal deals with the solution to the distortions caused by inflation. Brinner (1973), Helliwell (1969), Feldstein (1983), Diamond (1975) and Klemperer and O'Neil (1986) are all proponents of indexing of capital gains for inflation. Diamond further suggests that for equity, inflation adjustment should be made available to all capital income and not just to capital gains.

Helliwell (1969) is also in favor of indexing for inflation. But, he goes further and suggests that the effects of deferment of taxes should also be considered at the same time. Thus, Helliwell's proposal is to adjust for inflation and for the interest on unpaid accrued taxes. This adjustment for deferral is also proposed by Brinner (1973), Folsom (1978) and Diamond (1975). These authors point out that the tax deferral adjustment should be larger, the longer the holding period and the higher the taxpayer's real rate of return on investment, but it should be smaller the higher the tax rate. Diamond cautions further that inflation adjustment should be accompanied by taxing full capital gains at ordinary income tax rates. Otherwise, capital gains will be taxed too lightly, especially if there is no adjustment for deferral of taxes.

Several authors object to this proposal of inflation-indexing (Folsom, 1978; Break and Pechman, 1975). They point out that inflation-indexing can only be neutral if gains and losses on all assets and all liabilities are considered. This raises some major difficulties because it means adjusting for inflationary loss not only on capital gains but also on savings and time deposits and on life insurance, for example. It also involves calculating the inflationary gain on all the taxpayer's debt. Most taxpayers would probably accept the procedure during inflation but during periods of falling price levels, when nominal losses would be converted into real gains, their responses might be an entirely different thing (Folsom, 1978; Break and Pechman, 1975). For these reasons, Break and Pechman (1975) recommend trying to stabilize the general price level sufficiently to preclude any need for indexing.

E. Reduce capital gains tax rates as holding period increases

Reducing the capital gains tax rate as the holding period increases is another proposal aimed at alleviating the ill effects of inflation on capital gains. Smith (1961), Diamond (1975) and Brinner (1973) reject this proposal by noting that deferral benefits suggest that tax rates should increase when holding periods lengthen. Diamond further stated that capital gains have received a larger tax break than inflation would justify and that deferral benefits, in the long run, will outweigh inflationary loss.

F. *Eliminate capital gains taxation*

Some authors propose to eliminate capital gains taxation altogether. Their proposal is based on the argument that capital in order to be effective must be mobile. If there is no capital gains tax, then there are no disincentives to gains realization. Then, capital can go where it gets a higher rate of return without impediment (Bartlett, 1985). This proposal is rejected by many authors on grounds of equity (Break and Pechman, 1975, Smith, 1961, Folsom, 1978; Diamond, 1975; Balcer, 1983, Brinner, 1973). Dworsky (1986) says there is a doubt about the advisability of eliminating capital gains taxes. In fact, Dworsky recommends increasing the capital gains tax rate. Dworsky bases this recommendation on the observation that low capital gains tax rates have led to a rise in venture capital spent to develop more new technologies than new markets can absorb. Dworsky claims that, as a result, many of these new ventures are on the verge of bankruptcy.

3. Reform Proposals For Timber Capital Gains Taxation

Tax reform proposals for timber capital gains center around the removal of the preferential tax treatment of timber income, as actually happened in the 1986 Tax Reform Act.

Removal of the preferential treatment for timber capital gains was proposed by Sunley (1972) and Mead (1965). Mead argued that the initial inequity that was present between the different kinds of timber owners before 1943 could have been solved better. He maintained that instead of extending the preferential treatment to all timber owners, the treatment should have been denied to all timber owners, lump sum sales or not, and whether or not these timber owners were in the business of selling timber every day.

Some minor reforms were proposed as a package in order to alleviate the possible ill effects of removing the preferential tax treatment of timber capital gains. These reforms were proposed by Sunley (1972), the GAO (1981) and the Treasury (1969). These reforms formed a package providing a selection of alternatives to the preferential treatment of timber capital gains such as direct cost-sharing, amortization of reforestation expenditures, allowing limited deductions for reforestation, loan programs, elimination of preferential treatment to timber cut from public forests, extending the holding period, limiting capital gains provisions to the amounts reinvested in forest management, and limiting current deduction of expenses.

Elimination of preferential treatment on public timber is based on the argument that those who cut from public forests do not have concrete reforestation efforts to show as proof that the capital gains provisions induced them to practice sustained yield management and to reinvest in reforestation (GAO, 1981; Treasury, 1969). Extending the holding period is proposed because if preferential treatment provisions were really aimed at providing some relief from the inequity of paying abnormally high taxes due to bunched gains, then the tax structure should ensure that only those who do have bunched gains receive relief (Smith, 1961; Break and Pechman, 1975). The previous holding period requirement of six months was short enough that gains could not have bunched within that time. Yet, those who held contract rights to cut for just six months also received the same preferential tax treatment given to a forest landowner who had been managing timber for decades.

The proposal to limit the preferential treatment to that portion of timber capital gains that is reinvested in forest management is based on the argument that one reason for the preferential treatment is the assumption that gains are reinvested (Break and Pechman, 1975). This proposal is similar to the consumption-type proposal of Feldstein (1976) and other authors where capital gains that are reinvested are not taxed while gains that are withdrawn and used to finance consumption are taxed fully at ordinary income rates.

Mead (1965) proposes limiting current deductions and says that in order to avoid expense and income shifting, all expenses that make the timber asset grow in value should be capitalized. The proposal for cost-sharing, expanded loan programs and for amortization and limited deduction of reforestation expenditures are based on the result of a study by GAO and the Treasury. The proposals rest on the assumption that the preferential treatment of timber gains was an incentive for reforestation (GAO, 1981; Treasury, 1969). Based on the estimates of the Treasury, during the late seventies, nonindustrial forest owners received about 0.4 billion dollars of capital gains. Yet, unforested nonindustrial lands continue to grow at a rate of about 500,000 acres per year, the reasons being (Treasury, 1969):

1. lack of capital for long-range investments in site establishment and reforestation;
2. higher interest costs than returns from investments in forestry;
3. long time lags between investment and return;
4. high management costs and market disadvantages because of small land holdings;
5. cash flow problems.

The GAO and the Treasury are particularly interested in the nonindustrial forest lands because, based on Forest Service reports, these lands have the major potential in increasing the timber supply for the future (GAO, 1981). Because these lands continue to be cut and left unforested, GAO concluded that the capital gains treatment of timber by itself alone cannot overcome the initial cost problems of site preparation and reforestation. The conclusion suggests that a more direct subsidy to reforestation might be better than the tax device. The direct subsidy is more certain of its target beneficiaries. It can achieve better matching of benefit and compliance. Also, it may be less expensive (Sunley, 1972; GAO, 1981; Treasury, 1969; Hadd, 1982). Apparently, GAO, the Treasury and the private forestry sector want to know how much less expensive this alternative subsidy really is (GAO, 1981; Treasury, 1969; Glascock, 1973).

5. Concerns About the Current Capital Gains Tax Structure

The current capital gains tax structure removes the preferential treatment of long-term capital gains. Because of this, many articles and papers about the implications of this structure on investments and tax revenues have been written (Aten, 1988; Auerbach, 1988, 1989; Auten *et al*, 1989; Darby *et al*, 1989; Herber, 1988; Howitt and Sinn, 1989; Minarik, 1986; Kopcke, 1989; Lindsey, 1987a, 1987b; McConaghy, 1986; McLure, Jr., 1988; McLure, Jr. and Zodrow, 1987; Pechman, 1987b, 1990; Rose and Milliken, 1986; Condrell, 1986; Dangerfield, Jr. and Gunter, 1986; Siegel, 1986; Klemperer, 1987; Hoover, 1986; Hyde *et al*, 1987). Several authors have enumerated the good and bad aspects of the current capital gains tax structure (Rose and Milliken, 1986; Condrell, 1986, Dangerfield, Jr. and Gunter, 1986; Siegel, 1986; Klemperer, 1987; Hoover, 1986). One good feature of the tax, according to Klemperer (1987), is that it treats capital gains the same as ordinary income. This has efficiency-improvement connotations. Also, for individuals, the tax allows for full expensing of management costs, other taxes and interest. The investment tax credit and 7-year amortization of the first $10,000 reforestation costs are still allowed. However, because timber capital gains are now taxed at the same rate as ordinary income, and because the 60% exclusion has been eliminated, both federal and state taxes to be paid may increase considerably. State taxes may increase if they are based on federal adjusted gross income which now includes 100% of capital gains. Such an increase in federal adjusted gross incomes may place taxpayers in a higher marginal state tax rate bracket which increases their state taxes even more.

Because of this tax increase, some studies to evaluate possible implications of the current tax structure on forest investment have been reported. Guertin and Rideout (1987) evaluated the theoretical effects of the tax on optimal planting density, rotation age and removal of marginal lands from production. In general, they reported that optimal planting density and rotation periods decreased due to the higher capital gains taxes. Also, while site index 50 previously was the lowest site for economic production of loblolly pine, under their assumptions and the current tax structure, economically productive sites begin at site index 59 for the same species.

Sedjo *et al* (1986) used a timber supply model to project long-term effects of proposed tax changes on timber harvests and prices in the United States. The tax rates that they used were higher than the current tax rates, however. Their analysis indicated that the long-term price increase in timber would average about 8 percent, while long-term declines in U.S. timber harvests would average about 12 percent.

Banzhaf and Co. (1986), as cited by Sedjo *et al* (1986), compared the after-tax rates of return under the previous law and one with higher tax rates than the current one. They used a discounted cash flow model of a southern pine plantation. Their results showed that the higher tax rates and the proposed requirement to capitalize all costs severely reduced rates of return.

Although the majority of literature reviewed dealt with partial equilibrium analyses, there were several works that used a general equilibrium framework to study forest capital gains taxation. Boyd and Daniels (1985) used a two-factor, two-sector general equilibrium model to examine the incidence and welfare effects of a preferential federal capital gains tax on timber. They reported that the welfare losses and rate of return incidence figures attributable to preferential treatment of timber capital gains are much greater than what were previously believed. They also found that eliminating capital gains treatment of public timber is a more efficient means of reducing tax losses than a policy that extends the required holding period.

Two general equilibrium models were developed by Boyd and Newman (1988) and Boyd and Hyde (1989). Boyd and Hyde (1989) showed, based on empirical data, that preferential treatment of capital gains encourages the use of capital inputs because the treatment reduces the relative cost of capital. This result is related to the analysis of a computable general equilibrium model of the United States economy developed by Boyd and Newman (1988). The analysis showed that without preferential capital gains treatment, there was a decline in output in the forest sector as well as in several other capital intensive sectors. However, some other sectors gained from this reduction in output in other sectors. Foremost of the gainers, accordingly, is the financial sector. Their model showed that the loss of preferential treatment for capital gains is the major cause of the output decline. This decline is reduced somewhat by changes in factor usage and by price increases in forest sector products. The price increases are caused by increased demand from the sector gainers.

CHAPTER III

METHODS

In this and succeeding chapters, some key terms are used. These terms are defined when they are first used in this work. A glossary of terms is also found in Appendix G.

In order to measure the effects on decisions to invest in new forest investments of the three capital gains tax structures studied here, net present values for the forest investment under each tax structure were derived and compared with each other. The three capital gains tax structures are: the current federal income tax with no basis indexing, the current tax structure with basis indexing, and a variant of the accrued income tax with basis indexing. The forest investment is an acre of bare land which may be planted with White pine for Christmas trees or Douglas fir for timber production.

The net present value equation has other factors aside from the capital gains tax structure. Any combination of a capital gains tax structure, capital gains tax rate, species, interest rate, inflation rate, product price behavior, (whether price is constant or increasing in real terms), site, management regime, and tax treatment of fertilization cost is called a simulation environment. How the net present values under each capital gains tax structure were affected by each factor in the simulation environment was also determined. This was achieved by deriving present values for the same simulation environment, at various levels of a given factor, while holding all the other factors constant.

1. General MAXPAY Models for Bare Land

The buyer's maximum willingness to pay (MAXPAY) for an investment should equal the net present value of the investment. If the investment is bare land for planting with a given tree species, and assuming that once bought, the land will never be sold again and will be planted with the same tree species to perpetuity, the buyer's maximum willingness to pay (MAXPAY) for the land should be equal to the net present value of all harvests from the land to perpetuity. This net present value is also called the land expectation value (LEV) [3] which traces its roots to Faustmann (1849). In general equation form, LEV is expressed as:

$$LEV = \frac{\sum_{i=1}^{R} H_i (1+r)^{R-i} - \sum_{i=1}^{R} C_i (1+r)^{R-i}}{(1+r)^R - 1} \qquad [3.1]$$

where

LEV = land expectation value;

H_i = harvest revenue in constant dollars at any age i from year 1 to harvest age, R;

R = optimal rotation or harvest age;

C_i = cost incurred at any age i, in constant dollars;

r = real rate of interest, in decimals.

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[3] Assumptions are outlined in Section 4.

When ordinary income and capital gains taxes are incorporated, under the current federal income tax law, and assuming only one harvest per rotation, the *LEV* formula of Equation 3.1 becomes:

$$LEV = \frac{H - \sum_{i=1}^{R} C_i (1-m)(1+r)^{R-i} - E(1+r)^R}{(1+r)^R - 1} - \frac{t\left[H - \dfrac{E}{(1+f)^R}\right]}{(1+r)^R - 1} \qquad [3.2]$$

where

LEV = land expectation value;

H = harvest revenue at year R, in constant dollars;

R = optimal rotation or harvest age that maximizes *LEV*;

C_i = cost, in constant dollars, incurred at any age i except reforestation cost;

m = ordinary income tax rate, in decimals;

t = capital gains tax rate, in decimals;

r = real after-tax rate of interest, in decimals;

E = forest establishment cost at year 0;

f = inflation rate, in decimals.

The expression inside the square brackets in the second term of Equation 3.2 is the capital gain. It is equal to the difference between the harvest revenue at year *R* and the forest establishment cost at year 0. The forest establishment cost is also known as the cost basis. The cost basis is not deductible from any income in the year it was incurred. It can only be deducted from the harvest revenue when the forest is finally harvested and sold at rotation age. Furthermore, it is not allowed to grow with inflation. For example, if rotation is 45 years, forest establishment cost at year 0 is \$200, and harvest revenue is \$3,800, then capital gain is \$3,600. Note that both \$3,800 and \$200 are in nominal dollars of the year of harvest because the cost basis ($200) is not allowed to grow with inflation, assuming that there was inflation during the period.

In Equation 3.2, since all values are expressed in constant dollars, the nominal E in the brackets of the second term is divided by $(1+f)^R$ to express the cost basis in constant dollars. The above equation assumes that the harvest or rotation age, R , is already known. In reality, the economic rotation age, even for the same species, can vary when factors like interest rates, inflation rates, costs (which include taxes) and revenues change. Thus, for every combination of factors studied here, the optimal rotation, when needed, was derived by iteration using the LEV equation (3.2). For any forest investment with any combination of factors, the optimal rotation maximizes the land expectation value. By iteration, maximum LEV and optimal rotation are found simultaneously.

When it is assumed that the land will be sold along with the tree crop at the first rotation, as is assumed in this study, MAXPAY for the land will no longer be equal to the land expectation value (LEV). Assuming no real change in land value from the computed MAXPAY, MAXPAY now has the following form, given current income tax laws:

$$BL = \frac{H + BL - \sum_{i=1}^{R} C_i (1-m)(1+r)^{R-i} - E(1+r)^R}{(1+r)^R} - \frac{t\left[H + BL - \dfrac{E+BL}{(1+f)^R}\right]}{(1+r)^R} \qquad [3.3]$$

where

BL = maximum willingness to pay (MAXPAY) for bare land;

t = capital gains tax rate, in decimals;

m = ordinary income tax rate, in decimals;

E = forest establishment cost at year 0;

f = inflation rate, in decimals;

H = harvest revenue at rotation age, R, in constant dollars;

r, R, and C_i are as defined in Equation 3.2.

Note that the denominators of Equation 3.2 and Equation 3.3 differ by -1. This is because the LEV equation (3.2) assumes that the land will never be sold by the buyer. The equation for MAXPAY for bare land (3.3) assumes that the land will be sold after one rotation. Solving further for *BL*, by collecting like terms and simplifying, results in Equation 3.4 below. All variables in Equation 3.4 are as defined above.

$$BL = \frac{H - \sum_{i=1}^{R} C_i (1-m)(1+r)^{R-i} - E(1+r)^R}{(1+r)^R - 1 + t - \frac{t}{(1+f)^R}} - \frac{t\left[H - \frac{E}{(1+f)^R}\right]}{(1+r)^R - 1 + t - \frac{t}{(1+f)^R}} \qquad [3.4]$$

When inflation is zero, the factor $(1+f)^R$ disappears from both Equation 3.2 *(LEV)* and Equation 3.4 *(BL)*. Both equations can then be simplified further to show that *LEV* equals *BL* when there is no inflation. This follows logically because, without inflation, and assuming no real increase in land values, the maximum bid for bare land should be equal to the land expectation value.

When there is inflation, Equation 3.2 and Equation 3.4 show that *BL* will be slightly lower than *LEV* because a tax is paid on land sold in year *R*. This is shown by comparison of the respective denominators of the two equations. When inflation is greater than zero, the denominator for Equation 3.4 will always be greater than the denominator of Equation 3.2, all other things equal.

Distinction should be made about the location of BL relative to the equal sign in Equation 3.3. BL at the right hand side of the equal sign is the original purchase price for the land. Thus, in the bracketed expression of Equation 3.3, BL, the purchase price of land, is part of the cost basis.

Its value is not allowed to grow with inflation. On the other hand, BL to the left of the equal sign is the MAXPAY for bare land, which depends in part on the original purchase price of the same piece of land.

Equation 3.4 results from solving Equation 3.3 further for BL. With perfect markets, BL in Equation 3.4 will be equal to the market price of bare land. Since perfect markets do not exist, *BL* values are sometimes much lower or possibly higher than what actually exists in the market. If this difference is significant, a more realistic estimate for MAXPAY for bare land may be derived if the projected price of an acre of bare land is substituted for *BL* in the right hand side of Equation 3.3.

2. MAXPAY Models with Capital Gains Tax Structures

The first capital gains tax structure modeled follows the current federal income tax law where cost basis indexing is not allowed. Equations 3.2, 3.3, and 3.4 are models of this tax structure. In all of them, capital gains taxes form part of the total cost. The cost bases in them have all been deflated by the inflation rate in order to express them in constant dollars corresponding to the year the costs were incurred. In Equation 3.3, for example, since all costs and revenues are in constant dollar terms, the basis $(E + BL)$ is divided by $(1 + f)^R$ in order to convert it into values corresponding to year 0. Otherwise, its value will be nominal for year *R*.

The second capital gains tax structure modeled is basis indexing. This tax structure differs from the first structure only in that the cost basis is allowed to grow with inflation. Hence, the corresponding equations to Equations 3.2 and 3.3 are Equations 3.21 and 3.31, respectively. In all of them, the cost bases were no longer deflated. These equations are shown below.

$$ILEV = \frac{H - \sum_{i=1}^{R} C_i (1-m)(1+r)^{R-i} - E(1+r)^R}{(1+r)^R - 1} - \frac{t(H - E)}{(1+r)^R - 1} \qquad [3.21]$$

$$IBL = \frac{H + IBL - \sum_{i=1}^{R} C_i (1-m)(1+r)^{R-i} - E(1+r)^R}{(1+r)^R} - \frac{t(H - E)}{(1+r)^R} \qquad [3.31]$$

where all variables are as defined previously. The letter 'I' in *ILEV* and *IBL,* indicates 'indexed to inflation'.

The third capital gains tax structure, is the ERITAX method, which is a variant of the accrued income tax. The cost basis is also indexed to inflation. However, the capital gains tax rate applied at harvest time is adjusted in order to collect taxes, at that time, equal in amount to what the investor would have paid if accrued taxes were paid yearly and accumulated with interest up to rotation age. In this study, this adjusted capital gains tax rate is called ERITAX, for equivalent realized income tax rate. It is the capital gains tax rate, applied to capital gain when it is realized, that yields the same rotation-start present value of tax revenues whether the investor pays capital gains taxes upon realization or upon accrual. Conversely, the ERITAX rate is the capital gains tax rate applied to capital gain, when it is realized, that gives the tax revenue at rotation age equal to the sum of capital gains taxes paid each year and accumulated with interest to rotation age. The steps involved in this tax structure require these terms to be defined:

g = annual growth rate of the investment, in decimals;

V = harvest value less inflation-adjusted cost basis, in constant dollars;

H = gross harvest value, in constant dollars;

E = regeneration cost at year 0;

R = optimal rotation age, in years;

A = total accrued taxes accumulated with interest to R;

t = capital gains tax rate, in decimals, applied on annual accrued capital gains;

r = real interest rate, in decimals;

$ERITAX$ = equivalent realized income tax rate that yields tax revenues at year R equal to annually paid accrued income taxes accumulated with interest to rotation age.

1. Determine the yearly growth of the investment by solving for g in Equation 3.5.

$$H = E(1+g)^R \qquad [3.5]$$

2. Determine the total accrued capital gains taxes accumulated with interest to rotation age from Equation 3.6. Note that there is no indexing for inflation allowed for taxpayers paying upon accrual.

$$A = \sum_{i=1}^{R} t\left[E(1+g)^i - E(1+g)^{i-1}\right]\left[(1+r)^{R-i}\right] \qquad [3.6]$$

3. Find the equivalent realized income tax rate (ERITAX) with Equation 3.7. This is where indexing for inflation is incorporated into the model. Capital gains recipients who choose to pay taxes upon gain realization are allowed to index their cost basis to inflation. However, the tax rate applied to their inflation-adjusted capital gain will be the adjusted tax rate, *ERITAX*. This adjusted tax rate will require capital gains taxpayers who pay taxes upon gains realization to pay taxes equal in rotation-start present value

to the accrued taxes paid by capital gains taxpayers who pay taxes upon accrual. When the cost basis is indexed to inflation, the denominator of Equation 3.7 becomes smaller and *ERITAX* becomes larger. Therefore, as formulated here, under the ERITAX, basis indexing offers no advantage to the landowner.

$$ERITAX = \frac{A}{V} \qquad [3.7]$$

After *ERITAX* is found, corresponding equations to Equations 3.21, and 3.31 can be derived. The equations are similar to Equations 3.21 and 3.31 except that t is replaced by the *ERITAX* rate. In all cases where either the interest rate or the original capital gains tax rate is greater than zero, the equivalent realized income tax rate (ERITAX) is expected to be at least equal to the initial tax rate. (Proof of this is presented with the results in the next chapter.)

The current federal income tax structure with no basis indexing was used as a benchmark. The current tax structure with basis indexing and the ERITAX structure were modeled here because these approaches were suggested by many capital gains tax reform proposals (see Chapter II). Basis indexing is aimed at the effects of inflation on capital gains. The ERITAX method, which is a variant of the annual accrued income tax, is aimed at the deferral of taxes associated with unrealized capital gains.

The effects of these tax structures on maximum willingness to pay (MAXPAY) for bare land were evaluated further under situations of varying capital gains tax rates, real interest rates (3%, 6%, 9%), and inflation rates (0%, 5%, 15%). One short-rotation (White pine), and one long-rotation (Douglas fir) species were used in simulation runs of all possible combinations of capital gains tax structures, tax rates, interest rates and inflation rates considered in the study.

The following were the capital gains and ordinary income tax rate combinations used with each of the three capital gains tax structures:

1. No income taxes;

2. The current combination where corporations pay income taxes at 34% on both ordinary income and capital gains;
3. Corporate capital gains tax rates decrease to 20% while ordinary income tax rates remain at 34%;
4. Capital gains are taxed higher than ordinary income, such as 46% for capital gains and 34% for ordinary income;

Simulation runs using White pine managed as Christmas trees followed the practices of several Christmas tree farmers in Virginia and North Carolina. Simulations with Douglas fir used two management regimes. These were Plant and Clearcut (MR1); and Plant, Fertilize and Clearcut (MR2). There was only one site for White pine. Two sites were used with Douglas fir (SI = 100 and SI = 140, base age 50). A site index of 100 (base age 50) is slightly below average while site index of 140 is better than the average site for Douglas fir. Both species were used in simulations with a real increase in product prices. Only Douglas fir was used in simulations with different tax treatments for fertilization cost. Fertilization cost was expensed, amortized over seven years, or capitalized.

3. Data

Data for the short rotation species (White pine) came from Virginia and North Carolina. Data for the long rotation species (Douglas fir) came from Oregon because there is no species in the South that has a customary rotation exceeding 30 years. Douglas fir, on the other hand, has a usual rotation of at least 40 years.

For Christmas trees, the study drew heavily from data provided by Dr. Tom Nichols, a former faculty member and Extension Specialist at Virginia Polytechnic Institute and State University at Blacksburg, Virginia. Other data came from Vodak *et al* (1986).

Simulation runs for Christmas trees were based on one acre of average site land planted with White pine. Initial spacing was assumed to be six feet by six feet, or 1,080 trees per acre, after allowing for access roads. These seedlings were then managed with the intention of selling them as Christmas trees within the next ten years. Appendix A shows the basic data used in the models for White pine. It gives details on the assumptions made for Christmas trees. In summary, these assumptions are:

1. First year mortality is expected to be 300 seedlings which are replanted in the second year.
2. Additional mortality is expected every year until the trees are well established around the sixth year. By that time, some 30% of the second year population would have died.
3. Sale of Christmas trees is expected to start at year six and will continue up to the tenth year. Sales revenue is expected to increase every year, to reach a maximum at the eighth year and to taper off to the tenth year. Total number of stems sold is estimated to be 60% of initial population. Thirty percent is lost to mortality while 10% will be lost due to unacceptable form, color, or size.

For Douglas fir, the study made extensive use of yield tables derived from DFSIM With Economics, a Douglas fir simulator developed by Fight *et al* (1984). The simulator was used to generate yields for the two management regimes used in the study. For the most part, default values provided by the simulator were used in the study. In prescribing timing and intensity of fertilization, the guidelines set by the program were also followed. The authors have warned users, however, that generated yield values are reliable only up to stand age 60 years. For a more detailed description of these guidelines, the reader is referred to Fight *et al* (1984). Site index 100 (base age 50) represent a slightly below average site. Site index 140 (base age 50) is a slightly better than average site for Douglas fir.

Price and cost estimates for Douglas fir came from various sources. The Oregon Department of Revenue, Timber Section provided average stumpage prices for 1987, given different average scaling diameters.

The following are the general assumptions made in modelling various capital gains tax structures with Douglas fir:

1. Minimum merchantable diameter at breast height (DBH) was set at seven inches.
2. Stumpage price per thousand board feet (mbf) is $200 for average stand DBH equal to or greater than 22 inches. Oregon Department of Revenue data indicated that this price decreases by 2.5% for every inch the average stand DBH gets below 22 inches. The price decreases linearly until the average stand DBH reaches 7 inches, after which, price was assumed to be zero.
3. Because DFSIM gave yield values in cubic feet, it was necessary to convert these values to thousand board feet (mbf) by deriving and using the formula below:

$$mbf = \frac{cu.ft.\ x\ [4.176 + 0.108\,(DBH - 2)]}{1000}$$

Appendix B shows the assumptions about costs, revenue, and management activities for Douglas fir. Appendix C contains the derivation of the formula to convert DFSIM yield values in cubic feet to thousand board feet (mbf).

4. Assumptions

The models were all based on the following assumptions:

1. That discounted cash flows are acceptable measures of income tax impacts to the forest owner or buyer. In reality, maximum willingness to pay (MAXPAY) for

forest land may not be based on discounted cash flow analyses at all. More times than not, these decisions are based on a buyer's experience and observation of trends. Current owners, on the other hand, may base their decisions on what they or their neighbors have done in the past or what the extension specialist suggests. Nevertheless, since the discounted cash flow analysis is the most economically appealing method at hand, this study will employ this method. Furthermore, as Klemperer (1989) noted, discounted cash flow analyses are used by banks and major corporations in making decisions about sizable land and forest sales.

2. That both prospective buyers and current owners want to maximize their wealth which is assumed to be the net present value of all future cash flows.

3. That the effects of capital gains taxes are fully passed back to lower asset values of affected investments. This means that the study assumes that investors will reduce their bid (or maximum willingness to pay) for an investment when capital gains taxes are imposed instead of passing the tax on to consumers in the form of higher product prices. It is widely accepted that the effects of a tax may also be passed forward to higher prices, if the tax results in severely reduced outputs, or if investors can successfully set their own price. To date, however, no one has quantified the percentage of forest taxes passed in either direction. In the absence of such an estimate, this study assumes that taxes are fully passed back to lower asset values. This assumption has the added appeal of being more realistic. Private forest owners are most often price takers and they cannot, by themselves alone, pass taxes on to consumers. The analysis takes a short-term partial equilibrium view where investors consider interest rates and prices as given, regardless of the level and type of tax. This analysis is appropriate for a buyer's first reaction to a tax change. It is assumed that investors are likely to react to tax changes in this manner in the short run, without consideration of any long run equilibrium conditions.

4. Because an integral part of the study deals with indexing the cost basis to the inflation rate, it was assumed that positive inflation rates are expected by both buyers and current owners.
5. It was also assumed that the current owner and the prospective buyer both have sources of ordinary income annually from which they can deduct cost items that are allowed by law to be expensed.
6. It was assumed that for the land in question, forestry gives the highest net present value. Also, stands of both species were assumed to be even-aged.

The potential impacts being evaluated in the study are first-round effects only. Although it is recognized that changes in capital gains tax structures affect not only the forestry sector but the entire economy as well, the partial equilibrium approach was chosen, given time and data constraints. Boyd and Newman (1988) developed a computable general equilibrium model which showed that results of partial equilibrium analyses can offer quick and clear-cut guidelines for resource allocation decisions in a given sector when some policy is changed. The authors stated that these results are sufficient guidelines for discussion on impacts and assessment of direct policy effects.

4. Simulation Environments

Each possible combination of factors in the model is a simulation environment. For White pine, three capital gains tax structures, four capital gains tax rates, three real interest rates, three inflation rates, and two product price behaviors (whether price is constant or increasing in real terms) were combined. On the other hand, Douglas fir was used in all possible combinations of the variables listed above in addition to two sites, two management regimes, and three tax treatments for fertilization cost. Every possible combination of these factors for each species was used in Equations 3.4 (no basis indexing) and 3.31 (basis indexing) and the corresponding equation for the ERITAX method which has the same form as Equation 3.31 but whose tax rate is the ERITAX rate. The results from basis indexing and the ERITAX equation for each simulation environment were compared with the results from no basis indexing. These comparisons formed the basis for the discussion in the next chapter.

CHAPTER IV

RESULTS AND DISCUSSION

The organization and analysis of results from simulations using the models in the previous chapter are based on the assumption that:

1. capital gains tax structures affect maximum willingness to pay (MAXPAY) for a forest investment;
2. these effects on MAXPAY are affected in turn by the capital gains tax rates, interest rates, inflation rates, payoff periods, site quality, real increases in product prices, and tax treatment of other costs, like fertilization costs.

Thus, although the effects of capital gains tax structures on MAXPAY for bare land are the main focus, the effects of the other factors on these impacts are also discussed. Again, MAXPAY values under the current tax structure without basis indexing are used as benchmark. MAXPAY values under the current tax structure with basis indexing and those under the ERITAX method are compared to the benchmark.

A. Impacts of Capital Gains Tax Structures on MAXPAY for Bare Land

Table 1 shows the net present values under each capital gains tax structure at different capital gains tax rates when interest rate is 3% and inflation rate is 5%, for White pine and Douglas fir. Column C5 shows the difference in MAXPAY values between the current income tax law without basis indexing and the current tax law with basis indexing. Column C6 contains the difference in MAXPAY values between the current income tax law without basis indexing and the ERITAX method. All other things equal, when both the inflation rate and the capital gains tax rate are greater than zero, basis indexing gives higher MAXPAY values for bare land over no indexing, for both species. Under exactly the same set of variables, the ERITAX method, whether taxes are paid yearly or in one lump sum upon gains realization using the ERITAX rate, had the lowest MAXPAY values, also for both species.

The increase in MAXPAY values under the basis indexing structure over the no indexing case is due to capital gains tax savings afforded by a comparatively bigger cost basis with basis indexing. These tax savings are found by subtracting Equation 3.3 from Equation 3.31. This results in Equation 4.1 below.

$$TXSAV = \frac{tE - \dfrac{tE}{(1+f)^R}}{(1+r)^R} + \frac{tBL - \dfrac{tBL}{(1+f)^R}}{(1+r)^R} \qquad [4.1]$$

where

$TXSAV$ = rotation-start present value of tax savings from basis indexing.

t = capital gains tax rate, in decimals;

E = forest establishment cost, in constant dollars;

BL = purchase price for the land at year 0, in constant dollars;

and R, f, and r are as defined previously.

Equations 3.3, 3.31 and 4.1 assume a land sale at rotation age. When no land sale is assumed, tax savings (TXSAV) due to basis indexing per dollar of cost basis can be expressed as Equation 4.2, where all relevant variables are as defined in Equation 4.1.

$$TXSAV = \frac{tE - \dfrac{tE}{(1+f)^R}}{(1+r)^R - 1} \qquad [4.2]$$

Comparison of Equations 4.1 and 4.2 shows that unless land purchase price (BL) in Equation 4.1 was below or equal to zero, selling the land after the first rotation (Equation 4.1) gives more tax savings from basis indexing. When land sale is assumed, the higher the original purchase price of the land, (equal to BL in Equation 4.1), the higher the tax savings will be.

The tax savings in Equations 4.1 and 4.2 do not depend on land purchase price alone. The forest establishment cost forms part of the cost basis as well. As with the land, the higher the forest establishment cost, the higher the tax savings from basis indexing will be. In this study, forest establishment cost for White pine Christmas trees was assumed to be $364 per acre. The same cost item ranged from $380 per acre (when fertilization cost is expensed) to $580 per acre (when fertilization cost is capitalized) for Douglas fir for timber. If actual forest establishment costs are lower (higher) than these figures, improvement in MAXPAY values due to basis indexing will be lower (higher) than the results shown here.

For example, White pine's results in Table 1, when interest rate is 3%, inflation rate is 5%, and capital gains tax rate is 34%, show that MAXPAY values with basis indexing are higher by $133 than those without indexing (column C5). If no land sale was assumed, tax savings would have been less than $133. Even with a land sale, if the land was purchased originally at a very low price (close to zero), the tax savings will also be less than $133.

The relatively very low MAXPAY values under the ERITAX method were caused by much higher corresponding ERITAX rates. (See figures in parentheses in Table 1.) Higher original capital gains tax rates result in much higher ERITAX rates, and hence, much lower associated MAXPAY values in the ERITAX method compared to values without indexing. For example,

Table 1. Effects of capital gains tax structures and capital gains tax rates on MAXPAY for bare land

Species: White pine (Christmas trees)
Rotation: Fixed at 10 years.
Douglas fir (Timber)
Plant and Clearcut
SI = 100 (b.a. 50)
Density = 800 trees/ac.
Rotation: See Table 9.

Interest rate: .03
Inflation rate : .05

Tax Rates	Capital Gains Tax Structure				
Capital Gain/ Ordinary Income	No Indexing	With Indexing[1]	ERITAX[2] Method	Difference	
C1	C2	C3	C4	C5 (C3 - C2)	C6 (C2 - C4)
	$/ac.	$/ac.	$/ac.	$/ac.	$/ac.
White pine					
.00/.00	3419	3419	3419 (.00)*	0	0
.20/.34	2565	2643	1736 (.43)	78	829
.34/.34	1966	2099	559 (.74)	133	1407
.46/.34	1453	1634	-- (1.00)	181	
Douglas fir					
.00/.00	633	633	633 (.00)	0	0
.20/.34	367	410	261 (.33)	43	106
.34/.34	199	254	.70 (.57)	55	198
.46/.34	64	121	-- (.77)	57	

[1]Basis indexing with tax on realized income.
[2]ERITAX is the tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest to rotation age.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.
Dashed lines represent negative MAXPAY values.
C1 means column 1.

using Douglas fir's results, when the original capital gains tax rate is 20%, the ERITAX rate is 33% and the MAXPAY value under the ERITAX method is lower by $106 (column C6) than the corresponding MAXPAY value under the current tax law without basis indexing. When the original capital gains tax rate is 34%, the ERITAX rate is 57% and its associated MAXPAY value is lower by $198 than the MAXPAY value under the current tax without basis indexing.

When the ERITAX rate [4] is multiplied by the inflation-adjusted capital gains, it yields tax revenues whose present value is equal to the sum of the present value of taxes paid yearly. This tax revenue is fixed at amount A for a given simulation environment (see Equation 3.7). When basis indexing is allowed, the ERITAX rate increases but the capital gains decrease. When the cost basis is not indexed to inflation, the ERITAX rate decreases but the taxable capital gains increase. Thus, as designed in the study, basis indexing does not help the taxpayer at all under the ERITAX method.

Theoretically, in present value terms, the forest owner should be indifferent between paying one lump sum capital gains tax at ERITAX rates and paying annual capital gains taxes at original capital gains tax rates. This is in cases where the ERITAX rate is not high enough to drive bare land value to zero or below the land value for the next-best land use. However, owners without multi-aged forests might prefer to pay the total accrued taxes accumulated with interest at rotation age.

In any case, when ERITAX rates become greater than 100%, the associated investment becomes infeasible. Tax rates of these levels result in negative net present values for the investment.

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[4] ERITAX rates are the figures in parentheses in Table 1.

B. Effects of Other Factors on MAXPAY for Bare Land

1. Capital gains tax rates

Table 1 also shows the effects of capital gains tax rates on MAXPAY values for bare land, under each capital gains tax structure. All other things equal, improvement in MAXPAY values from basis indexing increases as capital gains tax rates increase. For example, using results from Douglas fir, improvement in MAXPAY values from basis indexing is greater when the capital gains tax rate is 34% (tax savings equal $55) than when the tax rate is 20% (tax savings equal $43), all other factors the same.

This result implies that, with progressive taxation, those in higher tax brackets will have more tax savings with basis indexing, all other things equal. However, the tax savings will probably be trivial compared to the tax payments in higher income tax brackets. Thus, the higher tax savings associated with higher capital gains tax rates under basis indexing will probably not influence an investor's decision about the timing of gains realization.

2. Interest rates

Table 2 shows MAXPAY values for bare land under each capital gains tax structure and how these values are affected by real interest rates. White pine's results show that improvement in MAXPAY values from basis indexing decreases as interest rates increase, all other things equal. Douglas fir's results show the same trend. However, Douglas fir's MAXPAY values for all simulations were negative when the interest rate used was 6% or higher. These results are tabulated in Tables D.1 and D.2 of Appendix D and Tables E.1 and E.2 of Appendix E. These tables show that basis indexing still gives higher MAXPAY values than no indexing, even though under both capital

Table 2. Effects of capital gains tax structures and capital gains tax rates on MAXPAY for bare land at various real interest rates

Species: White pine (Christmas trees)
Rotation: Fixed at 10 years.
Inflation rate : .05

Tax Rates	Capital Gains Tax Structure				
Capital Gain/ Ordinary Income	No Indexing	With Indexing[1]	ERITAX[2] Method	Difference	
C1	C2	C3	C4	C5	C6
				(C3 - C2)	(C2 - C4)
	$/ac.	$/ac.	$/ac.	$/ac.	$/ac.
Interest rate: .03					
.00/.00	3419	3419	3419 (0)*	0	0
.20/.34	2565	2643	1736 (.43)	78	829
.34/.34	1966	2099	559 (.74)	133	1407
.46/.34	1453	1634	-- (1.00)	181	
Interest rate: .06					
.00/.00	2551	2551	2551 (0)	0	0
.20/.34	1871	1930	1168 (.45)	59	703
.34/.34	1395	1495	200 (.76)	100	1195
.46/.34	987	1122	-- (1.02)	135	
Interest rate: .09					
.00/.00	1893	1893	1893 (0)	0	0
.20/.34	1347	1392	747 (.46)	45	600
.34/.34	966	1041	-- (.78)	75	
.46/.34	639	741	-- (1.05)	102	

[1]Basis indexing with tax on realized income.
[2]ERITAX is the tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest to rotation age.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.
Dashed lines represent negative MAXPAY values.
C1 means column 1.

gains tax structures, MAXPAY values for Douglas fir are negative when real interest rates are high. (Negative MAXPAY values will not be discussed here because they imply infeasible investments.)

In Table 2, at the same capital gains tax rate of 34%, improvement in MAXPAY values from basis indexing when real interest rate is 3% ($133) is greater than the corresponding value when the interest rate is 6% ($100), everything else constant.

Under the ERITAX method, ERITAX rates rose when interest rates increased, even with all other things the same. Thus, MAXPAY values with the ERITAX method decreased further from corresponding values under the no indexing structure when interest rates increased. For example, using the same original capital gains tax rate of 34%, the ERITAX rate, when the interest rate is 3%, is 74%, compared to 76% when the interest rate is 6%. The MAXPAY values under the ERITAX method (column C4) dropped from $559 when the interest rate is 3% to $200 when the interest rate is 6%. ERITAX rates associated with long rotations also increased more rapidly with increasing interest rates.

Table 3 shows some combinations of rotation age, interest rate, timber value growth rate and initial capital gains tax rates and how they affect the value of the ERITAX rate. In general, if the rotation is long enough, and timber value growth rate low enough relative to the interest rate, accumulated taxes can exceed total capital gains. For example, if rotation is 40 years, capital gains tax rate is 40%, timber value growth rate is 2%, and interest rate is 6%, ERITAX is 134%. If the interest rate is higher than the value growth rate of the asset, the accumulated taxes will overtake the capital gains sooner. These results can be shown mathematically. Define:

g = real annual timber value growth, in decimals; (See Equation 3.5)

r = real interest rate, in decimals;

E = forest establishment cost at year 0;

R = rotation age in years;

t = initial capital gains tax, in decimals; applied to yearly accrued income;

V = total capital gain accumulated from year 1 to year R, equal to harvest value less the inflation-adjusted basis;

Table 3. **ERITAX rates yielding realized income taxes equal to accrued income taxes accumulated with interest to given rotation ages, at given initial capital gains tax rates**

Initial Tax Rate	Optimal Rotation	Interest Rate	Timber Value Growth*	ERITAX Rate
.20	20	.00	.02	.20
		.02	.02	.24
		.04	.02	.29
			.06	.28
			.08	.27
.20	20	.08	.02	.44
			.06	.40
			.08	.38
.20	40	.02	.02	.29
		.04	.02	.43
			.04	.39
			.06	.35
.40	20	.02	.02	.48
			.06	.47
		.06	.02	.71
			.04	.68
			.06	.66
.40	40	.02	.02	.57
			.04	.55
			.06	.52
		.06	.02	1.34
			.04	1.15
			.06	1.00

*See Equation 3.5.

$ERITAX$ = equivalent realized income tax, in decimals;

A = accrued taxes accumulated with interest to rotation age;

We can then express the ERITAX rate as:

$$ERITAX = \frac{A}{V}.$$

But we can also express A, the annual accrued income tax at rate t accumulated with interest to rotation age, as

$$\begin{aligned} A &= \sum_{i=1}^{R} t\left[E(1+g)^{i} - E(1+g)^{i-1} \right]\left[(1+r)^{R-i}\right] \\ &= t\sum_{i=1}^{R} E\left[(1+g)^{i} - (1+g)^{i-1} \right]\left[(1+r)^{R-i} \right] \\ &= tE\sum_{i=1}^{R} \left[(1+g)^{i} - (1+g)^{i-1} \right]\left[(1+r)^{R-i}\right] \end{aligned} \qquad [4.3]$$

Further, V, the capital gain for one rotation, can be expressed as:

$$\begin{aligned} V &= E(1+g)^{R} - E \\ &= E\left[(1+g)^{R} - 1\right] \end{aligned} \qquad [4.4]$$

Hence,

$$\begin{aligned} ERITAX &= \frac{tE\sum_{i=1}^{R}\left[(1+g)^{i} - (1+g)^{i-1}\right]\left[(1+r)^{R-i}\right]}{E\left[(1+g)^{R} - 1\right]} \\ &= \frac{t\sum_{i=1}^{R}\left[(1+g)^{i} - (1+g)^{i-1}\right]\left[(1+r)^{R-i}\right]}{(1+g)^{R} - 1} \end{aligned} \qquad [4.5]$$

When $r = 0$, by expanding the numerator, Equation 4.5 simplifies to

$$ERITAX = \frac{t\left[\,(1+g)^R \;-\; 1\right]}{(1+g)^R \;-\; 1}$$

$$= \; t$$

When $r = g$, by collecting like terms and simplifying the terms in the numerator, Equation 4.5 becomes

$$ERITAX \;\; (when\, r \,=\, g) = \frac{t\sum_{i=1}^{R}\left[(1+g)^R \;-\; (1+g)^{R-1}\right]}{(1+g)^R \;-\; 1} \qquad [4.6]$$

$$= \frac{tR\left[(1+g)^R \;-\; (1+g)^{R-1}\right]}{(1+g)^R \;-\; 1}$$

The numerators of Equation 4.5 and Equation 4.6 are actually the accumulated yearly taxes, while the denominators are the total capital gains, when $E = 1$. By inspection, when r *is greater than zero* in Equation 4.5, the numerator can become greater than the denominator. When this happens, *ERITAX* exceeds 100%. This becomes more likely if the initial capital gains tax rate is high, or if the rotation is long, or if the interest rate is high. When all t, R and r are high, ERITAX can be very high, even when r is lower than the forest value growth rate (Table 3). Other things equal, when the value growth rate is significantly lower than the competitive after-tax interest rate, the ERITAX rate can exceed 100%. Such an investment is inefficient and it could be argued that the high ERITAX rate could be a useful deterrent.

Table 4. **Effects of capital gains tax structures and capital gains tax rates on MAXPAY for bare land at various inflation rates**

Species: White pine (Christmas trees)
Rotation: Fixed at 10 years.
Interest rate: .03

Tax Rates	Capital Gains Tax Structure				
Capital Gain/ Ordinary Income	No Indexing	With Indexing[1]	ERITAX[2] Method	Difference	
C1	C2	C3	C4	C5	C6
				(C3 - C2)	(C2 - C4)
	$/ac.	$/ac.	$/ac.	$/ac.	$/ac.
Inflation rate: .00					
.00/.00	3419	3419	3419 (0)*	0	0
.20/.34	2643	2643	1736 (.43)	0	0
.34/.34	2099	2099	559 (.74)	0	0
.46/.34	1634	1634	-- (1.00)	0	0
Inflation rate: .05					
.00/.00	3419	3419	3419 (0)	0	0
.20/.34	2565	2643	1736 (.43)	78	829
.34/.34	1966	2099	559 (.74)	133	1407
.46/.34	1453	1634	-- (1.00)	181	
Inflation rate: .15					
.00/.00	3419	3419	3419 (0)	0	0
.20/.34	2490	2643	1736 (.46)	153	754
.34/.34	1840	2099	559 (.74)	259	1281
.46/.34	1282	1634	-- (1.00)	352	

[1]Basis indexing with tax on realized income.
[2]ERITAX is the tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest to rotation age.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.
Dashed lines represent negative MAXPAY values.
C1 means column 1.

Table 5. Effects of capital gains tax structures and capital gains tax rates on MAXPAY for bare land at various inflation rates

Species: Douglas fir (Timber)
Plant and Clearcut
SI = 100 (b.a. 50)
Density = 800 trees/ac.
Rotation: See Table 9.
Interest rate: .03

Tax Rates	Capital Gains Tax Structure				
Capital Gain/ Ordinary Income	No Indexing	With Indexing[1]	ERITAX[2] Method	Difference	
C1	C2	C3	C4	C5	C6
				(C3 - C2)	(C2 - C4)
	$/ac.	$/ac.	$/ac.	$/ac.	$/ac.
Inflation rate: .00					
.00/.00	633	633	633 (.00)*	0	0
.20/.34	410	410	261 (.33)	0	149
.34/.34	254	254	.70 (.57)	0	253
.46/.34	121	121	-- (.77)	0	
Inflation rate: .05					
.00/.00	633	633	633 (.00)	0	00
.20/.34	367	410	261 (.33)	43	106
.34/.34	199	254	.70 (.57)	55	198
.46/.34	64	121	-- (.77)	57	
Inflation rate: .15					
.00/.00	633	633	633 (.00)	0	0
.20/.34	364	410	261 (.33)	46	103
.34/.34	194	254	.70 (.57)	60	193
.46/.34	60	121	-- (.77)	61	

[1]Basis indexing with tax on realized income.
[2]ERITAX is the tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest to rotation age.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.
Dashed lines represent negative MAXPAY values.
C1 means column 1.

3. Inflation rates

The effects of inflation on MAXPAY values for bare land under each capital gains tax structure are shown in Table 4 and Table 5. Table 4 shows the results for White pine; Table 5 is for Douglas fir. For both species, when basis indexing is not allowed, MAXPAY values decreased as inflation rates increased, other things equal. For example, using a capital gains tax rate of 34%, Douglas fir's MAXPAY values dropped from $199 (inflation equals 5%) to $194 when inflation rate is 15%. White pine's MAXPAY values for the same situation are $1966 (inflation equals 5%) and $1840 when inflation rate is 15%. Because basis indexing removes the effects of inflation, MAXPAY values under basis indexing and the ERITAX method (Tables 4 and 5) do not change for the same tax rates even when inflation rates increase. Thus, tax savings from basis indexing increase as inflation rates rise, other things equal.

Tax savings from basis indexing are found by subtracting MAXPAY values without basis indexing from those with basis indexing. Table 6 compares these tax savings for White pine and Douglas fir. All other things equal, White pine has higher tax savings per acre from basis indexing than Douglas fir. Also, the increase in tax savings as inflation rises, given the same tax rates and interest rates, is higher with White pine than with Douglas fir. This can be seen by comparing tax savings values for the two species in any given line Table 6, given that the inflation rate is greater than zero. For example, when the capital gains tax rate is 34%, White pine's tax savings from basis indexing increase by $126 ($259 - $133) when the inflation rate goes up from 5% to 15 %. Under exactly the same set of variables, Douglas fir's tax savings increase by $5. This suggests that, with all other things the same, the benefits of basis indexing are higher with short-rotation species than with long- rotation ones. Note, however, that these results are true only if everything else but the rotation period is kept constant. The reverse could be true under a different set of assumptions about costs and revenues. Because the model has other factors in it other than payoff periods and basis indexing, it is difficult to make general conclusions about the effects of basis indexing and payoff periods on MAXPAY values when more than one factor is changing at one time.

Table 6. Comparison of tax savings per acre from basis indexing for White pine and Douglas fir when inflation rates rise

Species: White pine (Christmas trees)
Rotation: Fixed at 10 years.
Douglas fir
Plant and Clearcut
SI = 100 (b.a. 50)
Density = 800 trees/ac.
Rotation: See Table 9.
Interest rate: .03

Tax Rates	Tax Savings from Basis Indexing	
Capital Gain/ Ordinary Income	White pine (Rotation: 10 years)	Douglas fir (Rotation: 48 years minimum)
	$/ac.	$/ac.
Inflation rate: .00		
.00/.00	0	0
.20/.34	0	0
.34/.34	0	0
.46/.34	0	0
Inflation rate: .05		
.00/.00	0	0
.20/.34	78	43
.34/.34	133	55
.46/.34	181	57
Inflation rate: .15		
.00/.00	0	0
.20/.34	153	46
.34/.34	259	60
.46/.34	352	61

Table 7. Tax savings from basis indexing per dollar of cost basis for various combinations of inflation rates, tax rates, interest rates, and holding periods

			HOLDING PERIODS (years)									
f*	t	r	5	8	10	12	16	20	30	40	50	60
5	20	2	.039	.055	.063	.070	079	.084	.085	.078	.067	.058
		3	.037	.051	.057	.062	.068	.069	.063	.053	.042	.032
		4	.036	.047	.052	.055	.058	.057	.047	.036	.026	.018
		5	.034	.044	.047	.049	.050	.047	.036	.024	.016	.010
		6	.032	.041	.108	.044	.043	.039	.027	.017	.010	.006
		9	.028	.032	.033	.032	.027	.022	.012	.005	.002	.001
		12	.025	.026	.025	.023	.018	.013	.005	.002	.001	.000
5	34	2	.067	.094	.108	.119	.134	.143	.144	.132	.115	.098
		3	.063	.087	.098	.106	.115	.117	.108	.089	.071	.055
		4	.060	.080	.089	.094	.098	.097	.081	.061	.044	.031
		5	.058	.074	.081	.083	.084	.080	.060	.041	.027	.017
		6	.055	.069	.073	.075	.073	.066	.046	.028	.017	.010
		9	.048	.055	.056	.054	.046	.038	.020	.009	.004	.002
		12	.042	.044	.042	.039	.030	.022	.009	.003	.001	.000
15	34	2	.155	.195	.210	.218	.221	.215	.185	.153	.126	.104
		3	.147	.181	.190	.194	.189	.177	.138	.104	.077	.058
		4	.141	.167	.173	.172	.163	.146	.103	.071	.048	.032
		5	.134	.155	.157	.154	.139	.120	.077	.048	.030	.018
		6	.128	.144	.143	.137	.120	.100	.058	.033	.018	.010
		9	.111	.115	.108	.098	.076	.057	.025	.011	.005	.002
		12	.097	.092	.082	.071	.050	.033	.011	.004	.001	.000

*f is inflation rate in %
t is capital gains tax rate in %
r is real interest rate in %
Tabular values of Table 7 were derived using Equation 4.1.

Table 7 summarizes the combined effects of capital gains tax rates, interest rates, inflation rates and payoff periods on the tax savings due to basis indexing. The values inside the table represent tax savings from basis indexing per dollar of cost basis. They were derived using Equation 4.1 by combining E and BL into just one cost basis called E. (If we assume no land sale after the first rotation, using Equation 4.2, the tax savings will be higher but the trends will be the same as those shown in Table 7.)

Because the tax savings from basis indexing in Table 7 are based on per dollar of cost basis, to find the tax savings associated with a given cost basis, the cost basis is multiplied by the tabular values of Table 7. For example, if interest rate is 6%, inflation rate is 5%, and capital gains tax rate is 20%, an investment with a holding period of 5 years and a cost basis of one dollar ($1) will save $0.039 in taxes if there is basis indexing. Under exactly the same conditions, an investment with a cost basis of $100 will save $3.90 in taxes.

Thus, Table 7 shows that higher cost bases give higher tax savings, all other things equal. Also, as the capital gains tax rate, or the inflation rate, increases, tax savings from basis indexing per dollar of cost basis increase, everything else the same. When interest rates increase, however, tax savings decrease, all other things equal.

For any combination of positive tax rate, interest rate and inflation rate (Table 7), the tax savings from basis indexing per dollar of cost basis increases, reaches a maximum, and decreases as the holding period is increased. For example, when the inflation rate is 5%, the tax rate is 34% and the interest rate is 6%, tax savings from basis indexing per dollar of cost basis is $0.055 when the payoff period is 5 years. Tax savings increase as the payoff period increases up to a maximum of $0.075 when the payoff period is 12 years. For this example, after 12 years, tax savings decrease as the payoff period increases further. Also, the holding period at which maximum tax savings occur becomes shorter as the interest rate, or the inflation rate, increases, all other things equal. (See Figures 1 and 2.)

For example, at a capital gains tax rate of 34% and inflation rate of 5%, maximum tax savings occur with a holding period of 20 years when the interest rate is 3%. Under exactly the same conditions, but with an interest rate of 6%, maximum tax savings occur with a holding period of

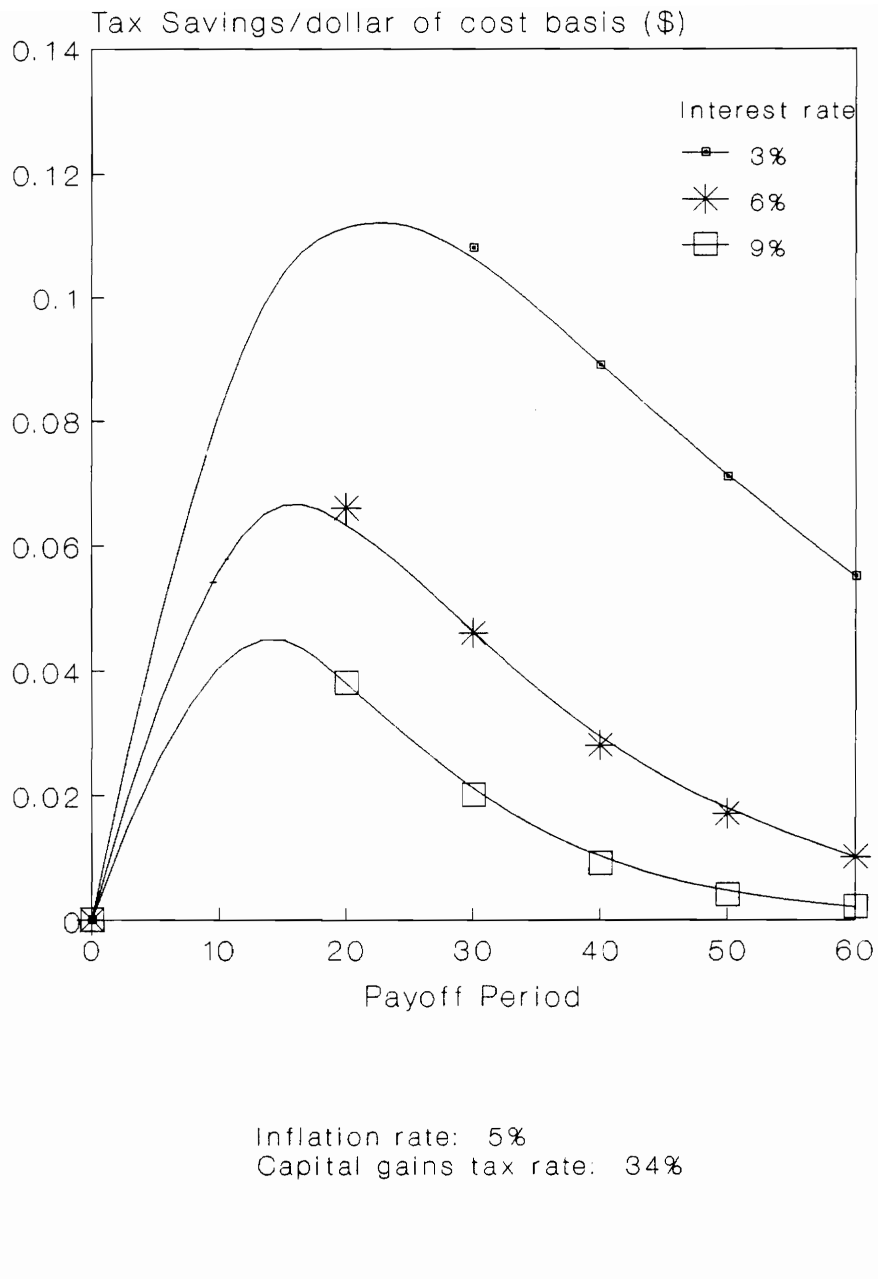
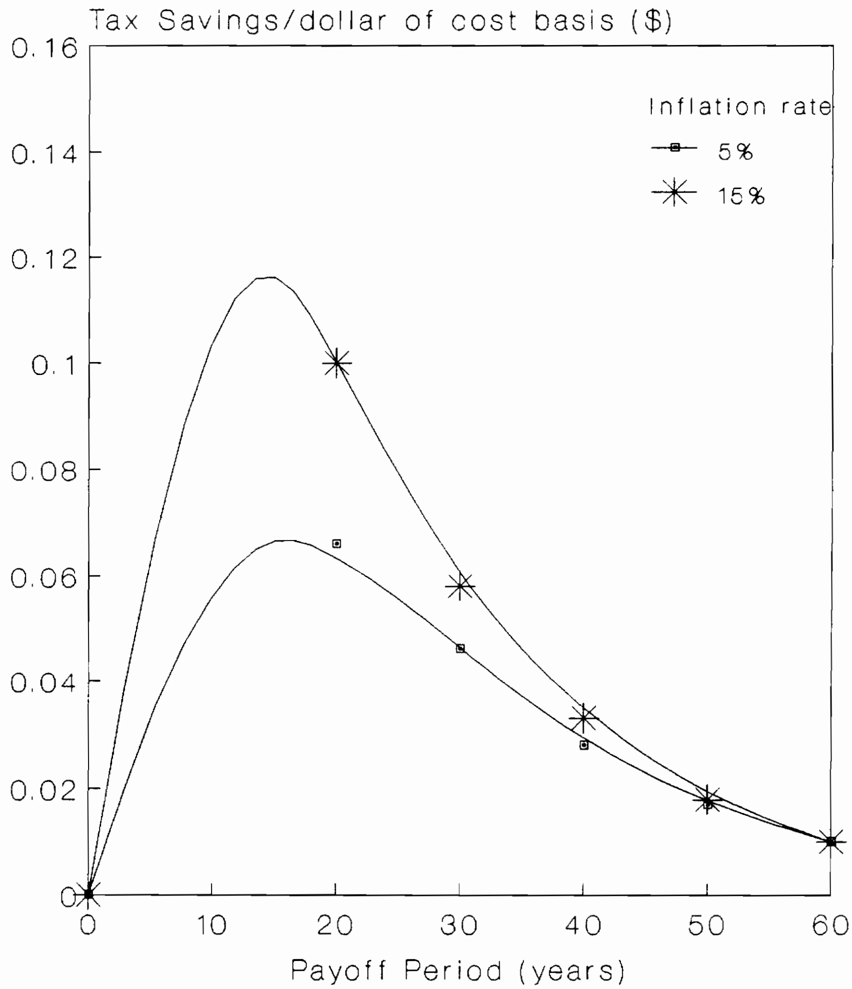


Figure 1. Tax savings from basis indexing per dollar of cost basis at various real interest rates



Interest rate: 6%
Capital gains tax rate: 34%

Figure 2. Tax savings from basis indexing per dollar of cost basis at various inflation rates

12 years. When the interest rate is 6% and the capital gains tax rate is 34%, maximum tax savings occur at 12 years when the inflation rate is 5%. When the inflation rate is 15%, maximum tax savings occur with holding periods of 8 years.

Similar results and conclusions were reported by Bullard and Klemperer (1986) and by Klemperer and O'Neil (1987). In particular, Klemperer and O'Neil (1987) reported that when interest rate is 6%, assets with holding periods of around 10 years get maximum benefits from basis indexing, other things equal. These findings imply that although basis indexing gives higher MAXPAY values than the no indexing structure, not all capital assets benefit equally from it. For most common discount rates, and holding all other things constant, assets with comparatively short rotations benefit more from basis indexing.

4. Tax treatment of fertilization cost

The manner in which certain costs are treated in accordance with tax laws can affect net present values of assets. For example, fertilization costs in forestry are sometimes recommended to be expensed in the year they are incurred. Sometimes they are proposed to be amortized over a 7-year period after the cost is incurred. Some proposals would have the fertilization cost capitalized just like the forest establishment cost.

When fertilization cost is expensed, the cost is deducted fully from ordinary income in the year it is incurred. Thus, it lowers ordinary income tax payments for that year. In the amortization case, one-seventh of the fertilization cost is deducted from ordinary income for seven years after the cost is incurred. When fertilization cost is capitalized, it cannot be deducted from ordinary income in the year it is incurred. Instead, the cost is added to the tax-deductible cost basis which is then deducted from harvest revenue in order to determine taxable capital gains. All three proposals were simulated in the study using the same interest rate, inflation rate, site, and timing and intensity of fertilization.

Table 8. Comparison of effects of tax treatment for fertilization cost on MAXPAY for bare land

Species:	Douglas fir (Timber) Plant, Fertilize and Clearcut Fertilization at age 35 SI = 100 (base age 50) Density = 800 trees/ac. Rotation: See Table 9.
Interest rate :	.03
Inflation rate :	.05
Tax treatment :	Capital Gains Taxed when Realized With No Basis Indexing

Tax Rates	Fertilization Cost Treatment		
Capital Gain/ Ordinary Income	Expensing	Amortization	Capitalization
.00/.00	642	641	641
.20/.34	402	362	356
.34/.34	258	184	175
.46/.34	100	41	30

MAXPAY is maximum willingness to pay.

Table 8 shows MAXPAY values for bare land at 3% interest rate, 5% inflation rate and without basis indexing for the three tax treatments of fertilization costs. With all other variables kept constant, at any given capital gains tax rate, expensing the fertilization cost at the year it was incurred gave higher MAXPAY values than either the capitalization or amortization case. Amortizing the cost of fertilizers gave higher MAXPAY values than capitalizing the cost as part of the cost basis, all other things equal. The difference in MAXPAY values between the amortization and capitalization methods is not very significant. However, it might become so if fertilization cost becomes very high relative to other costs.

Although these tax treatments were modeled using fertilization cost only, it can be concluded that the effects on MAXPAY values will be the same if other costs are used.

5. Effects of site quality and real increases in product price

Because all simulation environments used exactly the same models, the effects of capital gains tax structures and all the other factors on forest investments in Douglas fir on a different site had the same trends as those with the ones discussed previously. In general, the better site (SI = 140) had higher MAXPAY values in all simulation runs compared with those of a poorer site, all other things equal. Also, with a better site, timber value growth rate is higher, and so, ERITAX rates were not as high as those in a poorer site, with all other things the same.

The effect of real increases in product price on MAXPAY values is similar to the effect of a better site. The direction of effects of the three capital gains tax structures and the other factors in the model on MAXPAY values for forest investments are the same when product price is constant and when it is increasing. The difference is in the magnitude of effects. When the product price is increasing in real terms, and with all other things equal, tax savings from basis indexing are greater. Under this price behavior, and with all other things equal, ERITAX rates were lower than when price is constant.

6. Effects of capital gains tax structures and tax rates on rotation

Note that this study was not aimed at measuring the effects of model variables on optimal rotation of Douglas fir. However, two interesting results about optimal rotation were observed (Table 9). In general, and keeping all other factors constant, optimal rotation of Douglas fir is not very sensitive to changing capital gains tax rates. A 46- percentage point increase in the capital gains tax rate resulted in only 3 additional years in the optimal rotation of Douglas fir, under the two management regimes used in the study, with all other things the same. Chang (1982) reached the same conclusion in his analysis of the impact of forest taxation on optimal rotation age.

The other interesting observation is that for both management regimes, (MR1 and MR3), the optimal rotations in all capital gains tax rates greater than zero modeled here are slightly shorter under the ERITAX method than under the realized income tax without basis indexing. When the initial capital gains tax rate is zero, the rotation length under each tax structure is the same (48 years). As the initial capital gains tax rate is increased, the rotation lengthens. However, because the ERITAX rate (see Table 3 and Equation 4.5) increases as the rotation increases, other things equal, the resulting high ERITAX rate tends to limit further lengthening of the rotation age.

IMPLICATIONS

Under current federal income tax law, when capital gains are taxed, they have the simultaneous negative effects of inflation and the positive effects of tax deferral. Basis indexing has been proposed by some in order to counteract the ill effects of inflation on the capital gain. Taxing capital gains as they accrue every year has also been proposed in order to treat capital gains and ordinary income taxpayers equally. Both capital gains tax structures were modeled here along with the current federal income tax structure.

Table 9. Effects of capital gains tax structures and capital gains tax rates on optimal rotation of Douglas fir

SI = 100 (b.a. 50)
Density = 800 trees/ac.
Interest rate: .03
Inflation rate: .15

Tax Rates	Capital Gains Tax Structures	
Capital Gain/ Ordinary Income	No Basis Indexing (Years)	ERITAX[1] (Years)
Plant and Clearcut (MR1)		
.00/.00	48	48
.20/.34	49	48
.34/.34	50	48
.46/.34	51	48
Plant, Fertilize and Clearcut (MR2)		
.00/.00	48	48
.20/.34	49	48
.34/.34	50	48
.46/.34	51	49

[1]ERITAX is the tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest to rotation age.

1. Implications of basis indexing

Results show that basis indexing will not benefit all forest investments equally. When real interest rates are very low, (2% or lower), both short and long rotations benefit from basis indexing, all other things equal. However, when real interest rates, or inflation rates, increase, most benefits of basis indexing go to assets with short holding periods. For example, when the capital gains tax rate is 34%, inflation rate is 5%, and real interest rate is 6%, the highest tax savings per dollar of cost basis occur with holding periods of around 12 years (Table 7).

Most traditional forest investments have lives longer than 12 years and real interest rates cannot be expected to be as low as 1% all the time. This means that for most likely conditions of interest rates and inflation rates, and for most traditional forest investments like sawtimber, basis indexing cannot be an incentive to invest at all. For assets that had been held for a very long time, not necessarily limited to forestry only, basis indexing cannot serve as an inducement to realize capital gains because there is not much percentage difference in the tax payments with and without basis indexing.

These results argue against the clamor for basis indexing based on the argument that the longer the investment is exposed to inflation, the more it needs basis indexing for relief. However, not all investments are in forestry. And not all forest investments have long lives. In times of high real interest rates, high capital gains tax rates, and high inflation rates, short-term capital gains will benefit from basis indexing in addition to tax deferral benefits. For this class of investments, and under those conditions, basis indexing has appeal.

2. Implications of taxing timber capital gains upon accrual

Under the ERITAX method, results showed that at any positive initial capital gains tax rate and real interest rate, the resulting ERITAX rate is higher. Because of these high tax rates, MAXPAY values under the ERITAX were much lower than those under the realized income tax without indexing.

Table 10 illustrates the annual accrued income tax levied as an "equivalent realized income tax rate" at realization (ERITAX). It traces the accumulation of capital gains from year 1 to rotation age (column for Timber Value Growth). (For now, inflation rate is assumed to be zero.) It also shows the yearly capital gain taxes that the owner would have paid under an accrued income tax (Annual Tax Paid). These yearly tax payments are accumulated with interest up to rotation age (Accumulated Tax). At the end of the rotation of 48 years, the accumulated tax paid by an accrued income taxpayer is $1980.50. If a taxpayer pays the same amount of tax in one lump sum at rotation age, the equivalent realized income tax rate (ERITAX rate) should be 57% (see bottom of Table 10 for ERITAX rate computation).

If the timber value growth rate is low enough relative to the real interest rate, the accumulated yearly taxes can exceed total capital gains. Hence, the equivalent realized income tax rate (ERITAX rate) can become greater than 100% of the capital gain. Even before the ERITAX rate exceeds 100%, the asset owner would have incurred losses or gone out of business because there are other costs in addition to the taxes. Also, when the ERITAX rate is very high, land values could become too low for forestry and would likely cause shifts to the next best land use.

Note that in the ERITAX method, the annual taxable value is equal to the product of the previous year's forest market value and the value growth rate, g. This tax base rises at the same growth rate, g, annually. Under the unmodified annual property tax, taxable forest market value also increases annually at rate g, which is the timber's growth rate. Therefore, an accrued income tax such as the ERITAX, with a tax rate, t_a, would function exactly like an unmodified annual property tax at rate $t = g\,(t_a)$ (Gaffney, 1967; Kovenock, 1986). If the annual accrued income tax rate is 34% and timber growth rate is 10%, then the ERITAX method is like an unmodified annual property tax of 3.4% ($t = .10\,(.34)$) which is higher than most rural property tax rates.

In addition, Klemperer (1982) showed that the unmodified annual property tax is biased against land uses with long rotations, high establishment costs, or high annual costs, all other things equal. Forestry, with its long payoff periods, would tend to be burdened more heavily by the

Table 10. Annual accrued income tax on timber

Future Revenue =	$3866
Rotation =	48 years
Initial Tax Rate =	34%
ERITAX Rate =	.57*
Timber Value Growth Rate =	4.95%
Interest Rate =	3%
Reforestation Cost =	$380
Inflation Rate =	0%

Age	Timber Value[1] ($)	Timber Value Growth[2] ($)	Annual Tax Paid[3] ($)	Accumulated Tax[4] ($)
1	398.82	18.82	6.40	25.67
2	418.56	19.75	6.71	51.82
3	439.29	20.73	7.05	78.47
4	461.04	21.75	7.40	105.62
5	483.87	22.83	7.76	133.29
6	507.83	23.96	8.15	161.48
7	532.98	25.15	8.55	190.20
8	559.37	26.39	8.97	219.47
9	587.07	27.70	9.42	249.30
10	616.14	29.07	9.88	279.69
11	646.65	30.51	10.37	310.65
12	678.67	32.02	10.89	342.21
13	712.28	33.61	11.43	374.36
14	747.55	35.27	11.99	407.12
15	784.56	37.02	12.59	440.50
16	823.41	38.85	13.21	474.51
17	864.19	40.77	13.86	509.17
18	906.98	42.79	14.55	544.48
19	951.89	44.91	15.27	580.46
20	999.03	47.14	16.03	617.13
21	1048.50	49.47	16.82	654.49
22	1100.41	51.92	17.65	692.56
23	1154.90	54.49	18.53	731.35

continued

[1]Value in year $n = 380\,(1.0495)^n$
[2]Difference between timber values, or the annual accrued income.
[3]Annual accrued income x 0.34
[4]Accumulated tax to year 48 at 3% interest.

$$\text{*ERITAX Rate} = \frac{1980.50}{3486.24} = .57$$

Table 10 continued

Age	Timber Value[1] ($)	Timber Value Growth[2] ($)	Annual Tax Paid[3] ($)	Accumulated Tax[4] ($)
24	1212.09	57.19	19.44	770.87
25	1272.11	60.02	20.41	811.15
26	1335.10	62.99	21.42	852.18
27	1401.21	66.11	22.48	894.00
28	1470.60	69.38	23.59	936.60
29	1543.42	72.82	24.76	980.02
30	1619.85	76.43	25.99	1024.26
31	1700.06	80.21	27.27	1069.33
32	1784.24	84.18	28.62	1115.26
33	1872.59	88.35	30.04	1162.06
34	1965.32	92.73	31.53	1209.75
35	2062.64	97.32	33.09	1258.34
36	2164.77	102.14	34.73	1307.85
37	2271.97	107.19	36.45	1358.30
38	2384.47	112.50	38.25	1409.70
39	2502.54	118.07	40.14	1462.08
40	2626.46	123.92	42.13	1515.45
41	2756.52	130.06	44.22	1569.84
42	2893.01	136.50	46.41	1625.25
43	3036.27	143.26	48.71	1681.72
44	3186.62	150.35	51.12	1739.25
45	3344.41	157.79	53.65	1797.87
46	3510.02	165.61	56.31	1857.61
47	3683.83	173.81	59.09	1918.48
48	3866.24	182.41	62.02	1980.50

[1]Value in year $n = 380\,(1.0495)^n$
[2]Difference between timber values, or the annual accrued income.
[3]Annual accrued income x 0.34
[4]Accumulated tax to year 48 at 3% interest.

property tax, compared to most competing land uses. Since it was shown that the ERITAX and the unmodified annual property tax have the same mechanism for taxing property, it can be concluded that the ERITAX is also biased against the same types of land uses.

3. Implications of taxing timber capital gains upon realization

The major implication of the ERITAX method concerns equity in taxation of capital gains and other incomes. Table 10, by comparing after-tax wealth positions of realized income and accrued income taxpayers at investment maturity, shows that taxing capital gains upon realization favors long-term capital gains over other incomes. This is due to the tax deferral benefits of taxing capital gains only upon realization. In order for the realized income taxpayers to pay the same tax revenues as the accrued income taxpayers paid ($1980.50), they should be paying at the ERITAX rate of 57% for the given example. Under current federal income tax law, however, they pay at the same annual accrued income tax rate of only 34%.

For another example, assume that capital gains and ordinary income are taxed at the current corporate rate of 34%. Assume no inflation. A firm investing $380 in a forest that grows at a real rate of 4.95% per year does not pay taxes until the harvest at rotation age assumed here to be 48 years. Another investor who puts the same amount in a bank paying real interest at 4.95% per year would pay income taxes every year on the interest income from the bank deposit. If we assume further that tax payments come from a source other than the bank deposit itself, then the column titled "Accumulated Tax" in Table 10 would actually trace the accumulation of the yearly income tax collected with interest at 3% per year from the interest income.

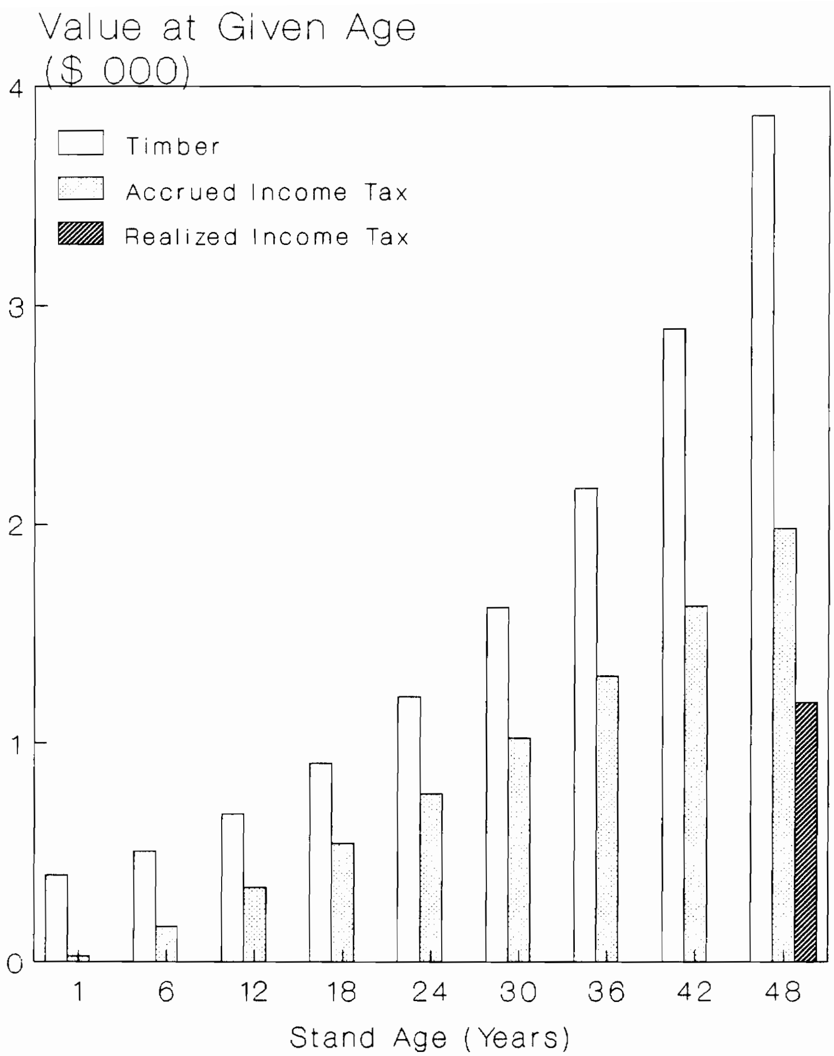
At rotation age, the forest owner would pay capital gain taxes amounting to 34% of the total capital gain of $3,486 ($3,866, which is constant dollars of year 0, less $380). The tax will amount to $1,185. At that same time, the bank depositor would have paid a total of $1,980 in taxes, with interest. In this example, at year 48, the initial deposit of $380 has grown to $3,866, but the bank investor has spent $1,980 in taxes. In that same year, the after-tax wealth of the forest owner is $2,681, ($3,866 less $1,185), while the bank depositor has $1,886.

Figure 3 shows the sum of annual taxes accumulated with interest to rotation age for accrued income and realized income taxpayers. Each vertical bar represents that year's accrued income tax compounded with interest to rotation age, plus all the previous years' accrued income taxes which have also been compounded with interest to rotation age. Thus, at rotation age, the vertical bar for accrued income taxes in Figure 3 represents the sum of accrued income taxes accumulated with interest. If capital gains taxes are paid upon realization, only one tax is paid at the end of the rotation. Note that at rotation-age, the sum of annual taxes accumulated with interest paid by the accrued income taxpayer is more than the tax paid by the realized income taxpayer.

In the previous examples, no inflation was assumed. If the inflation rate is greater than zero, the difference in taxes paid by realized income and accrued income taxpayers, in present value terms, will decrease. However, taxes paid upon gains realization will still be lower compared to those paid upon accrual, in present value terms.

The implication, therefore, is that because capital gains taxes are paid only upon gains realization, capital gains and other incomes are not taxed equally. Capital gains recipients eventually pay less tax, other things equal. Hence, the tax does not meet the equity criterion requiring realized capital gains to pay, at investment maturity, taxes equal to the sum of annual taxes accumulated with interest paid by annually received incomes. The tax is, therefore, biased in favor of capital gains recipients over those who receive incomes annually.

However, one must guard against making forest tax policy prescriptions based on comparison of timber with a savings account, as in Table 10. Since the savings account principal is contractually fixed, when tax rates increase sufficiently, banks must eventually offer higher interest to attract the same amount of savings. On the other hand, given a competitive projected stumpage price, if income taxes increase, the forest land value will decrease in order for the investor to earn an acceptable after-tax rate of return, given the competitive assumptions made here. Thus, it is important to examine the percentage tax-induced reduction in the theoretical no-tax bid price for land under different tax systems. A neutral tax, which would not distort the theoretically optimal



Interest rate: 3%
Asset growth rate: 4.95%
Capital gains tax rate: 34%
Inflation rate: 0%

Figure 3. Comparison of accumulated taxes paid by accrued income and realized income taxpayers at rotation age

market allocation of land to different uses, would reduce, by the same percent, the bid price which alternative uses could make for the same tract. In that case, the best use before taxes would remain best after taxes. This is the basis for this study's second equity criterion dealing with the effect of the tax on allocation of land to different uses.

Table 11 shows the percent tax-induced reduction in MAXPAY values for bare land, assuming uses with different payoff periods and assuming that capital gains are taxed upon realization. These values were derived using Equation 4.11. Equation 4.11 was derived from Equation 4.7 below.

$$PCTRED = \frac{BL_b - BL_a}{BL_b} (100) \qquad [4.7]$$

where

$PCTRED$ = percent reduction in MAXPAY value of bare land;

BL_b = before-tax MAXPAY value for bare land;

BL_a = after-tax MAXPAY value for bare land.

Assuming no other cost but reforestation cost, and assuming that land will not be sold at rotation age, BL_b and BL_a have the following forms:

$$BL_b = \frac{H - E(1+r)^R}{(1+r)^R - 1} \qquad [4.8]$$

$$BL_a = \frac{H - t\left[H - \dfrac{E}{(1+f)^R}\right] - E(1+r)^R}{(1+r)^R - 1} \qquad [4.9]$$

where

t = capital gains tax rate, in decimals;

E = forest establishment cost at year 0;

f = inflation rate, in decimals;

H = harvest revenue at rotation age, R, in constant dollars;

Table 11. Percent reduction (PCTRED) in MAXPAY for bare land in uses with different rotations due to the current federal income tax

				Establishment Cost-Pre-tax MAXPAY Ratio (E / BL_b)							
f*	t	r	R	0	0.1	0.4	0.8	1	4	7	10
0	34	3	1	34	37	48	61	68	170	272	374
			5	34	37	48	61	68	170	272	374
			10	34	37	48	61	68	170	272	374
			20	34	37	48	61	68	170	272	374
			30	34	37	48	61	68	170	272	374
			40	34	37	48	61	68	170	272	374
			50	34	37	48	61	68	170	272	374
			60	34	37	48	61	68	170	272	374
5	34	3	1	34	43	69	104	121	386	650	914
			5	34	42	66	98	114	355	595	836
			10	34	41	63	92	106	323	539	756
			20	34	40	58	82	94	275	456	637
			30	34	39	55	76	86	243	400	557
			40	34	39	53	72	81	222	362	503
			50	34	38	51	69	77	207	336	466
			60	34	38	50	66	75	196	318	440
5	34	6	1	34	40	58	83	95	278	461	644
			5	34	40	56	79	90	257	424	592
			10	34	39	54	74	85	236	388	540
			20	34	38	51	69	78	208	339	470
			30	34	38	50	66	74	192	311	429
			40	34	38	49	64	71	183	294	405
			50	34	38	48	63	70	177	284	392
			60	34	38	48	62	69	174	279	384

*f is inflation rate in %
t is capital gains tax rate in %
r is real interest rate in %
R is rotation age in years
Tabular values of Table 11 were derived using Equation 4.11.
MAXPAY is maximum willingness to pay for bare land.

r = interest rate, in decimals;

R = rotation age, in years.

Substituting BL_b and BL_a into Equation 4.7 and simplifying the results after substituting in, further, the value for H solved from Equation 4.8, gives the following equation for percent reduction (PCTRED) in MAXPAY values caused by taxing capital gains upon realization:

$$PCTRED = \frac{t\,BL_b\left[(1+r)^R - 1\right] + t\,E\,(1+r)^R - \dfrac{t\,E}{(1+f)^R}}{BL_b\left[(1+r)^R - 1\right]}\,(100) \qquad [4.10]$$

Dividing the numerator and denominator of Equation 4.10 by BL_b gives Equation 4.11, from which values in Table 11 were derived.

$$PCTRED = \frac{t\left[(1+r)^R - 1\right] + \dfrac{t\,E}{BL_b}\left[(1+r)^R - \dfrac{1}{(1+f)^R}\right]}{(1+r)^R - 1}\,(100) \qquad [4.11]$$

where all variables are as defined previously. If inflation is zero, which has the same effect as that of allowing basis indexing when the inflation rate is greater than zero, percent reduction in MAXPAY for bare land is given by Equation 4.12.

$$PCTRED\ (when\ f = 0) = \left[t + \frac{t\,E}{BL_b}\right](100). \qquad [4.12]$$

This shows that, without inflation, capital gains taxes paid upon realization reduce the bid prices of bare land for land uses with different rotations at equal percentages, all other things equal. This is also shown by the top portion of Table 11 where the inflation rate is zero. At any given value for the ratio of establishment cost to pre-tax bid price for land, percent reduction in bid price is the same for all rotations. The results mean that, without inflation, and with all other things equal, two land uses that differ in rotation lengths, but have the same pre-tax bid for the same piece of land, will also have the same after-tax bid for the land, when capital gains taxes are paid upon gains realization. Without inflation, therefore, the current federal income tax law is neutral with respect to allocation of land to land uses with different rotations, all other things equal.

When inflation is greater than zero, however, Table 11 shows that the percent reduction in MAXPAY for bare land of uses with long rotations are slightly lower than those with short rotations. This implies that inflation affects the measurement of capital gains taxes unevenly for different payoff periods such that there now appears a distortion in favor of long-term land uses, with all other things equal. In this sense, inflation caused the current federal income tax law to be non-neutral with respect to allocation of land to uses with different rotations to favor land uses with long rotations, given other things equal.

Table 11 also shows that for a given rotation, percent reduction in bid price increases as the ratio of the establishment cost to the pre-tax land bid price increases. This means that, other things equal, the current income tax law is biased against land uses with high establishment costs. The results in Table 11 imply that, other things equal, when inflation is greater than zero, the current federal income tax will be slightly biased in favor of land uses with long rotations. This bias, as shown in Table 11 and in Equation 4.11, can be removed by allowing basis indexing since basis indexing, in effect, makes the inflation rate equal to zero.

Results of the study show that no single tax structure can treat all assets equally because equity criteria can vary. In this study, two equity criteria were used. One equity criterion (Criterion One) dealt with the effect of the tax on allocation of land to various uses. The tax is said to be equitable or neutral if the before-tax allocation of land to various uses is maintained after the tax is imposed. This happens if the percentage tax-induced reductions in bid prices for all land uses are the same, given other things equal. The other equity criterion (Criterion Two) was based on after-tax wealth positions at investment maturity of realized income and accrued income taxpayers, other things equal for both taxpayers. This criterion requires that, other things equal, taxes paid on realized capital gains should equal taxes paid on accrued income accumulated with interest to investment maturity.

A tax that satisfies one equity criterion sometimes does not satisfy other criteria. For example, taxing capital gains upon accrual (as in the accrued income tax) satisfies Criterion Two regarding after-tax wealth positions of realized and accrued income taxpayers at investment maturity. It, however, does not meet Criterion One which deals with neutrality with respect to allocation of land to different uses. On the other hand, taxing capital gains upon realization (the current federal income tax structure) satisfies Criterion One with respect to allocation of land to uses with different payoff periods, when there is no inflation. Even when inflation is greater than zero, the current federal income tax can maintain said neutrality under Criterion One by allowing basis indexing. However, the current federal income tax does not meet Criterion Two regarding after- tax wealth positions at investment maturity of realized capital gains and accrued income taxpayers.

CHAPTER V

SUMMARY AND CONCLUSIONS

1. Scope of the Study

The main objective of the study was to determine potential effects of various capital gains tax structures on decisions to invest in new forest investments. This was achieved by measuring and comparing the net present values of a forest investment under various capital gains tax structures modeled here. The effects on these present values of payoff periods, interest rates, inflation rates, capital gains tax rates, and tax treatment of fertilization costs, were also determined. The forest investment is an acre of bare land which may be planted with White pine for Christmas trees, or Douglas fir for timber production. The capital gains tax structures modeled were:

1. The current federal income tax law without basis indexing;
2. The current federal income tax law with basis indexing: regardless of the tax rates, the cost basis is indexed to inflation before taxable capital gain is determined;

3. Equivalent realized income tax method (ERITAX Method): a variant of the accrued income tax where the basis is indexed to inflation but timber harvesters pay at the capital gains tax rate (the ERITAX rate) that will yield the equivalent yearly accrued income taxes accumulated with interest to rotation age. Thus, the rotation-start present values of taxes collected by the ERITAX Method and the yearly accrued income tax are equal.

In addition, the following capital gains and ordinary income tax rate combinations were modeled for each of the three capital gains tax structures:

1. No income taxes;
2. The current federal income tax rates where corporations pay income taxes at 34% on ordinary income and capital gains;
3. Corporate capital gains tax rates decrease to 20% while ordinary income tax rates remain at 34%;
4. Capital gains are taxed higher than ordinary income, such as 46% for capital gains and 34% for ordinary income.

Each one of the capital gains tax structures were modeled with three real interest rates (3%, 6%, 9%) and three inflation rates (0%, 5%, 15%). For each combination of a capital gains tax structure, tax rate, interest rate, and inflation rate, two species (White pine for Christmas trees and Douglas fir for timber production) were used. For White pine, one management regime and one fixed rotation (10 years) were assumed.

For Douglas fir, two management regimes (Plant and Clearcut; Plant, Fertilize, and Clearcut) were used. In addition, Douglas fir's optimal rotation was allowed to change in response to changes in any factor in the models.

Major assumptions of the study include the following:

1. That discounted cash flows are acceptable measures of income tax impacts to the forest owner or buyer.
2. That both prospective buyers and current owners want to maximize their wealth which is assumed to be the net present value of all future cash flows.
3. That the effects of capital gains taxes are fully passed back to lower asset values of affected investments. This is a short-term view where prices are unaffected by taxes, and asset values are reduced by the present value of the taxes.
4. That positive inflation is expected by both buyers and current owners.
5. That both buyers and current owners consider only first-round effects of changes in any variable in the models.
6. That stands of both species are even-aged. Also, that for the land in question, forestry gives the highest net present value, before taxes.

2. Results and Conclusions

The following are the general results and conclusions of the study:

When capital gains tax rates and inflation rates are positive, and with all other things equal, net present values of bare land are higher with basis indexing than without basis indexing. This difference in net present values for any given set of factors is due to the present value of tax savings from basis indexing. Net present values of the same investment are much lower under the accrued income tax as compared to values under the current tax structure without basis indexing. This is because the sum of the present values of taxes collected upon accrual is higher than the present value of one lump sum tax collected when gains are realized, even when the capital gains tax rate applied in both cases is the same, with all other things equal.

When interest rates increase, and with all other things equal, maximum willingness to pay for bare land decreases. This negative effect of increasing interest rates on maximum willingness to pay for the investment is lessened somewhat by basis indexing. It is made worse by the accrued income tax. Thus, keeping all other factors constant, basis indexing gives higher net present values for the investment than no basis indexing when interest rates increase.

The optimal rotation of Douglas fir is not very sensitive to increases in capital gains tax rates. Under the assumptions of this study, and with all other things equal, Douglas fir's rotation without any capital gains tax was 48 years. When the capital gains tax rate was increased to 46%, the optimal rotation lengthened by only three additional years. Chang (1982) reached a similar conclusion about the effect of forest taxation on optimal rotation age.

Expensing the fertilization cost in the year it was incurred gave the highest net present values of the three tax treatments for fertilization cost modeled here, all other things equal. Capitalizing the cost as part of the cost basis had the lowest present values for the investment, everything else the same. Maximum willingness to pay for bare land under the amortization and capitalization schemes did not differ significantly. However, this difference might become significant if fertilization cost is very high relative to other costs in the model. Although these tax treatments of costs were modeled only with fertilization cost, the same conclusion about their effects on net present values of investments may be drawn when other cost items are used.

Results show that basis indexing will not benefit all forest investments equally. At any given inflation rate, capital gains tax rate, and interest rate, tax savings from basis indexing per dollar of cost basis increase, reach a maximum, and then decrease as holding periods of assets increase. The length of the holding period that maximizes the tax savings per dollar of cost basis decreases as the interest rate, or the inflation rate, increases, all other things equal. For a capital gains tax rate of 34%, inflation rate of 5%, and interest rates ranging from 3% to 9%, the holding period that maximizes tax savings per dollar of cost basis ranges from 10 to 20 years (see Table 7). Similar results have also been reported by Bullard and Klemperer (1986) and Klemperer and O'Neil (1987). Klemperer and O'Neil (1987) emphasized further that assets with payoff periods close to one year or less do not benefit from basis indexing. Also, basis indexing does not give much benefit when inflation rates are close to zero.

These results imply that for most likely conditions of interest rates and inflation rates, and for most long-term reforestation investments like sawtimber, basis indexing cannot significantly increase incentives to invest. If maximum willingness to pay for an investment with a payoff period that is considerably longer than 20 years is low to begin with, basis indexing will not improve maximum willingness to pay significantly. Also, with investments other than in forestry, it cannot serve as an incentive for gains realization when assets had been already held for longer than 20 years. These results do not support the clamor for basis indexing based on the argument that the longer the investment is exposed to inflation, the more it needs basis indexing for relief. The results above about basis indexing and the following findings from the ERITAX method are the most significant conclusions of this study.

Two equity criteria were used in comparing the tax burden on different assets. The first equity criterion (Criterion One) requires the tax to cause equal percent reductions in bid prices for land in various land uses. The second equity criterion (Criterion Two) requires realized capital gains to pay, at investment maturity, taxes equal to the sum of annual taxes on increases in asset value, (accumulated with interest), thereby creating the same tax burden borne by savings accounts. Under Criterion One, whether there is inflation or not, it was shown that the current federal income tax law is biased against land uses with high establishment costs, other things equal. When there is no inflation, it was shown that the current income tax law is neutral with respect to allocation of land to land uses with different rotations, other things equal. This means that two land uses generating the same pre-tax bid price for a given tract and differing only in rotation lengths will also generate equal after-tax bids under the realized income tax. When inflation is greater than zero, however, land uses with long rotations showed lower percent reductions in after-tax bid prices, other things equal. This implies that inflation affects the measurement of capital gains taxes differently for different payoff periods. This further suggests that correction for this uneven effects of inflation is needed in order to maintain the neutrality of the tax with respect to allocation of land to uses with different rotations.

Using Criterion Two, Table 10 in Chapter IV shows that taxing capital gains upon realization favors capital gains over other incomes. This is due to the tax deferral benefits of taxing capital gains only upon realization. In order for the deferred income taxpayers to pay the same tax revenues as the accrued income taxpayers paid ($1980.50), they should be paying at the ERITAX rate of 57%, given the 48 year rotation example. Under current federal income tax law, however, they pay at the same annual accrued income tax rate of only 34%.

In another plantation example, it was assumed that capital gains and ordinary income were taxed at the current corporate rate of 34%. No inflation was assumed. Given exactly equal original investments, asset value growth rates, payoff periods and discount rates, the realized capital gains taxpayer attained a higher after-tax wealth than the ordinary income taxpayer at investment maturity. In taxes accumulated with interest to rotation-age, the realized capital gains taxpayer paid a lower tax than the accrued income taxpayer. This was shown in Figure 3 of Chapter IV.

These results lead to the conclusion that under the second equity criterion, the current federal income tax law is biased in favor of capital gains taxpayers over ordinary income taxpayers who pay taxes upon accrual. The current tax law allows capital gains taxpayers to defer tax payments until gains are realized. They also pay at the same tax rate as the accrued income taxpayers. Because capital gains recipients do not pay taxes on the yearly appreciation in their assets, and because they are not charged for deferring tax payments to the time of their own choosing, they eventually attain better after-tax wealth positions than those who pay annual taxes as these accrue, even given the same initial wealth, asset growth rate, tax rate and holding periods. Given exactly the same conditions, and where the capital gain tax rate is greater than zero and the payoff period is at least two years, capital gains taxpayers eventually pay less taxes than the ordinary income taxpayers, in present value terms, assuming an interest rate greater than zero.

The above conclusion was reached using examples that assumed no inflation. When inflation is greater than zero, the difference in taxes paid, in present value terms, between the realized capital gains taxpayer and the accrued income taxpayer will become smaller. However, the accrued income taxpayer will still pay a higher tax, other things equal. Considering assets not related to land use, this bias in favor of realized capital gains over incomes received annually results in economic inefficiency because it distorts the market allocation of resources between assets that give rise to capital gains and those that give ordinary income.

A related conclusion that may be drawn is that, under current federal income tax laws, capital gains, including timber capital gains, already receive a substantial benefit from tax deferral compared to assets realizing annual incomes. Reduction of capital gains tax rates below ordinary income tax rates, or exclusion of portions of capital gain from taxation will make the current federal income tax structure even more biased in favor of capital gains over ordinary incomes.

If basis indexing is incorporated into the current federal income tax structure, the bias that existed without basis indexing in favor of capital gains taxpayers over ordinary income taxpayers will become larger. Tax savings due to basis indexing will be added to tax deferral benefits of both short-term and long-term capital gains especially when interest rates are very low. Thus, all other things equal, allowing basis indexing in the current income tax law will make the inequity in taxation between capital gains and ordinary income taxpayers worse. Equity is used here to mean that, given all else equal, equal amounts of income should pay equal amounts of taxes, in present value terms, regardless of income source. However, among capital gains taxpayers only, basis indexing has efficiency-improvement aspects. Recall that, when capital gains are taxed upon gains realization, greater tax deferral benefits go to assets that had been held longer. Basis indexing, by giving maximum tax savings to assets with payoff periods ranging from 20 years to 10 years, will lessen this disparity in taxation between short-term and long-term capital gains. Also, under the first equity criterion, when inflation is greater than zero, basis indexing is needed in order to maintain the realized income tax's neutrality with respect to allocation of land to uses with different rotations.

Based on the above, taxing capital gains upon realization, as in the current federal income tax, does not meet the second equity criterion. However, it satisfies the first equity criterion with respect to allocation of land to uses with different payoff periods, when there is no inflation, other things equal. Even when inflation is greater than zero, the current federal income tax can be made to maintain said neutrality by allowing basis indexing, other things equal.

In order for the current federal income tax to meet the second equity criterion, capital gains should be taxed as they accrue, whether annually or in one lump sum using the equivalent realized income tax rate. The tax then effectively becomes an accrued income tax, which was shown to function like a property tax. Thus, the accrued income tax, like the property tax, is biased against land uses with long holding periods, high establishment costs or high annual costs (Klemperer, 1982). It will cause inefficiency due to distortion in the choice of land uses in favor of less capital-intensive investments with shorter holding periods and lower annual costs. Because most forest investments are long term in nature, it is likely that, based on present values, an accrued income tax will bear more heavily on timber than on many competing short-term land uses. Thus, an accrued income tax on timber might reduce some after-tax bare land values to zero or less. (This was actually shown by the empirical results in Chapter III.) In some cases, forest lands with such low present values might be taken out of forestry and moved to the next best land use, when, indeed, the socially most valuable use was forestry.

All three capital gains tax structures modeled show a bias against one or more types of taxpayers. A tax on accrued income from an appreciating capital asset will accumulate to the same amount as the current ordinary income tax on a savings account, *ceteris paribus*. However, because it functions like a property tax, the accrued income tax is non-neutral with respect to allocation of land to different uses (Klemperer, 1982). (A neutral tax in this regard would not change the before-tax land use pattern.) Based on previous discussion, the accrued income tax is likely to be biased against forest investments. Under this tax structure, the area devoted to forestry is likely to be less than the optimal allocation under a neutral tax. Also, when rotations are long and capital gains tax rates are high, the accrued income tax on timber can reduce present values of bare land to zero or less, driving land out of forestry. This result suggests a need to measure the net effects to the economy of this reallocation of resources under an accrued income tax.

Based on the effect of the tax on allocation of land to uses with different rotations but similar establishment costs, the current federal income tax was shown to be neutral, when there is no inflation. This means that, other things equal, the percent reduction in bid prices for bare land, due to the tax, is the same for all land uses that vary only in rotation length. Thus, under this tax, when there is no inflation, the after-tax allocation of land to forestry will tend to be similar to the before-tax allocation relative to competing land uses. When inflation is greater than zero, however, land uses with long rotations show lower percent reductions in bid prices due to the tax. This implies that inflation has an uneven effect on the impact of capital gains taxes on assets with varying payoff periods. Under inflation, the realized income tax is biased in favor of land uses with long rotations. This result suggests that in order to maintain the tax's neutrality with respect to allocation of land to uses with different rotations, the effects of inflation should be removed. This can be achieved by allowing basis indexing under the current federal income tax law.

Based on the foregoing, it can be concluded that it is difficult for any tax structure to simultaneously meet the two equity criteria examined in this study. One criterion (Criterion One) was based on the tax-induced percent reduction in bid prices (or maximum willingness to pay) for bare land for various land uses. The other equity criterion (Criterion Two) was based on taxpayers' after-tax wealth positions at investment maturity. No tax structure modeled here was able to satisfy the two criteria simultaneously. The accrued income tax satisfies Criterion Two but does not satisfy Criterion One. The current federal income tax satisfies Criterion One, when there is no inflation, but does not satisfy Criterion Two. When basis indexing is incorporated into the current federal income tax, the tax satisfies Criterion One, even when inflation is greater than zero, but still does not satisfy Criterion Two. However, of the three tax structures modeled here, the current federal income tax law with basis indexing is least likely to distort the market allocation of land to forestry.

In general, the choice of a tax structure depends on policy objectives of the tax. For example, policy objectives determine whether it is more important for the tax to satisfy Criterion One or Criterion Two, as the case may be. Since the tax cannot satisfy both criteria at the same time, there are net efficiency effects to society when one criterion is chosen over another. It is socially desirable to choose the criterion that gives the least net losses when compared to other criteria. General equilibrium studies are needed in order to measure the net gains or losses, economy-wide, when following alternative equity criteria.

3. Future Research

The study's empirical examples focused on 10 years as a short payoff period. It is worthwhile investigating the results of examining land uses with payoff periods shorter than 10 years under different capital gains tax structures.

Forest investments usually have longer payoff periods than other types of investment. Because of this, they are exposed to risks for a relatively longer time. Another area of possible study, therefore, is on how risk affects present values of investments under each capital gains tax structure.

More research is needed to develop a general equilibrium approach for analyzing economy-wide impacts of tax alternatives. A general equilibrium model would entail a much longer time and require more data. It would, however, undoubtedly settle questions about how different sectors will respond to changes in capital gains tax structures. A general equilibrium model might show that lower present values and investments in forestry under certain tax alternatives would be offset by higher asset values in other sectors. If the supply of capital is unchanged in the economy, investments lost by the forestry sector will be invested elsewhere. A general equilibrium model might be able to show whether such a transfer of capital would result in greater economic output. General equilibrium analysis supports the partial equilibrium results of reduction in land value when capital gains tax rates increase. However, general equilibrium models allow further analysis of relative gains and losses of certain sectors in the economy. It may be of interest to develop a general equilibrium model which can be used to analyze potential effects of moving from the current federal income tax to an accrued income tax.

This study also showed that the after-tax present values of a forest investment under the accrued income tax can be zero or less for certain combinations of timber value growth rate, interest rate, capital gains tax rate and rotation. Because of these low present values, forest bare land values might be driven below values in alternative uses. It would be interesting to know whether capital intensive sectors, including the forestry sector, would suffer from flight of capital if capital gains were taxed upon accrual. Again, knowing the sectors that gain or lose capital is important. Perhaps, a general equilibrium model could show, after some period of adjustment in all sectors, the degree to which changes in capital gains tax structures would affect the level of sectoral investments. Such results would be of great use for national and regional planning.

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Appendix A. CHRISTMAS TREES

DATA ASSUMPTIONS

A. Original number of trees per acre = 1080

B. Total mortality up to sixth year = 324 (30% of 1080)

C. Total number of stems sold = 648 (60% of 1080)

D. Number of unacceptable stems = 108 (10% of 1080)

E. First year establishment costs (1080 seedlings):

1. Land cultivation/acre = $85

2. Establishment cost/seedling

a. site preparation = .05

b. seedling cost = .04

c. planting cost = .07

d. mowing cost = .03

e. fertilizer cost = .03

Total/seedling = $0.22

F. Second year establishment costs (300 seedlings)

a. seedling cost = .04

b. planting cost = .07

c. fertilizer cost = .03

Total/seedling = $0.14

G. Other costs and revenues per tree from year 1 to year 10

Table A.1 shows the yearly costs and revenues per tree from year 1 to year 10. The price/tree shown in the table is already net of the $1 harvest cost per tree.

Table A.1. Assumed annual costs and revenues of Christmas trees from year 1 to year 10

Age	No. of Trees	Cost/Tree ($)							Price/ Tree	Stems Sold
		SH	HB	MW	BC	FT	IN	AC		
1	1080	.04							0	0
2	1080	.04	.05	.03					0	0
3	980	.04	.05	.03					0	0
4	880	.08	.05	.03	.01				0	0
5	805	.10	.05	.03			.02		0	0
6	755	.12	.05	.03		.03			5	65
7	690	.18	.05	.03					7	162
8	528	.22	.05	.03	.01			.16	9	292
9	236	.26		.03					9	97
10	139	.26		.03					9	32

SH is shearing cost; HB is herbicide cost; MW is mowing cost; BC is brush clearing cost.
FT is fertilizer cost; IN is insecticide cost; AC is artificial color cost.

Appendix B. DOUGLAS FIR

DATA ASSUMPTIONS

For the most part, the timing of optional management practices followed recommendations from DFSIM.

A. Cost assumptions/acre

1. Establishment cost = \$300 + (\$0.10 x number of trees/acre)

2. Fertilization cost = \$200

4. Annual administration cost = \$3

B. Revenue assumptions

Selling price/mbf = \$200 for 16-foot logs with scaling diameter of 20 inches or larger

C. Taper assumption: 2 inches per 16-foot log

For scaling diameters below 20 inches but greater than 7 inches, the price decreases by 2.5% for every inch below 20 inches.

Appendix C. CONVERSION FORMULA

DERIVATION OF CUBIC FOOT-BOARD FOOT CONVERSION FORMULA

The formula made use of data from the table below which is copied from the Forestry Handbook, Second Edition, (Karl E. Wenger, Editor). Making use of values under the columns for 'Diameter' and 'Scribner' under 'Board feet per cubic foot', ordinary least squares regression resulted in the equation

$$Bdft/cuft\ ratio \;=\; 4.1760 + 0.108\,(Scaling\ \ Diameter).$$

DFSIM gives yield values in cubic feet and DBH instead of scaling diameters. The available price figure is in thousand board feet units based on scaling diameters. Hence, the taper assumption was used to convert DBH to scaling diameter.

Given yield in cubic feet, it may be converted to thousand board feet units by putting the cubic feet volume in the following equation:

$$mbf \;=\; \frac{[\;cu\,ft\ \ volume\;]\;[\;4.1760 + 0.108\,(Scaling\ \ Diameter)\;]}{1000}$$

Table C.1. Comparison of board-foot volumes and board-foot-cubic-foot ratios for three log rules (16-ft logs)

Diameter	Volume	Volume in bd ft			Bd ft per cu ft		
(in)	cu ft	Doyle	Scribner	Inter-$\frac{1}{4}$	Doyle	Scribner	Inter-$\frac{1}{4}$
6	4.3	4	18	20	0.92	4.13	4.59
8	7.1	16	32	40	2.23	4.47	5.59
10	10.6	36	50	65	3.38	4.70	6.11
12	14.8	64	79	95	4.32	5.24	6.42
14	19.7	100	114	135	5.08	5.78	5.85
16	25.3	144	159	180	5.69	6.28	7.11
18	31.5	196	213	230	6.22	6.76	7.30
20	38.5	256	280	290	6.65	7.27	7.53
25	59.0	441	459	460	7.47	7.78	7.80
30	83.9	676	657	675	8.06	7.83	8.05
35	113.1	961	876	925	8.50	7.75	8.18
40	146.7	1296	1204	1220	8.83	8.21	8.32
45	184.7	1681	1518	1550	9.10	8.22	8.39

Source: Forestry Handbook, 1984. (Karl E. Wenger, editor)

Appendix D. SIMULATION RESULTS (DOUGLAS FIR)

SENSITIVITY OF MAXPAY FOR BARE LAND TO CHANGING GIVEN FACTORS

Management Regime 1 (Plant, Clearcut)

Site: SI = 100 (base age 50)

Table D.1. Impacts on MAXPAY for bare land and on rotation of capital gains tax structures at various interest rates

Species: Douglas fir
MR1 (Plant and Clearcut)
SI = 100 (b.a. 50)
Density = 800 trees/ac.

Inflation rate : .05

Tax Rates	Capital Gains Tax Structures		
Capital Gain/ Ordinary Income	No Indexing	Simple Indexing[1]	ERITAX[2] Method
A. Effects on MAXPAY	$/ac.	$/ac.	$/ac.
Interest rate: .03			
.00/.00	633	633	633 (.00)*
.20/.34	367	410	261 (.33)
.34/.34	199	254	.70 (.57)
.46/.34	64	121	-222 (.77)
Interest rate: .06			
.00/.00	-180	-180	-180 (.00)
.20/.34	-232	-230	-322 (.57)
.34/.34	-268	-265	-422 (.97)
.46/.34	-298	-295	-432 (1.31)
Interest rate: .09			
.00/.00	-342	-342	-342 (.00)
.20/.34	-356	-356	-413 (1.13)
.34/.34	-366	-366	-413 (1.92)
.46/.34	-375	-375	-414 (2.59)

continued

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.

Table D.1 continued

Tax Rates Capital Gain/ Ordinary Income	Capital Gains Tax Structures No Indexing	 Simple Indexing[1]	 ERITAX[2] Method
B. Effects on Rotation	Years	Years	Years
Interest rate: .03			
.00/.00	48	48	48 (.00)*
.20/.34	48	48	48 (.33)
.34/.34	49	48	48 (.57)
.46/.34	51	48	48 (.77)
Interest rate: .06			
.00/.00	43	43	43 (.00)
.20/.34	43	43	43 (.57)
.34/.34	43	43	43 (.97)
.46/.34	43	43	99 (1.31)**
Interest rate: .09			
.00/.00	43	43	43 (.00)
.20/.34	43	43	99 (1.13)
.34/.34	43	43	99 (1.92)
.46/.34	43	43	99 (2.59)

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
**Rotation ages greater than 60 years are based on unreliable extrapolations of yield values.
MAXPAY is maximum willingness to pay for bare land.

Table D.2. Impacts on MAXPAY for bare land and rotation of capital gains tax structures at various inflation rates

Species: Douglas fir
MR1 (Plant and Clearcut)
SI = 100 (b.a. 50)
Density = 800 trees/ac.

Interest rate : .03

Tax Rates	Capital Gains Tax Structures		
Capital Gain/ Ordinary Income	No Indexing	Simple Indexing[1]	ERITAX[2] Method
A. Effects on MAXPAY	$/ac.	$/ac.	$/ac.
Inflation rate: .00			
.00/.00	633	633	633 (.00)*
.20/.34	410	410	261 (.33)
.34/.34	254	254	.70 (.57)
.46/.34	121	121	-222 (.77)
Inflation rate: .05			
.00/.00	633	633	633 (.00)
.20/.34	367	410	261 (.33)
.34/.34	199	254	.70 (.57)
.46/.34	64	121	-222 (.77)
Inflation rate: .15			
.00/.00	633	633	633 (.00)
.20/.34	364	410	261 (.33)
.34/.34	194	254	.70 (.57)
.46/.34	60	121	-222 (.77)

continued

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.

Table D.2 continued

Tax Rates	Capital Gains Tax Structures		
Capital Gain/ Ordinary Income	No Indexing	Simple Indexing[1]	ERITAX[2] Method
B. Effects on Rotation	Years	Years	Years
Inflation rate: .00			
.00/.00	48	48	48 (.00)*
.20/.34	48	48	48 (.33)
.34/.34	48	48	48 (.57)
.46/.34	48	48	48 (.77)
Inflation rate: .05			
.00/.00	48	48	48 (.00)
.20/.34	48	48	48 (.33)
.34/.34	49	48	48 (.57)
.46/.34	51	48	48 (.77)
Inflation rate: .15			
.00/.00	48	48	48 (.00)
.20/.34	49	48	48 (.33)
.34/.34	50	48	48 (.57)
.46/.34	51	48	48 (.77)

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
**Rotation ages greater than 60 years are based on unreliable extrapolations of yield values.
MAXPAY is maximum willingness to pay for bare land.

Appendix E. SIMULATION RESULTS (DOUGLAS FIR)

SENSITIVITY OF MAXPAY FOR BARE LAND TO CHANGING GIVEN FACTORS

Management Regime 2 (Plant, Fertilize, Clearcut)

Site: SI = 100 (base age 50)

Table E.1. Impacts on MAXPAY for bare land and on rotation of capital gains tax structures at various interest rates

Species: Douglas fir
MR2 (Plant, Fertilize and Clearcut)
Fertilization at age 35
SI = 100 (b.a. 50)
Density = 800 trees/ac.

Inflation rate : .05

Tax Rates	Capital Gains Tax Structures		
Capital Gain/ Ordinary Income	No Indexing	Simple Indexing[1]	ERITAX[2] Method
A. Effects on MAXPAY	$/ac.	$/ac.	$/ac.
Interest rate: .03			
.00/.00	642	642	642 (.00)*
.20/.34	402	465	305 (.33)
.34/.34	258	295	- 23 (.56)
.46/.34	100	149	-219 (.76)
Interest rate: .06			
.00/.00	-183	-183	-183 (.00)
.20/.34	-218	-212	-308 (.55)
.34/.34	-261	-250	-414 (.93)
.46/.34	-298	-283	-440 (1.26)
Interest rate: .09			
.00/.00	-343	-343	-343 (.00)
.20/.34	-346	-345	-409 (1.06)
.34/.34	-359	-356	-410 (1.80)
.46/.34	-370	-365	-412 (2.44)

continued

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.

Table E.1 continued

Tax Rates	Capital Gains Tax Structures		
Capital Gain/ Ordinary Income	No Indexing	Simple Indexing[1]	ERITAX[2] Method
B. Effects on Rotation	Years	Years	Years
Interest rate: .03			
.00/.00	48	48	48 (.00)*
.20/.34	48	48	48 (.33)
.34/.34	49	48	48 (.56)
.46/.34	50	48	49 (.76)
Interest rate: .06			
.00/.00	42	42	42 (.00)
.20/.34	42	42	42 (.55)
.34/.34	42	42	42 (.93)
.46/.34	42	42	99 (1.26)**
Interest rate: .09			
.00/.00	42	42	42 (.00)
.20/.34	42	42	99 (1.06)
.34/.34	42	42	99 (1.80)
.46/.34	42	42	99 (2.44)

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
**Rotation ages greater than 60 years are based on unreliable extrapolations of yield values.
MAXPAY is maximum willingness to pay for bare land.

Table E.2. Impacts on MAXPAY for bare land and on rotation of capital gains tax structures at various inflation rates

Species: Douglas fir
MR2 (Plant, Fertilize and Clearcut)
Fertilization at age 35
SI = 100 (b.a. 50)
Density = 800 trees/ac.

Interest rate : .03

Tax Rates	Capital Gains Tax Structures		
Capital Gain/ Ordinary Income	No Indexing	Simple Indexing[1]	ERITAX[2] Method
A. Effects on MAXPAY	$/ac.	$/ac.	$/ac.
Inflation rate: .00			
.00/.00	641	641	641 (.00)*
.20/.34	398	398	239 (.33)
.34/.34	228	228	- 43 (.56)
.46/.34	82	82	-294 (.76)
Inflation rate: .05			
.00/.00	641	641	641 (.00)
.20/.34	356	398	239 (.33)
.34/.34	175	228	- 43 (.56)
.46/.34	30	82	-294 (.76)
Inflation rate: .15			
.00/.00	641	641	641 (.00)
.20/.34	353	398	239 (.33)
.34/.34	171	228	- 43 (.56)
.46/.34	27	82	-294 (.76)

continued

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.

Table E.2 continued

Tax Rates Capital Gain/ Ordinary Income	Capital Gains Tax Structures: No Indexing	Simple Indexing[1]	ERITAX[2] Method
B. Effects on Rotation	Years	Years	Years
Inflation rate: .00			
.00/.00	48	48	48 (.00)*
.20/.34	48	48	48 (.33)
.34/.34	48	48	48 (.56)
.46/.34	48	48	48 (.76)
Inflation rate: .05			
.00/.00	48	48	48 (.00)
.20/.34	48	48	48 (.33)
.34/.34	49	48	48 (.56)
.46/.34	50	48	49 (.76)
Inflation rate: .15			
.00/.00	48	48	48 (.00)
.20/.34	49	48	48 (.33)
.34/.34	50	48	48 (.56)
.46/.34	51	48	49 (.76)

[1]Basis indexing with tax on realized income.
[1]ERITAX is tax rate applied to realized income that yields taxes equal to accrued income taxes accumulated with interest.
*The numbers in parentheses are the corresponding ERITAX rates.
MAXPAY is maximum willingness to pay for bare land.

Appendix F. SIMULATION RESULTS (DOUGLAS FIR)

SENSITIVITY OF MAXPAY FOR BARE LAND TO CHANGING GIVEN FACTORS

Management Regime 2 (Plant, Fertilize, Clearcut)

Site: SI = 100 (base age 50)

Comparison of Fertilization Cost Treatment

Table F.1. Impacts on MAXPAY for bare land and on rotation of various tax rate combinations at various interest rates with varying fertilization cost treatment

Species: Douglas fir
MR2 (Plant, Fertilize and Clearcut)
Fertilization at age 35
SI = 100 (b.a. 50)
Density = 800 trees/ac.

Inflation rate : .05
Tax Scheme: No basis indexing

Tax Rates	Fertilization Cost Treatment	
Capital Gain/ Ordinary Income	Amortized	Capitalized
A. Effects on MAXPAY	$/ac.	$/ac.
Interest rate: .03		
.00/.00	641	641
.20/.34	362	356
.34/.34	184	175
.46/.34	41	30
Interest rate: .06		
.00/.00	-183	-183
.20/.34	-238	-240
.34/.34	-275	-279
.46/.34	-307	-312
Interest rate: .09		
.00/.00	-343	-343
.20/.34	-358	-359
.34/.34	-369	-370
.46/.34	-378	-380

MAXPAY is maximum willingness to pay for bare land.

Table F.1 continued

Tax Rates Capital Gain/ Ordinary Income	Fertilization Cost Treatment: Amortized	Fertilization Cost Treatment: Capitalized
B. Effects on Rotation	Years	Years
Interest rate: .03		
.00/.00	48	48
.20/.34	48	48
.34/.34	49	49
.46/.34	49	50
.34/.38	49	49
Interest rate: .06		
.00/.00	42	42
.20/.34	42	42
.34/.34	42	42
.46/.34	42	42
.34/.38	42	42
Interest rate: .09		
.00/.00	42	42
.20/.34	42	42
.34/.34	42	42
.46/.34	42	42
.34/.38	42	42

MAXPAY is maximum willingness to pay for bare land.

Table F.2. Potential impacts on MAXPAY for bare land and rotation of various tax rate combinations at various inflation rates with varying fertilization cost treatment

Species: Douglas fir
MR2 (Plant, Fertilize and Clearcut)
Fertilization at age 35
SI = 100 (b.a. 50)
Density = 800 trees/ac.

Interest rate : .03
Tax Scheme: No basis indexing

Tax Rates	Fertilization Cost Treatment	
Capital Gain/ Ordinary Income	Amortized	Capitalized
A. Effects on MAXPAY	\$/ac.	\$/ac.
Inflation rate: .00		
.00/.00	641	641
.20/.34	411	398
.34/.34	250	228
.46/.34	112	82
Inflation rate: .05		
.00/.00	641	641
.20/.34	362	356
.34/.34	184	175
.46/.34	41	30
Inflation rate: .15		
.00/.00	641	641
.20/.34	354	353
.34/.34	173	171
.46/.34	28	27

MAXPAY is maximum willingness to pay for bare land.

Table F.2 continued

Tax Rates	Fertilization Cost Treatment	
Capital Gain/ Ordinary Income	Amortized	Capitalized
B. Effects on Rotation	Years	Years
Inflation rate: .00		
.00/.00	48	48
.20/.34	48	48
.34/.34	47	48
.46/.34	47	48
Inflation rate: .05		
.00/.00	48	48
.20/.34	48	48
.34/.34	49	49
.46/.34	49	50
Inflation rate: .15		
.00/.00	48	48
.20/.34	49	49
.34/.34	50	50
.46/.34	50	51

MAXPAY is maximum willingness to pay for bare land.

Appendix G. GLOSSARY

accrued income tax - An annual tax on the change in asset value over the past year.

amortization - As used in this study, the practice of deducting from ordinary income over a given number of consecutive years, a portion of a cost until the total cost is recovered.

basis indexing - Process of allowing the cost basis to grow with inflation. All other things equal, basis indexing reduces the taxable capital gain.

capital gain - The difference between the final sale price of a capital asset and its cost basis. Under current federal income tax laws, capital gain is taxed only when the asset is sold, that is, when gain is realized.

capitalization - As used in this work, refers to holding a cost item and deducting it only from the final sale price of a capital asset before taxable capital gain is determined.

cost basis - The original purchase price of a capital asset; it is not deductible from ordinary income in the year it is incurred, under current federal income tax laws. It is also not allowed to grow with inflation. It is deducted from the revenue when the asset is sold. Note that if the asset is sold in year R, both the revenue and the cost basis would be in nominal dollars of year R. If there was inflation between year 0 and year R, the real value of the cost basis being deducted from the taxable capital gain is less than its value when it was incurred in year 0.

ERITAX - Equivalent realized income tax. This is a capital gains tax structure that uses the ERITAX rate as its capital gains tax rate. The ERITAX rate is the tax rate applied on capital gain when it is realized and which gives tax revenues with a rotation-start present value equal to the rotation-start present value of an accrued income tax up to rotation age.

expensing - the practice of deducting a cost from ordinary income in the year the cost is incurred prior to computation of taxable ordinary income

holding period - The length of time a capital asset is kept by an investor. Under prior capital gains tax laws, a capital asset must have been held for the required minimum holding period in order for capital gains to qualify for preferential tax treatment. Holding periods have been changed frequently, and in the United States, have varied from 6 months to 2 years.

MAXPAY - Maximum willingness to pay for any investment.

neutrality - When used in connection with a tax, neutrality refers to the effects the tax has on resource allocation. Assuming that before the tax is imposed, all resource uses have resource allocations relative to each other, imposition of a neutral tax will not change the before-tax relative allocation of resources to different resource uses. This means that a neutral tax will reduce present values of all resource uses in equal magnitudes.

payoff period - In this study, payoff period is used interchangeably with holding period and rotation.

simulation environment - A combination of any capital gains tax structure, tax rate, interest rate, inflation rate, payoff period, product price behavior, tax treatment of other costs, and management regime.

tax rate progression - In connection with bunched capital gains, tax rate progression is said to happen when one gets moved up to a higher tax bracket than what one would otherwise be in if capital gains did not bunch up.

timber depletion allowance - The capital expenses for buying and growing timber cannot be deducted from ordinary income of that year. It is put in a depletion account. When the depletion account is divided by the total yield at rotation, the depletion rate is found. When timber is not harvested all at one time, the depletion rate is used to find the depletion allowance. Multiplying the depletion rate and the volume harvested gives the depletion allowance which is then used like a cost basis to determine taxable capital gain. Meanwhile, the same depletion allowance is deducted from the original depletion account. The sum of all deducted depletion allowances can never exceed the original depletion account.

TXSAV - Rotation-start present value of tax savings from basis indexing.

Vita

Corazon L. Rapera was born 38 years ago in Lambunao, Iloilo, Philippines. She is currently a faculty member at the College of Forestry of the University of the Philippines at Los Banos, in College, Laguna, Philippines. She is also a licensed forester having passed the Forestry Licensure Examinations in 1973. She obtained her Bachelor of Science in Forestry *cum laude* and Master of Science in Forestry degrees from the University of the Philippines at Los Banos. Her masteral thesis was on the use of an integer linear programming model to simultaneously determine optimal locations for wood processing centers and their sources of raw materials in the Philippines.

She was a technical program specialist for the Forestry Research Division of the Philippine Council for Agriculture and Resources Research from 1972 until 1980. In 1980, she joined the UPLB College of Forestry as Researcher and Instructor. She taught Microcomputer Applications and Computer Mathematics at Longwood College in Farmville, Virginia in 1988 and 1989 while she was completing her Ph. D. program. She also taught middle school pre-algebra and high school geometry for six months in 1989.

She plans to go back to teach in the Philippines. She is interested in economics, applied statistics and operations research. She takes pride and joy in being married to Roberto B. Rapera, (Ph. D., Forest Resources Management, Univ. of Washington, 1980), with whom she has two children. Ranee Angeli is ten years old; Rainier Alexis is four years younger.