AN ABSTRACT OF THE THESIS OF

T. Lincoln Cannon for the degree of Master of Science in Forest Resources presented on December 9, 1991.

Title: A Comparison of Timber Tax Options Available to Western Oregon Small Nonindustrial Private Forest Land Owners

Abstract approved: Signature redacted for privacy. :d for privacy.
Rebecca L. Johnson

Most forests and timber in Western Oregon are taxed under the Western Oregon Forest Land and Severance Tax (WOST), a system which is accepted as one that promotes "correct" economic rotation lengths. This study was motivated by the observation that an optional tax with the same stated purpose - the Western Oregon Small Tract Optional Tax (WOSTOT) - continued to coexist for the benefit of small nonindustrial private forest (NIPF) land owners. Inferring that some small NIPF land owners must be receiving beneficial tax treatment under WOSTOT, the study sets out to examine and compare the tax effects of WOST and WOSTOT on forest management, productivity, land-uses, and tax burdens on a variety of different sites under different sets of assumptions.

The specific objectives of the study are fourfold. First, compare WOSTOT and WOST in terms of their common

objective of fostering timber production. Second, compare the equitability of the two tax systems. Third, compare the neutrality of the two tax systems with respect to land use? Fourth, identify which NIPF landowners are likely to use WOSTOT rather than WOST, and why?

First, a historical review of timber taxes in Western Oregon is conducted to provide some perspective and understanding regarding the existing NIPF timber tax systems. Next, the forest taxation literature is examined for insights into how others have dealt with similar questions.

A methodology utilizing the Stand Optimization System (SOS), a dynamic programming optimization model, is used to examine if and how timber taxes affect: (1) timber production, including the timing and intensity of thinnings and final harvest rotation age, as well as merchantable **m**ean **a**nnual **i**ncrement (MAI); and (2) **S**oil **E**xpectation **V**alues (SEVs) and site burdens.

The results of the simulations show that there are no timber production or land-use impacts attributable to either timber tax system. It was found, however, that the two tax systems were not always equitable, i.e., certain NIPF landowners were likely to find WOSTOT provided preferential tax treatment (higher SEVs) when compared to WOST. Taxpayers most likely to benefit under the WOSTOT system included

those; (1) in high WOST land tax zones, (2) with lower site lands, and (3) with low discount rates.

NIPF land ownerships are examined by county and tax type to determine if the simulation results help explain actual behavior of tax-paying NIPF land owners. Current NIPF ownership patterns tended to be consistent with the model results. It appears that WOSTOT is most used in those counties with highest WOST land values.

Finally, other WOST and WOSTOT related issues are discussed, first from the perspective of NIPF land owners, and then from a public policy perspective.

A Comparison of Timber Tax Options Available to Western Oregon Small Nonindustrial Private Forest Land Owners

by

T. Lincoln Cannon

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed December 16, 1991

Commencement June 1992

DEDICATION

In loving memory of my grandmother,
the late Dorothy Williams,
who never doubted me.

In addition, this is
dedicated to my wife
Rosie,
and our two children,
Ted and Dorothy --
my raison d'être.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

A COMPARISON OF TIMBER TAX OPTIONS AVAILABLE TO WESTERN OREGON SMALL NONINDUSTRIAL PRIVATE FOREST LAND OWNERS

INTRODUCTION

According to Niemi (1978), "... [taxation] has become one of the major considerations in timber management. Aside from the cost of capital or holding, the cumulative tax burden exceeds every other direct capital cost including the cost of land, site preparation, planting, and intermediate cultural practices. Naturally anyone owning timberland or managing it has become extremely concerned over increasing taxation," (page 65).

Income from timber production on private lands is taxed in the United States in a number of ways. Timber-related income is taxed at both the federal and state levels, through the provisions of the income tax laws. Timber lands are also subject to federal estate taxes, as well as state inheritance taxes in many states. Finally, timber lands and timber are taxed as property at the local government level. This study will examine timber property tax laws at the local level, in Western Oregon.

Taxes can serve two functions. The most obvious function of taxes is to raise revenues for governments - particularly county governments and school districts, in this instance. Given that there are many different taxation

systems that could raise roughly equal revenues, the criteria for a "good" tax system hinge on issues of equity, neutrality, and efficiency (Seigel 1982, Gregory 1987). Klemperer (1975) lists a number of different (often conflicting) measures of equity and neutrality that might be used to compare different forest tax systems. A secondary function of taxes may be to encourage certain types of behavior by providing tax incentives, e.g. in the presence of market failures. Public policies and state land-use planning goals have recognized the important social and economic benefits of forestry and wood fiber production to Oregonians and the Oregon economy. Western Oregon timber taxes, while apparently fulfilling the revenue-raising function adequately, were crafted to promote social policy as well (discussed in detail in the next section). Klemperer (1975) stresses that there are often conflicts between different taxing goals. It is not possible to design a tax system that will simultaneously achieve equity, neutrality, efficiency, and social goals; there are always trade-offs.

Because of long, uncertain investment periods associated with timber management, taxes play an important role in influencing timber investment. Meeks (1982) found that states use tax legislation extensively to encourage timber management on nonindustrial private forest (NIPF) lands. Henke (1969) declares that since timber and

timberlands are such an important source of public revenue in Oregon, timber tax policies that influence management and harvest practices of private land holders are of particular importance in Oregon.

Currently, many Western Oregon NIPF lands are being under-managed for timber production (Gedney 1988; Gedney et al. 1986a, 1986b, 1987; MacClean 1988). However, given forecasted timber shortages on industry lands (Adams and Haynes 1990; Sessions et al. 1990) and projected adverse impacts of spotted owl conservation measures on federal harvest levels (Greber et al. 1990), there is likely to be increasing public interest in Oregon in fostering timber management on NIPF lands to help alleviate forecasted timber shortages in the next half century and beyond. MacClean (1988) identifies substantial opportunities for increasing future harvests from Oregon NIPF timber lands. Sessions et al. (1990) contend that if NIPF landowners were to harvest closer to potential and adopt moderate increases in management intensity, they could offset almost 50% of economic declines related to reduced timber availability on public or forest industry lands. Tax policy is one tool that can be used to encourage NIPF landowners to manage their lands for timber production.

The purpose of this study is to compare and contrast two different timber tax systems available to small NIPF

landowners in Western Oregon; (1) the Western Oregon Small Tract Optional Tax (WOSTOT), and (2) the Western Oregon Forest Land and Severance Tax (WOST). These two systems have both been enacted within the last thirty years, but at different times and for different reasons.

Examination of these tax systems will focus on 4 issues: (1) effectiveness - is either tax superior in eliciting the desired behavior (greater timber production) on small NIPF lands, and does either tax cause distortions in optimal thinning and harvesting schedules; (2) equity - do both taxes impose similar tax burdens on similar sites; (3) neutrality - is either tax more likely to cause a reallocation of land uses, i.e., forcing marginal lands out of timber production; and (4) based on the answers to the first three questions, which landowners tend to use WOSTOT instead of WOST, and why?

The study begins with an overview of the historical development and current state of timber tax laws in Western Oregon.

WESTERN OREGON NIPF TIMBER TAXES

The Cascade Mountain range neatly divides Oregon into two distinct physiographic regions. The west-side forests are blessed with ample precipitation, and the primary merchantable species is Douglas-fir (Pseudotsuga menziesii). The drier east-side forests, in contrast, are dominated by Ponderosa Pine (Pinus ponderosa). Forest tax laws in Oregon follow this geographic division. The focus of this study is Western Oregon forest tax law, with special attention to how these laws affect NIPFs. Figure 1 is a map of the counties subject to Western Oregon timber tax laws.

The most common type of tax on property is an unmodified ad valorem tax. However, due to the unique nature of forest resources, many alternative tax systems have been developed for timberlands. Hickman (1982) identifies three general types of timber tax systems often employed as alternatives to the unmodified ad valorem tax. These include; (1) exemptions and rebates, (2) yield taxes, and (3) modified property (ad valorem) taxes. The modified property taxes can be further subdivided into; (1) deferred payment laws, (2) modified rate laws, and (3) modified assessment laws.

This section will describe how and why Western Oregon's NIPF timber tax laws have evolved into their present state. Historically, four major timber property tax laws have

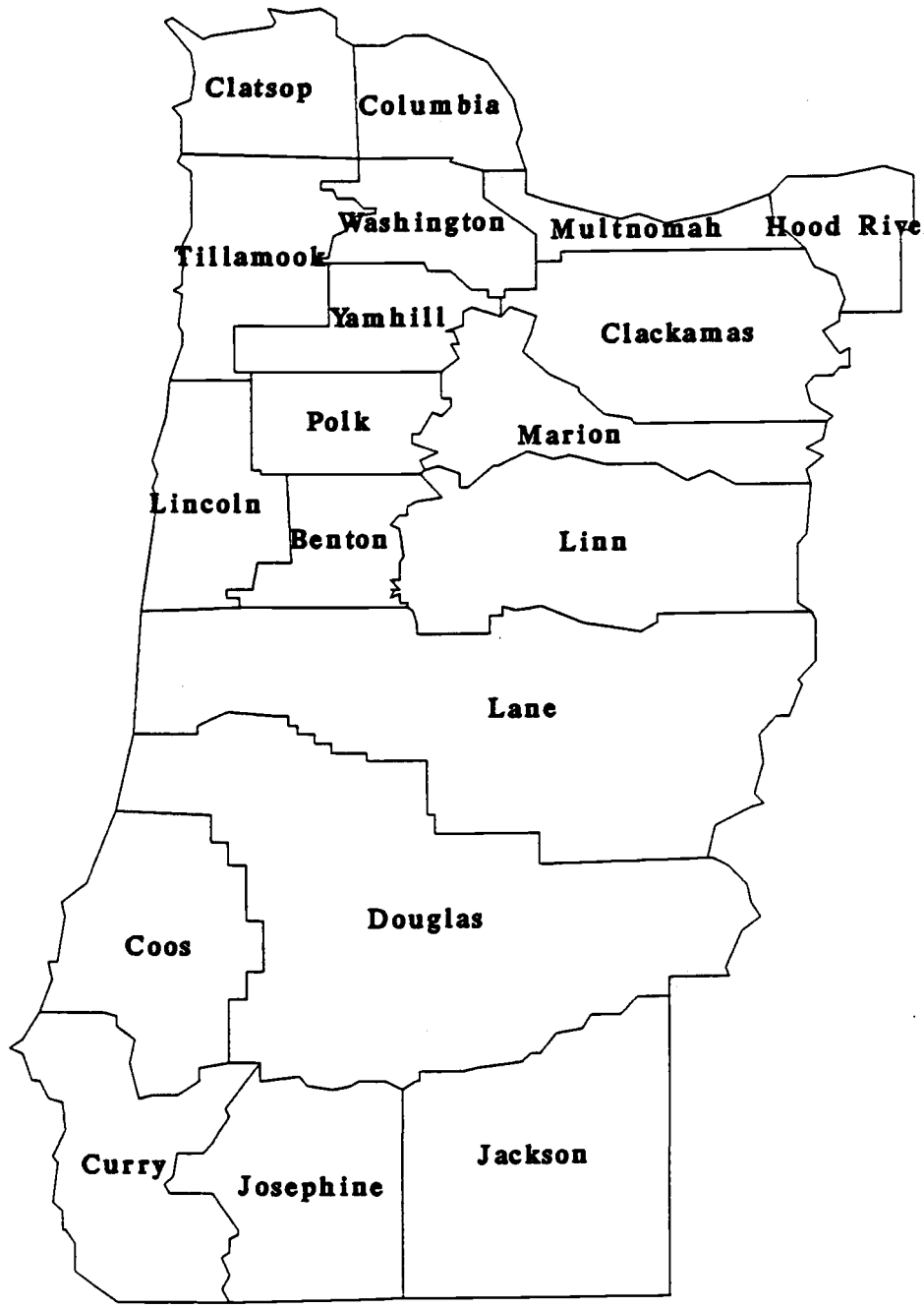


Figure 1. Western Oregon

been applicable at various times in Western Oregon since the mid-1850s: (1) The **A**d **V**alorem **P**roperty **T**ax (AVPT), an unmodified ad valorem tax system; (2) The **F**orest **F**ee and **Y**ield **T**ax (FFYT), a combined modified assessment and yield tax; (3) The **W**estern **O**regon **S**mall **T**ract **O**ptional **T**ax (WOSTOT), a modified assessment (site productivity) tax; and (4) The **W**estern **O**regon Forest Land and **S**everance **T**ax (WOST), a combined modified assessment and yield tax. Figure 2 is a stylistic representation of these four different tax systems (assuming constant markets and no inflation), which will be described in detail in this section.

The Ad Valorem Property Tax (AVPT) -

The ad valorem tax system is the most common type of property tax, and is familiar to all property owners who pay county property taxes. Under an ad valorem tax system, property is taxed annually at some percentage (mill levy) of the assessed value, which is determined by the county assessor. When assessing timberlands, that value is based on the combined values of both the land and the standing timber. Unlike most other types of property, however, the assessed values (and associated taxes) of growing timber increase annually as a function of stand density, site index, stand treatments, etc. This unique feature has generated considerable debate in forest taxation literature as to the equity of ad valorem taxes on timberlands.

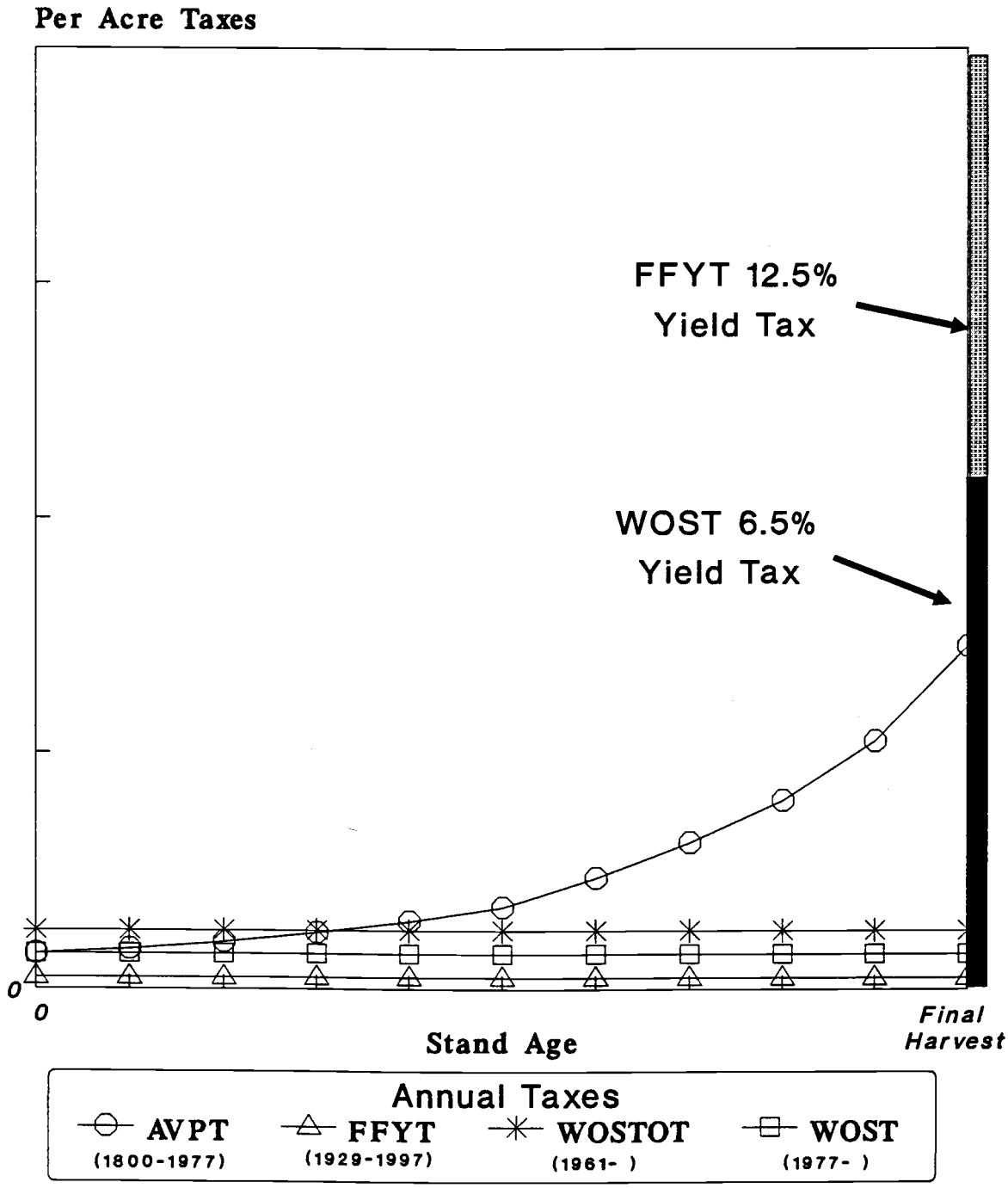


Figure 2. Western Oregon Forest Taxes - Historical Overview

Early theoretical analysis of forest taxes by Fairchild (1908, 1935) concluded that an unmodified ad valorem tax on timber has an inherent bias against deferred yields, and imposes an excess tax burden on timber and timberlands relative to other types of property. The unmodified ad valorem tax allegedly; (1) fosters premature harvesting, (2) is biased against reforestation, and (3) results in distorted land allocations, i.e., drives forestlands (whose highest and best use is forestry) into other uses through the imposition of excessive tax burdens. Fairchild's conclusions have been widely accepted, and have served as the basis for many similar arguments (Duerr 1960; Manning and Thompson 1969; Gregory 1987) against an unmodified ad valorem tax on forests. In 1969, however, Trestrail argued that the theoretical underpinnings of Fairchild's analysis were flawed - that forest growth is more correctly viewed as reinvested income, rather than deferred income - and he concluded that an ad valorem tax on forestry is not inequitable. Lindholm (1973) and Pasour and Holley (1976) supported Trestrail's findings. More recent analysts, while recognizing faults associated with both Fairchild's and Trestrail's analyses, have concluded that an unmodified ad valorem tax is likely to be biased against at least some forestland uses (Klemperer 1974, 1975, 1977, 1978; Bentick 1979, 1980; Dowdle 1980; Noguchi 1982).

In addition to these theoretical considerations, there are operational problems associated with the implementation and administration of an unmodified ad valorem tax when applied to timber and timber lands. Hickman (1982) lists 5 criteria for a "good tax system", and explains how an ad valorem property tax is deficient in each, when applied to timber. As a timber tax system, the ad valorem property tax system is **not:**

(1) equitable - accurate assessments are difficult, and low (high) sites tend to be over (under) valued,

(2) neutral - distorts resource allocation, encourages exploitation, short rotations, reduced stocking, and tends to shift marginal forestland into other uses [Fairchild's argument],

(3) convenient in the time and manner of the levy - taxes are levied and must be paid annually while income is received only periodically,

(4) certain - uncertainty about future tax obligations, due to the long time periods involved, is a deterrent to forestry investment,

(5) economical - difficult and costly to accurately assess.

In spite of these difficulties, from the 1800s through 1977 most of Oregon's private timber lands were taxed under the AVPT system.

Up through the Great Depression, most of the timber logged in Oregon was mature old growth, of which there was an abundance. Real ad valorem taxes on old growth stands tended to be fairly constant from year to year, since there was little annual increment or real value growth. All other things being equal, these conditions favored rapid liquidation of old growth to avoid future timber tax bills (Fairchild 1935) under the AVPT. Timber prices were low, however. Forest property appraisals tended to be low, and there were political pressures on county assessors to hold property values down (Oregon State Legislative Revenue Office 1986c). As a result, the tax burden remained relatively small on lands with standing old growth, and perhaps did not exert undue influence on harvesting decisions. Once the timber had been harvested, however, many land owners considered logged land virtually worthless, and any tax burden was considered excessive. Land was usually left to naturally regenerate or converted to other uses. Returns to reforestation investments from future timber harvest were uncertain and far in the future, while taxes on reforested land increased annually as the value of the stand increased. A great deal of private forestland was abandoned to county governments (Fairchild 1908), particularly in Clatsop, Columbia, and Douglas counties (Oregon State

Legislative Revenue Office 1986c). Tax delinquency and defaults continued to be an ongoing problem into the 1920s.

Forest Fee and Yield Tax (FFYT) -

In 1929, the Legislature - to stem the tide of tax defaults and to encourage reforestation - passed the **optional** Forest Fee and Yield Tax. The annual ad valorem taxes on land and timber were replaced with an annual land tax of 5 cents/acre and a 12.5% tax on the value of the yield at the time of harvest (Figure 2). This allowed forestland owners to pay the bulk of their taxes when they received the bulk of their income, at harvest. However, only forestlands lacking merchantable timber - designated as "reforestation lands" - were eligible for this tax option. By 1936, 917,731 acres in Oregon were classified as reforestation lands (Special Committee on Timber Taxation 1937). However, rising real stumpage prices following the end of World War II made the high 12.5% yield tax rate much less attractive. Also, some land owners considered administrative regulations associated with the FFYT to be an encumbrance. As a result, few new acres - roughly 75,000 acres from 1936 to 1967 (Henke 1969) - were reclassified as reforestation lands after the depression. Meanwhile, tax defaults continued to be a problem on lands - even some with merchantable timber (Wilson and Malone 1948) - which remained subject to the AVPT. The FFYT existed in its

original form up until 1977, when it began to be gradually phased into WOST (phase-in will be complete in 1997).

Western Oregon Small Tract Optional Tax (WOSTOT) -

After World War II, timber prices rose much more rapidly than prices in general, spurred by increased demand for wood products associated with new urban and commercial construction. As a result, the value of old growth stands increased dramatically. Annual tax burdens on these properties - which were mostly subject to the AVPT - increased disproportionately, compared to other types of property. These conditions encouraged old-growth owners to harvest rather than hold inventory.

Owners of younger reforested lands found the ad valorem tax even more disadvantageous. Not only did taxes increase with the general rise in the value of forest products, but taxes also increased with the volume (and value) growth of individual stands as they matured. In the meantime, small land owners could expect no offsetting revenues until the trees were mature enough to harvest. Substantial incentives existed for small NIPF owners of reforested land to harvest prior to the culmination of the economic rotation to escape the heavy and increasing tax burden at the end of the rotation.

To provide tax relief to these small land owners, the Western Oregon Small Tract Optional Tax (WOSTOT) was enacted in 1961, to:

> "...provide an optional method of ad valorem taxation for certain owners of forest land in Western Oregon which will tax the land alone at its productivity value...(T)he normal system of taxing ...tends to force those smaller owners to...harvest their timber before it has properly matured because of the constantly increasing taxes imposed on the timber and the lack of sufficient annual income from mature timber to meet the overall tax burden. The optional tax...is intended to make it possible for such owners to hold their timber to the proper rotation age," (Oregon Revised Statutes 1989a).

Implicit in this language is the debatable supposition that the ad valorem tax system was not unfair to larger timberland owners, presumably because they received annual incomes from their properties with which to pay the taxes.

WOSTOT is an annual tax on the productive value of the land, which allows small NIPFs with less than 2,000 acres, to pay a flat per acre rate (adjusted annually), based on the site quality of the land (Figure 2). WOSTOT contains five site classes, each of which has a **T**rue **C**ash **V**alue (TCV) determined by the Oregon State Department of Forestry, using an income approach that, "... capitalizes average annual net income over a rotation age including periodic and final harvest," (Oregon Revised Statutes 1989b). WOSTOT revenues are treated as a part of the local property tax

system, i.e. annual taxes are levied at the mill levy rate of the county times the TCV. Table 1 shows the 1990 TCVs.

Table 1. WOSTOT True Cash Values (TCVs)

1990 WOSTOT True Cash Values	
Site Class	True Cash Values/Acre (TCVs)
I	$431.00
II	$270.00
III	$183.00
IV	$81.00
V	$15.00

Source: Oregon Department of Forestry

TCVs are present net worth calculations based on site productivity, i.e. the potential yield for each site class under **full stocking and regulation** assumptions, referred to by Hickman (1989) as the "sustained yield" approach to forestland valuation. Timber and land are treated as a single producing unit, so timber is not taxed separately. The simplest representation of the equation for calculating the TCVs is:

$$TCV = \frac{(NVR/r)}{i}$$

where: NVR = the Net Value of One Rotation

r = the Rotation Age

i = the capitalization rate (set by the Oregon State Legislature, currently 17%)

Sutherland (1983) outlines the requirements that must be met for land to qualify under WOSTOT;

(1) land must be suitable for growing timber,

(2) the stand must be less than 8" diameter at breast height (dbh) or younger than 40 years old,

(3) the land owner must own at least 10 but not more than 2,000 acres of forestland in Western Oregon,

(4) no blood relatives may have forestland under WOSTOT (with some exceptions),

(5) the land owner must hold land for the primary purpose producing forest products (includes Christmas trees), and

(6) the land owner must manage the land in accordance with minimum standards as established by the state forester.

Compared to the ad valorem tax system, WOSTOT taxes are higher at the beginning of the rotation, which could theoretically be discouraging to reforestation, depending on alternate tax and land use possibilities. However once the reforestation decision has been made, WOSTOT taxes are lower at the end of the rotation (Figure 2), encouraging "correct" rotation lengths.

Clearly WOSTOT is an example of a tax that is intended to promote a specific behavior among small woodlot owners.

WOSTOT has remained in effect up to the present and is one of the taxes that will be the focus of this study.

Western Oregon Forest Land and Severance Tax (WOST) -

The ad valorem tax on all other timber lands survived essentially unchanged until 1977, when it was replaced with the Western Oregon Forest Land and Severance Tax.

According to McDonnell (1978), past taxpayer acceptance of an ad valorem tax system on forestlands - in spite of the alleged theoretical bias against forestry - could be attributed to several key factors; (1) tax levies were usually low, (2) tax revenues were used for limited local services, (3) land ownership was closely related to an individual's ability to pay taxes, and (4) reassessments were infrequent (sometimes decades apart). He argues that the ad valorem property tax system applied to timber has, "... often been acceptable in the past because it was poorly administered."

Post World War II urbanization, in addition to increasing timber values, placed increased social (and financial) demands on local governments. This produced pressures to raise tax levies and to assess properties more frequently and accurately. Assessments based on rapidly increasing stumpage prices and increased market values for land caused forest owners to pay a much greater proportion of the local tax bill than had previously been the case. In

many states, including Oregon, these pressures prompted state governments to begin searching for alternatives to existing (ad valorem) timber tax systems that;

(1) were viewed as equitable by all (timber and nontimber) taxpayers,

(2) provided sufficient local tax revenues,

(3) were easier (and less expensive) for county assessors to administer,

(4) were stable and predictable (forest owners would know what to expect from one year to the next), and

(5) did not discriminate against forestry.

While small tract owners in Western Oregon received some tax relief with the 1961 passage of WOSTOT, other landowners had to wait until 1977, when this process culminated with the passage of the Western Oregon Forest Land and Severance Tax.

WOST treats forestland and trees as two separate taxing units, and the total tax paid by the land owner over the course of a rotation is the sum of two taxes: (1) an annual modified ad valorem tax on the land; and (2) a 6.5% tax on the appraised stumpage value, levied at the time of harvest.

Annual Modified Ad Valorem Land Tax - The land is taxed annually at the prevailing county mill levy based on its assessed value. The tax is "modified" because some assessed land values are based on current use - as **designated**

forestland - rather than some higher use values[1]. The **F**orest-use **L**and **V**alues (FLVs) are calculated annually by the Oregon Department of Revenue. FLVs are based on 1977 forestland values set by the Oregon Supreme Court, upgraded annually based a three-year rolling average of young growth Douglas-fir stumpage values.

The local county mill levy times the assessed forestland value determines the annual land taxes due. WOST contains eight forest land classes, 4 market areas, with from 1 to 8 value areas in each county. The resulting forest-use land values are highly variable with market area (county location) and site index. Even for a given site index within a single county, forest-use land values differ depending on the value area (Tables 2a and 2b).

Yield tax - A tax of 6.5% of the appraised value of standing timber immediately before it is harvested (stumpage value) is levied at the time of harvest.

There is some confusion associated with the terms yield and severance taxes. A yield tax is usually defined as a fixed percentage tax on the **stumpage value** of harvested

---

[1] The highest and best use of most Western Oregon forestlands is in forest production, and the lands are valued accordingly. If an assessor determines that a parcel of forestland should be assessed at some higher-use value, however, the owner may apply to have that land classified as designated forestland. Designated forestland is then taxed based on it's value in forest production, rather than it's value in the higher-use.

Table 2a. WOST FLVs (Market Area 1)

TRUE CASH VALUE OF FOREST LAND AS OF JANUARY 1, 1990

$ / ACRE

MARKET AREA 1: LANE AND COUNTIES NORTH

Land Class	BENTON			CLACKAMAS				CLATSOP			COLUMBIA		HOOD RI
	A	B	C	A	B	C	D	A	B	C	A&C	B	ALL
FA	285	276	322	322	300	276	285	322	285	276	322	300	—
FB	231	211	265	265	231	208	240	265	231	202	265	231	—
FC	192	174	219	219	183	159	186	219	183	159	219	183	165
FD	157	151	190	190	162	142	166	190	153	132	190	162	142
FE	123	108	138	138	123	108	129	138	108	88	138	123	99
FF	81	78	94	94	85	72	85	94	72	69	94	94	69
FG	36	36	46	46	37	36	37	46	36	36	46	37	37
FX	27	27	27	27	27	27	27	27	27	27	27	27	27

Land Class	LANE				LINCOLN		LINN				MARION			
	A	B,C,D,E	F&G	H	A&C	B	A	B	C	D	A	B	C	D
FA	285	276	253	322	285	276	285	276	247	322	285	285	247	322
FB	231	211	195	265	231	216	231	211	189	265	231	222	195	265
FC	192	174	154	219	192	174	192	174	145	219	192	174	154	219
FD	157	151	138	190	157	138	157	151	123	190	157	151	138	190
FE	123	111	108	138	123	108	123	111	99	138	123	108	99	138
FF	81	78	78	94	81	72	81	78	69	94	81	78	69	94
FG	36	36	36	46	36	36	36	36	36	46	36	36	36	46
FX	27	27	27	27	27	27	27	27	27	27	27	27	27	27

Land Class	MULTNOMAH		POLK			TILLAMOOK			WASHINGTON			YAMHILL	
	A	B	A	B	C	A&C	B,D,E	F	A	B	C	A	B
FA	322	300	285	276	322	285	276	322	322	300	285	322	285
FB	265	231	231	211	265	231	208	265	265	231	231	265	231
FC	219	183	192	174	219	192	165	219	219	183	192	219	192
FD	190	162	157	151	190	157	132	190	190	162	157	190	157
FE	138	123	123	108	138	123	88	138	138	120	123	138	123
FF	94	85	81	78	94	81	68	94	94	85	81	94	81
FG	46	37	36	36	46	36	33	46	46	37	36	46	36
FX	27	27	27	27	27	27	27	27	27	27	27	27	27

Source: Oregon Department of Revenue

Table 2b. WOST FLVs (Market Area 2, 3, and 4)

TRUE CASH VALUE OF FOREST LAND AS OF JANUARY 1, 1990

($ / ACRE)

MARKET AREAS 2, 3, & 4 – SOUTHERN OREGON

MARKET AREA 2 – DOUGLAS COUNTY

Land Class	A	B	C	D	E	F	G
FA	0	0	174	198	191	198	235
FB	144	144	137	162	155	162	191
FC	121	117	112	128	134	137	162
FD	107	96	96	117	107	117	134
FE	90	79	73	90	83	90	111
FF	55	48	48	63	68	63	71
FG	34	29	29	38	29	34	36
FX	20	20	20	20	20	20	20

MARKET AREA 3 – JACKSON & JOSEPHINE COUNTIES

JACKSON COUNTY

Land Class	A & B	C
FA	0	0
FB	0	0
FC	143	0
FD	128	143
FE	89	109
FF	58	71
FG	37	48
FX	24	24

JOSEPHINE COUNTY

Land Class	A	B
FA	0	0
FB	0	0
FC	0	0
FD	0	0
FE	109	94
FF	71	58
FG	48	37
FX	24	24

MARKET AREA 4 – COOS & CURRY COUNTIES

COOS COUNTY

Land Class	A	B & C	D
FA	180	163	147
FB	137	124	111
FC	112	104	89
FD	101	86	72
FE	79	69	57
FF	53	41	38
FG	26	22	18
FX	18	18	18

CURRY COUNTY

Land Class	A	B	C
FA	180	163	147
FB	137	118	111
FC	112	104	89
FD	101	86	72
FE	79	69	57
FF	53	41	38
FG	26	22	18
FX	18	18	18

Source: Oregon Department of Revenue

timber and is usually levied to replace the general property tax (Gregory 1987). A severance tax, on the other hand, generally refers to a fixed percentage tax levied **per unit** volume harvested (Klemperer 1975), and is levied in addition to a property tax, e.g. Oregon's Forest Products Harvest Tax (Oregon Revised Statutes 1989a). By these standards, the so-called WOST "severance" tax is more appropriately considered a **yield** tax (Timber Tax Journal 1984), and will be referred to hereafter as a yield tax.

WOST yield taxes (unlike WOSTOT) are not a separate budget resource. These revenues function as an offset to local district property tax levies, i.e. the tax levy of each district is reduced by the estimated yield tax distribution for the year (Oregon State Legislative Revenue Office 1986a).

WOST yield taxes are based on stumpage values calculated by the Oregon State Department of Revenue. Taxes are collected quarterly, and deposited into the Western Oregon Timber Tax Account. After adjustments, revenues are allocated to counties based on a formula that accounts for total assessed forestland value and total value of timber harvested within a county (Oregon State Legislative Revenue Office 1986b). This system of disbursements is designed to smooth out fluctuations in annual tax revenues related to variable annual harvests within each county.

WOST also has a small owner election, which allows small tract owners to compute taxable stumpage value as the gross delivered mill price minus administrative, logging, and transportation costs. It is designed to compensate small tract owners with less than 1,000 acres or 500 thousand board feet (MBF) annual harvest, for increased expenses and lower bid prices associated with harvesting small units. It should not be confused with WOSTOT.

Compared to the ad valorem property tax, WOST encourages reforestation and longer rotations (Gamponia and Mendelsohn 1987). WOST is mandatory for all private forestland owners ineligible for exceptions, and it is the source of the vast majority of timber tax revenues collected in Western Oregon.

MOTIVATION AND OBJECTIVES

The initial motivation for this study was the observation that, although West-side Oregon has a mandatory timber tax system (WOST) which is accepted as promoting "correct" rotation lengths, an optional tax with the same stated purpose (WOSTOT) continued to coexist for the benefit of small nonindustrial private forestland owners.

As early as 1965 (four years after its inception), a Legislative Tax Study Committee recommended that WOSTOT be "...terminated as to future applicants," (Henke 1969) but no action was taken.

In 1975, a study commissioned by the Oregon Legislative Interim Committee On Revenue (Klemperer 1975) advocated replacing the ad valorem tax system with a land and yield tax system, and eliminating WOSTOT. While the WOST was adopted in accordance with the study recommendations, WOSTOT was retained in **spite** of the study recommendations.

Surmising that some small NIPF owners found advantages in seeing the WOSTOT tax retained (why else has it not been repealed?), the study sets out to examine and compare the tax effects of WOSTOT and WOST taxes on forest management for different sites and under different sets of assumptions, to discover which ownership groups might benefit from the different tax options.

Unlike most previous timber tax research, this study will compare the two existing tax systems from an **applied** policy analysis vantage point rather than a theoretical perspective. Existing tax structures and rates are taken as **given** rather than trying to determine what they ought to be, and the management impacts of these taxes are addressed.

The objectives of the study are to compare WOSTOT and WOST, answering the following questions:

(1) How do WOSTOT and WOST compare in accomplishing their common objective of fostering timber production - does the different timing of WOST and WOSTOT taxes affect thinning regimes and total merchantable harvest?

(2) Are the two tax systems equitable relative to each other - are landowners paying a fair share of taxes under both tax systems, and if not, under which circumstances is one tax or the other preferential?

(3) Are the two tax systems neutral with respect to land use - is either tax system more likely to be confiscatory, i.e., is either tax preferred to retain marginal forestlands in forest use?

(4) Based on the answers to the previous questions, which NIPF landowners are likely to use WOSTOT rather than WOST, and why?

To address these objectives, the existing literature describing studies on forest taxes will be examined for insights into how others have dealt with timber property tax-related issues in the past. Combining this information with recent theoretical and technical advances in growth and yield models, forest economics models, and computer hardware and software, a methodology is designed to address the first three objectives of the study. The procedures are carried out and the results are reported. In light of the reported results, small NIPF land owner patterns are examined by tax type to address the fourth objective, "Who is using WOSTOT and why?" Finally, other land owner and public policy considerations related to Western Oregon NIPF timber taxes are discussed.

LITERATURE REVIEW

Up through the 1970s, most forest taxation research dealt with equity issues, concentrating primarily on whether the unmodified ad valorem property tax places an unfair burden of forest properties (Fairchild 1908,1935; Manning and Thompson 1969; Trestrail 1969; Lindholm 1973; Klemperer 1974, 1976a, 1977, 1978; Pasour and Holley 1976; Bentick 1979,1980; Dowdle 1980). Klemperer (1976a, 1982) was one of the first to examine mathematically yield and productivity taxes, focusing primarily on the equity and neutrality of these taxes when compared to an unmodified ad valorem tax. Chang (1982, 1983) examines effects of different forest taxation systems and assumptions of tax incidence on optimal rotations. Gamponia and Mendelsohn (1987) attempt to measure the magnitude of rotation age distortions caused by ad valorem and yield taxes. They note that tax-induced impacts on rotation lengths are well understood: ad valorem taxes shorten rotations, yield taxes lengthen rotations, and productivity taxes are neutral with respect to rotation age.

These studies are general in nature, using non-specific price, cost, and growth equations to arrive at conclusions, concluding with an empirical case study and sensitivity analysis. They tend to compare timber taxes and tax induced-effects by setting tax rates such that the taxes under consideration meet certain goals. For example, tax rates

have been set such that they: (1) raise equal revenues over time; (2) raise revenues comparable to taxes on nontimber properties; (3) have equal tax burdens, i.e., they do not force misallocation of resources, and so on. These analyses usually focus on how taxes affect reforestation investments, management intensity (e.g., fertilization, precommercial thinnings) , or rotation lengths in achieving the optimal Soil Expectation Value (SEV). SEV is defined as "...the present net worth of bare forestland for timber production calculated over a perpetual series of timber crops grown on that land," (Davis and Johnson 1987). Again the results tend to be non-specific, e.g., given some ad valorem and yield tax rates, ad valorem taxes tend to decrease the optimal rotation age compared to yield tax.

As has been previously noted, pragmatic administrative and political considerations may be as important as theoretical considerations when examining timber tax systems. Gaffney (1978) summarizes many of the arguments (both theoretical and pragmatic) that have been made for and against alternate (ad valorem, productivity, and yield) timber tax systems.

Perhaps the most extensive applied examination of Oregon timber taxes to date has been, "Evaluating Forest Tax Alternatives for Oregon," a study prepared in 1975 by W.D. Klemperer for the Oregon Interim Revenue Committee, when the

State Legislature was considering passing new timber taxes (which they did in 1977). Klemperer uses an iterative, engineering approach to compare different types of timber taxes. The study is exhaustive, containing over 10,000 Soil Expectation Value (SEV) calculations examining hypothetical forest tax situations. He uses sensitivity analyses to examine effects of different taxes on optimal rotation lengths and site burdens[2] under a variety of different assumptions. The study was commissioned to examine alternatives to the existing (at the time) ad valorem tax system. Klemperer was concerned with the equity and neutrality of different timber tax systems. Operationally, his objectives were to examine how alternate tax systems would have to be structured to; (1) collect equivalent revenues on a given a piece of forestland, (2) provide revenues comparable to the current (ad valorem) tax system, and (3) not be biased against forestry. Drawing on this previous work, a methodology will be proposed to address the tax impacts of WOST and WOSTOT.

---

[2] Reduction in land values attributable to taxes, assuming taxes are fully capitalized into land values.

METHODS

Introduction -

There are obvious difficulties in trying to compare productivity and yield taxes such as WOSTOT and WOST. Forest stand growth depends on many different variables, including; stand establishment decisions (type and intensity of site prep, regeneration method and density, species composition), intermediate treatments (timing and intensity of precommercial thinnings, fertilization, commercial thinnings, etc.), and final harvest age. On a given site, each different combination of these variables can produce a different yield tax schedule, both in terms of total taxes paid over the course of a rotation and timings of tax payments.

Comparison problems are further compounded by considering multiple sites of differing quality. Not only do optimal levels of various stand management inputs change with changes in site quality, but assessed land values (and corresponding annual taxes) change as well for both WOST and WOSTOT lands. These changes in annual taxes are not easily equated between WOST and WOSTOT. WOST FLVs are based on 8 "Land [site] Classes", subdivided into 5 different "Market Areas", which in turn can be subdivided into as many as 8 different "Value Areas," e.g. Douglas county alone has over 30 possible FLVs for an acre of designated forestland (Table

2b). WOSTOT TCVs, as previously mentioned, are based on only 5 site classes (Table 1), i.e. any acre of WOSTOT forestland in all of Western Oregon can only have one of five TCVs, dependent entirely on site quality.

A final problem encountered in comparing the two different tax systems relates to selecting an appropriate capitalization rate for financial calculations. The term capitalization rate simply refers to the interest rate used in discounting cash flows, and is also frequently referred to in the forestry literature as the interest or discount rate. These terms are used interchangeably in this study. As will be seen from the results of model simulations, tax impacts, as well as management decisions, can be dramatically influenced by the capitalization rate used in financial analyses (Klemperer 1976b). The study methods will be designed to overcome these difficulties while meeting the stated study objectives.

Overview -

The approach used here will have some similarities to Klemperer's 1975 study, although the objectives differ. Like Klemperer, an objective is to compare tax-induced changes in SEVs, rotation lengths, and productivity under differing assumptions about discount rate, site quality, and type and timing of taxes. Klemperer (and most previous work), however, set tax rates to collect equal revenues, then

carried out the comparisons. Commercial thinnings were never considered. In contrast, this study addresses a specific policy question, i.e. **given** existing tax structures, rates, and land values, what are the tax impacts on optimal SEV across a range of discount rates and site quality?

Rather than utilize the inefficient iterative method of finding optimal SEVs, the study will draw upon recent advances in optimization research, using a simulation approach to model the differences between WOST and WOSTOT. This is not only more efficient, but it also allows consideration of commercial thinnings as well as final harvest in finding optimal SEVs.

Information required by the models must first be developed prior to running any simulations. Once the inputs are calculated, The **S**tand **P**rojection **S**ystem (SPS) growth and yield model (Arney, 1985) will be used to simulate stand growth, given initial stand conditions and assumptions regarding management practices (e.g., regeneration method and density, precommercial and commercial thinnings, fertilization, etc.). The **S**tand **O**ptimization **S**ystem (SOS) combines SPS and economics information and assumptions, including annual land taxes and 6.5 % yield tax, to find the rotation age and thinning regime that will optimize the **S**oil **E**xpectation **V**alues (SEV) under the different tax systems. Simulations will be done across a range of site qualities

and discount rates, examining tax effects on: (1) rotation lengths; (2) number of thinnings; (3) merchantable mean annual increment (MAI); i.e., average annual merchantable growth over the course of a rotation (including both thinnings and final harvest); and (4) optimal SEVs. Figure 3 shows a schematic overview of the study.

Data Requirements -

Prior to undertaking simulations, data must be generated and standardized such that (1) data are in the form required by the SPS and SOS models, and (2) WOST and WOSTOT taxes are placed on an equal footing, so valid comparisons can be made.

Convert 100 year to 50 year site index classes - Both WOST and WOSTOT assessed land values are tied to a one hundred year site index scale. SPS and SOS, however, require 50 year site index values. 50 year site index values were obtained using conversion tables based on a family of Douglas-fir site index curves developed by King (1966). One hundred year and equivalent 50 year site index values of interest are shown in columns 1 and 2 in Table 3.

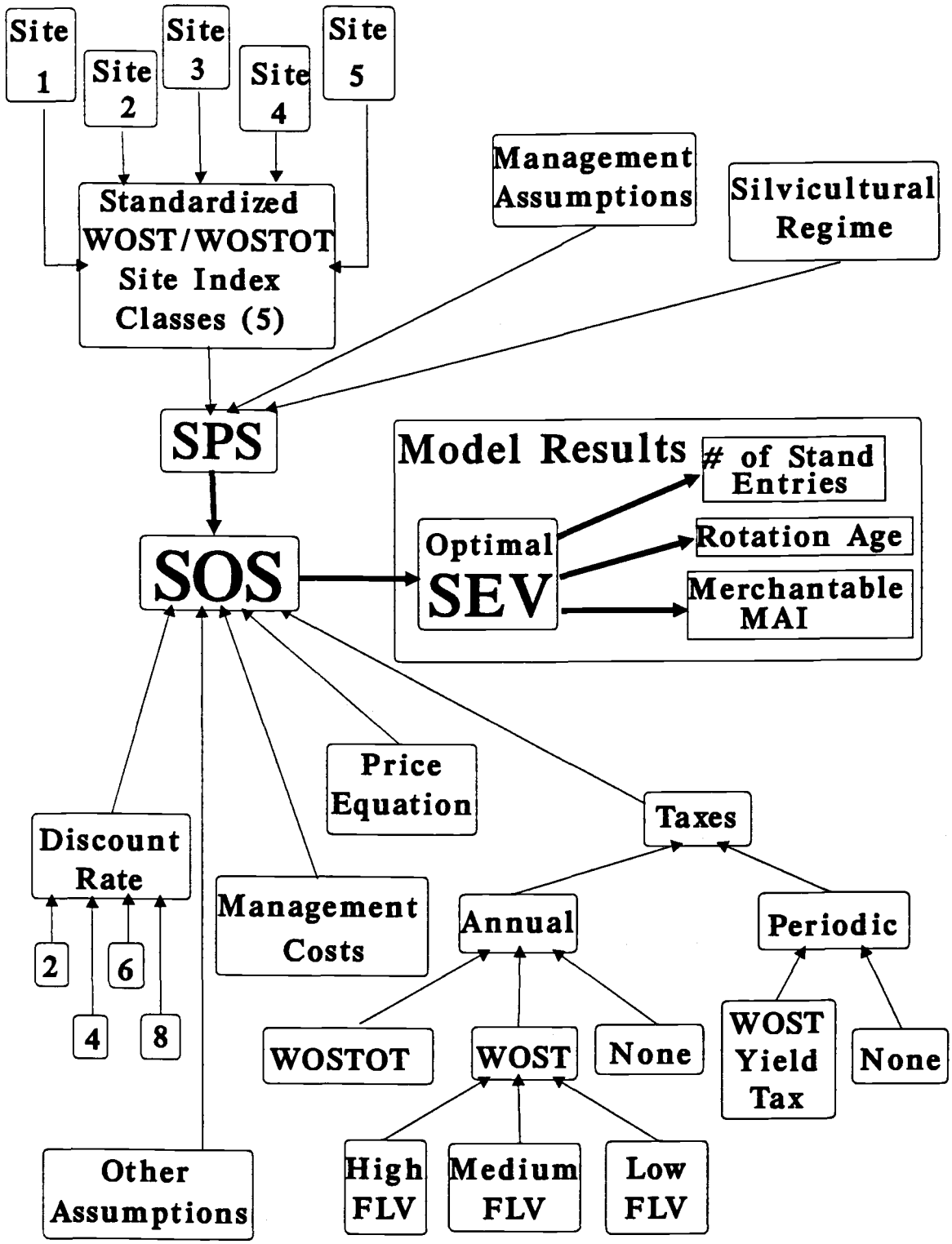


Figure 3. Information Flow Chart

Table 3. WOSTOT, WOST, and Adjusted WOST Site Classes

Douglas-fir 100 Year Site Index	Douglas-fir 50 Year Site Index	WOSTOT Site Class	Original WOST Land Class	Adjusted WOST Land Class
210	157			
200	**149**	I	FA	Fi
190	142			
180	135			
170	**128**	II	FB	Fii
160	121			
150	113		FC	
140	**106**	III	FD	Fiii
130	99			
120	92		FE	
110	**84**	IV		Fiv
100	77		FF	
90	70			
80	**63**	V	FG	Fv
70	56		FX	

Define new WOST land classes corresponding to WOSTOT site classes - In order to compare impacts of WOST and WOSTOT taxes on different quality sites, site classes used in model runs have to be equivalent for both tax systems. New adjusted WOST land classes are defined to correspond to the five WOSTOT land classes (Table 3, Column 5). 50 year site index figures (corresponding to the five site classes)

used in the model simulations are shown in bold type in column 2, Table 3.

Calibrate WOST FLVs by land class corresponding to WOSTOT TCVs by site class - To implement the analysis, land values under both tax systems must be placed on the equivalent site class scales. To this end, new WOST FLVs are calculated for all WOST market areas and value areas to match the new adjusted WOST land classes (WOSTOT TCVs remain unchanged). The new WOST FLVs are calculated for each new land class by taking a weighted average of the original WOST FLVs. For example, looking at Table 3, new WOST land class Fi exactly corresponds to original WOST land class FA, so no correction is needed in WOST FLVs. However, adjusted WOST land class Fii corresponds to WOST land class FB (2/3) and WOST land class FC (1/3). Weighted averages were used to compute new WOST FLVs for adjusted WOST Land Class Fii. This procedure was repeated for each WOST value area in a given market area within WOST land class Fii. The entire procedure was repeated for each WOST market area. Finally, all the preceding steps were repeated for adjusted WOST land classes Fiii, Fiv, and Fv.

Once the new WOST FLVs have been calculated, there are still some 285 (57 value areas * 5 land classes) calculated FLVs. To reduce this to a reasonable number of different cases over which to run the simulations, WOST FLVs

reflecting high, medium and low values in each of the 5 new land classes are selected (Table 4).

Table 4. WOSTOT TCVs and WOST FLVs (High, Medium, and Low)

Site/ Land Class	WOSTOT TCVs	WOST FLVs		
		HIGH	MID	LOW
I/Fi	$431.00	$325.00	$250.00	$175.00
II/Fii	$270.00	$250.00	$175.00	$100.00
III/Fiii	$183.00	$180.00	$135.00	$90.00
IV/Fiv	$81.00	$110.00	$75.00	$40.00
V/Fv	$15.00	$45.00	$35.00	$25.00

Calculate Annual Land Taxes Under WOST and WOSTOT - To compute annual land taxes, an average mill levy is required. This study calculates annual land taxes assuming an average levy of 20 mills (2%, based on conversations with local assessors). The results are shown in Table 5.

Table 5. Land Taxes, Assuming a 20 Mil Levy

Site/ and Class	ANNUAL TAXES (20 Mill Levy)			
	WOSTOT	WOST		
		HIGH	MID	LOW
I/Fi	$8.62	$6.50	$5.00	$3.50
II/Fii	$5.40	$5.00	$3.50	$2.00
III/Fiii	$3.66	$3.60	$2.70	$1.80
IV/Fiv	$1.62	$2.20	$1.50	$0.80
V/Fv	$0.30	$0.90	$0.70	$0.50

Examining WOST and WOSTOT annual land taxes, it is apparent that WOSTOT will always be preferred to WOST on site V/Fv lands from a landowner's perspective. WOSTOT TCVs (and taxes) are lower than WOST TCVs at the outset, without even considering the additional yield tax under WOST (Table 5). Land values and annual taxes are very low under both tax systems, and these lands are unlikely to substantially contribute to the timber supplied by the NIPF ownership class in Western Oregon. Therefore, site V/Fv lands were dropped from consideration for the rest of this study. The tax comparisons will only be conducted for site I/Fi - site IV/Fiv lands. The next step was to build the SPS input file for each of the remaining four site index classes.

The Stand Projection System (SPS) -

SPS is a single-tree, distance-independent, stand-projection growth and yield model, developed by James Arney (1985). An initial management regime was developed using a modified version (Long et al. 1988) of Drew and Flewelling's (1979) density management diagram for coastal douglas-fir (Pseudotsuga menziesii var. menziesii). Management objectives were to maintain a vigorously growing stand using periodic thinnings. Thinnings were initiated at the onset of density-induced mortality, reducing density to roughly the point of the onset of competition. Growing stock levels are derived from Reineke's Stand Density Index (SDI). Since SDI

is independent of site quality and stand age (Daniel et al. 1979), the regime developed is applicable on differing quality sites, which is particularly useful here. The resulting management regime was input into SPS to simulate stand growth on different sites given the management regime. The density management diagram does not, however, address the timings of thinnings or final harvest. These are based on economic (including taxes) as well as biological factors, and will be considered in the following section.

SPS model parameters include:

(1) STAND - Bare Land, planted, single species (Douglas-fir), at 250 TPA (consistent with accepted silvicultural practices, see Barrett 1980).

(2) MERCHANTABLE LIMITS - Stump height 1', Log length (including trim) 16.4', Top diameter limit 4", Smallest merchantable DBH 6".

(3) THINNINGS (the decision variable in optimizing the SEV) - Possible at 10 year intervals, not prior to age 30. The interval between allowable thinnings and/or final harvests was intentionally set to be relatively long, to limit opportunities for thinnings. While the model will often do lighter and more frequent thinnings (particularly on high sites) if allowed to do so, the underlying behavioral assumption here is that small NIPFs are unlikely to engage in intensive management,

i.e., frequent thinnings.

(4) CLUMP - Average per acre tree coverage is 90% since the stand is planted, it would be less for a naturally regenerated stand.

Other silvicultural and management assumptions in include: (1) even-aged management, clear cut at end of rotation; (2) commercial thinnings are from below; and (3) costs and intensity of management inputs are constant across all simulation runs. Intensive management practices such as precommercial thinnings and fertilization were not included, based on the assumption that most small NIPFs are unlikely to engage in these types of practices.

4 SPS input files (one for each standardized site index class, excluding site V) were created containing the initial stand conditions required by SPS to simulate the growth of a stand over time.

The Stand Optimization System (SOS) -

The central tenant of forest economics is optimal rotation theory. Martin Faustmann (1849) developed the original optimal rotation model, consisting of "...a single, even-aged forest stand on a uniform site, owned by a perfectly competitive forest owner whose sole goal is rent-maximization," who assumes that, "... the price of timber per cubic meter is independent of tree size, all economic variables maintain a constant real value, timber growing is

costless, and no management is performed. The owner is also presumed to plan an infinite series of identical rotations," (Nautiyal and Williams 1990). They go on to point out that Faustmann's model, and the many variants it has spawned (eg. Pearse 1967, Martell 1980, Nautiyal and Fowler 1980, Heaps 1981) have only a single decision variable - the age of final harvest - and are therefore "... not complex enough to evaluate actual projects where silvicultural management is undertaken, as it is in most forest estates."

Development of optimal rotation models using dynamic programming (Dykstra 1984, Buongiorno and Gilless 1987) and optimal control theory (Clark 1976, Silberberg 1990) have allowed incorporation of substantially more information than the old Faustmann-type models. An example of a simple linear optimal control model that yields an SEV optimizing thinning and harvest schedule is given by Clark (1976). Yoshimoto et al. (1988) have a good review of current optimization literature.

The SOS system is a "... deterministic, single descriptor, discrete-state, discrete-stage, dynamic programming model...[utilizing] a forward recursion." (Yoshimoto et al. 1988). SOS will be described in general terms here, for a detailed description of the SOS optimization procedure, see Yoshimoto et al. (1988).

SOS is able to incorporate the effects of management

inputs and different quality sites - as they affect growth in the SPS model - into the objective function. Annual and periodic costs (including taxes) related to management are also input into the SOS model. The result is a schedule of thinnings and final harvest that will maximize the objective function. SOS is capable of optimizing over several possible objective functions, e.g. total volume, total merchantable volume, basal area, present net worth (PNW), or SEV. The objective function maximized in these simulations is the SEV.

The rest of this section will be given over to explaining the functioning of the SOS model, describing in detail the objective function, parameters, and assumptions used in the simulations.

Soil Expectation Value (SEV) - The SEV equation is the objective function over which SOS will optimize. The precise form of the equation used by SOS is:

$$SEV = \frac{(1-y)\times HR_r}{(1+i)^r-1} + \frac{\sum (1-y)\times TR_t \times (1+i)^{(r-t)}}{(1+i)^r-1} - \frac{\sum C_t \times (1+i)^{(r-t)}}{(1+i)^r-1} - \frac{A}{i}$$

NET (AFTER TAX) HARVEST REVENUE

NET (AFTER TAX) THINNING REVENUES

MANAGEMENT COSTS

ANNUAL COSTS (INCLUDING TAXES)

WHERE:

i = Discount Rate

y = Yield Tax Rate

$\mathbf{HR_r}$ = Final Harvest Revenues

$\mathbf{TR_t}$ = Thinning Revenues (at time t)

$\mathbf{C_t}$ = Management Costs (at time t)

A = Annual Expenses (including annual taxes)

t = Intermediate Stand Age

r = Rotation Age

Optimal SEVs are assumed to represent the bid price for forestland. This presupposes that taxes are capitalized into land values, not passed forward in increased stumpage prices, a reasonable (Klemperer 1974, 1977, and 1978) although not universally held (Stier and Chang 1983) view.

Discount Rates - Davis and Johnson (1987) describe nominal interest rates as consisting of several components, including; (1) the pure rate - the risk-free cost of using money over time, (2) the expected inflation rate, and (3) the risk rate. They give several examples of how different land owners might operate under different assumptions regarding the interest (discount) rates. This simulation will assume real (inflation-adjusted) dollars, so the expected inflation rate is not a consideration in setting the discount rate for the model runs.

Usually, the interest rate used in computing forestry

investments and returns is considered to be the alternate rate of return, i.e. the highest rate of interest that could be obtained from the next best alternate investment. Clark (1976) defines real rate of interest, and suggests a real interest rate of 2 - 4%. Gregory (1987) suggests that an inflation adjusted, long-term, pure interest rate could be as low as 2¼ %. Buongiorno and Gilless (1987) suggest a real interest rate of 2.5% in evaluating private forestry investments, and 3-4% in evaluating forest investments on public lands. Row et.al. (1981) suggest that a 4% real discount rate approximates the long-term opportunity cost of capital in the private sector (excluding risk allowances), while Klemperer (1976b) concludes a 5-6% real discount rate is competitive with other forms of capital investment. Samuelson (1976) contends, however, that a present alternate rate of return is an unrealistically low rate to use for forestry investments, which grossly overstates returns to NIPFs from forest management.

An alternate way of viewing the discount rate is as a measure of impatience for realized income in the present versus higher income received at some point in the future, the so-called "time preference for money," (TPM) (Fisher 1930), i.e. a high discount rate reflects a high time preference for income today, while a low discount rate reflects a greater willingness to forgo income today for

increased future returns. Fisher (1930) suggests that TPM tends to increase with (among other things): (1) shortness and uncertainty of life, (2) selfishness, or lack of commitment to the future (e.g., no heirs), (3) lack of foresight and planning, and (4) low or precarious incomes. Birch et al. (1982) have found that most NIPF landowners tend to be white, male, and older (over 50). Alig et al. (1990) suggest that NIPF owners may have relatively short planning horizons, which could result in owners discounting future revenues at a higher rate than immediate costs. Kronrad and de Steiguer (1983) found (in contrast to Fisher's contention) that, among North Carolina NIPFs, as income increased discount rates increased as well. They posit two possible contributing factors; (1) high income individuals have more investment opportunities and a better chance of securing a higher alternate rate of return, and (2) high income groups have more experience and knowledge in making investments. Surveys done by Kronrad and de Steiguer (1983) found that, on a 25 year investment, the nominal average rate of return for North Carolina NIPFs ranged from 3% to 30%, with a mean of 15%. Even adjusted for inflation, these rates suggest that NIPF discount rates are higher than merely the real alternate rate of return.

Discount rates for model runs will be set at 2%, 4%, 6%, and 8%. This range accounts for varying expectations

about pure and risk-rates of interest and low and high time preferences for money from conservative expectations and/or low TPM (2%) to risky expectations and/or high TPM (8%) assumptions about the real rate of interest.

Price Equation - Assumptions about current market prices and future market expectations are necessary to simulate yield taxes, since value at harvest is a function of price as well as yield. The SOS model requires that stumpage prices are held constant over time. Current prices were modeled with the equation used by Yoshimoto (1987), a linear price equation giving unit value ($/MBF) as an increasing function of diameter at breast height (DBH);

$$V = 12.5 * DBH$$

Market conditions and prices are constantly changing, and stumpage prices are variable from one location to another. Since comparative tax analysis is the goal of this research, it was deemed that a relatively simple linear price equation that returned reasonable rotation lengths and thinnings was sufficient for these purposes. As a computational consideration, a simple linear price function is preferable to a piece-wise function, as it becomes possible for SOS to find suboptimal solutions when piece-wise linear functions are used (Yoshimoto 1987). Step-wise linear and nonlinear price equations are not acceptable in SOS.

A simple linear regression using values obtained from a trial run of the TREEVAL (Sachet et al. 1989) model yielded similar (although slightly lower) parameters for the price equation, with an R_2 value in excess of 0.9. Since the results of the optimization runs using Yoshimoto's price equation return realistic rotation lengths and thinning regimes, the equation was accepted as reasonable.

Other model inputs -

(1) Thinnings are only allowed from below. Thinnings and harvests may occur at ten year intervals, beginning at age 30.

(2) The node interval (TPA interval between thinning levels) is 50.

(3) Yield Tax - 6.5% on all thinnings and harvests under the different WOST scenarios.

(4) Annual Taxes - See Table 5.

(5) Entry costs are assumed to be $100/acre for both thinnings and final harvest (variable entry costs are not allowed in SOS).

(6) The value of thinnings is calculated as 80% of the value of a final harvest, to reflect increased costs associated with partial harvest methods and reduced piece size.

(7) The stand is planted with 250 TPA, at $150/acre.

The model runs generated 100 files (5 tax options x 4

sites x 4 discount rates), containing information on optimal harvest, MAI, SEVs, and rotation lengths under all possible combination of variables. The results are presented in the next section.

RESULTS

Overview -

The results from the simulation runs address the study objectives by examining tax-induced changes in optimal rotation age, number of stand entries, mean annual increment (MAI), and soil expectation value (SEV) caused by varying site quality and discount rate parameters under 5 different tax options; (1) No taxes, (2) WOSTOT, (3) WOST with high annual land taxes (high WOST), (4) WOST with intermediate annual land taxes (mid WOST), and (5) WOST with low annual land taxes (low WOST).

The first section addresses the first study objective; do WOSTOT and WOST affect timber production, in relation to the base line (no taxes) and in relation to each other? By examining the relationships between tax-induced changes in optimal rotation lengths, number of stand entries, and MAI - on differing sites and under different discount rate assumptions - these questions can be addressed. Note that it is of little benefit to look at any of these variables independently of the others, since they are all interrelated.

It is important to understand the relationships between thinnings, rotation lengths, and merchantable MAI. It is well accepted that thinnings have two effects on management regimes; (1) thinnings **lengthen** rotations, by periodically

reducing full site utilization in the short-term to grow larger trees in the long-term, and (2) thinnings **increase merchantable MAI**, by capturing merchantable mortality that would otherwise be lost and yielding larger, more valuable trees at the end of the rotation (Daniel, Helm, and Baker 1979; Smith 1986). Both of these assumptions are consistent with the results of this analysis.

Previous studies have generally focused on the impacts of different tax systems on rotation lengths. This analysis is more sophisticated in that it also examines tax impacts on timing and intensity of thinnings. By examining the effects of taxes on thinning regimes as well as rotation lengths, we are focusing on total sustainable production (merchantable MAI) rather than one factor affecting production (rotation age).

The second section looks at optimal SEVs and site burdens (the percent reduction in SEVs attributable to taxes), assuming a range of site qualities and discount rates, to address the second and third objectives: (1) compared to each other, are WOST and WOSTOT equitable; and (2) is either tax preferred to retain marginal forestlands in timber production? If SEVs tend to be similar for a given site and interest rate, then the taxes, at least in comparison with each other, are equitable. Similarly, if one tax yields a positive SEV while the other has a negative SEV

on marginal site lands, then the tax with a positive SEV would be preferred to retain marginal lands in forest production.

Rotation age, thinnings, and MAI -

Initial SOS runs showed some tax impacts attributable to WOST and WOSTOT on higher site lands (1 and 2) with high interest rates (6% and 8%). On further examination, it became apparent that some of the impacts shown were not always consistent with theoretical expectations. On Site 2 lands assuming a 6% discount rate, for example, the SOS solution showed that both WOST and WOSTOT shortened rotations, reduced number of stand entries, and had a lower MAI than the no-tax option. Theory holds however, that since WOSTOT is essentially an equal annual management cost, which must be paid whether timber is harvested or not, it should be neutral with respect to harvesting decisions.

Yoshimoto (1987) noted that SOS may sometimes produce a suboptimal solution when a one-stage look ahead period is insufficient to evaluate future stand conditions. Yoshimoto incorporated a multi-stage algorithm into the SOS model (MS-SOS), to more thoroughly evaluate possible optimal solutions. MS-SOS was not used originally because each individual model run requires interactive inputs (and longer computational time), making it more time-intensive. Site 1 and 2 lands, assuming 6% and 8% discount rates, under the

five different tax scenarios, were rerun through the MS-SOS model (20 individual runs). The MS-SOS model yielded higher SEVs, and all tax impacts on management disappeared. Since the SEVs are higher, MS-SOS gives better solutions under high site and high interest rate assumptions. Therefore, the SOS results were replaced with the MS-SOS results for Site 1 and 2 lands and 6% and 8% discount rates. Several MS-SOS runs were also made on randomly selected lower site lands, and high site lands under lower interest rates, under different tax options. None of these results differed from the SOS results. It was concluded that SOS, with a one-stage look ahead, produces optimal (or near optimal) solutions except on high site lands with high interest rates.

Once corrections were made using MS-SOS, no tax induced effects on rotation age, number of stand entries, or MAI were observed. The factors that did influence rotation age, number of thinnings, and merchantable MAI are site quality and discount rates (Figures 4, 5, and 6). Given a constant discount rate, optimal rotation age increases as site quality decreases (Figure 4), and number of stand entries and merchantable MAI decrease (Figure 5 and 6). Given a constant site quality, optimal rotation length, number of stand entries, and MAI all tend to decrease as the discount rate increases.

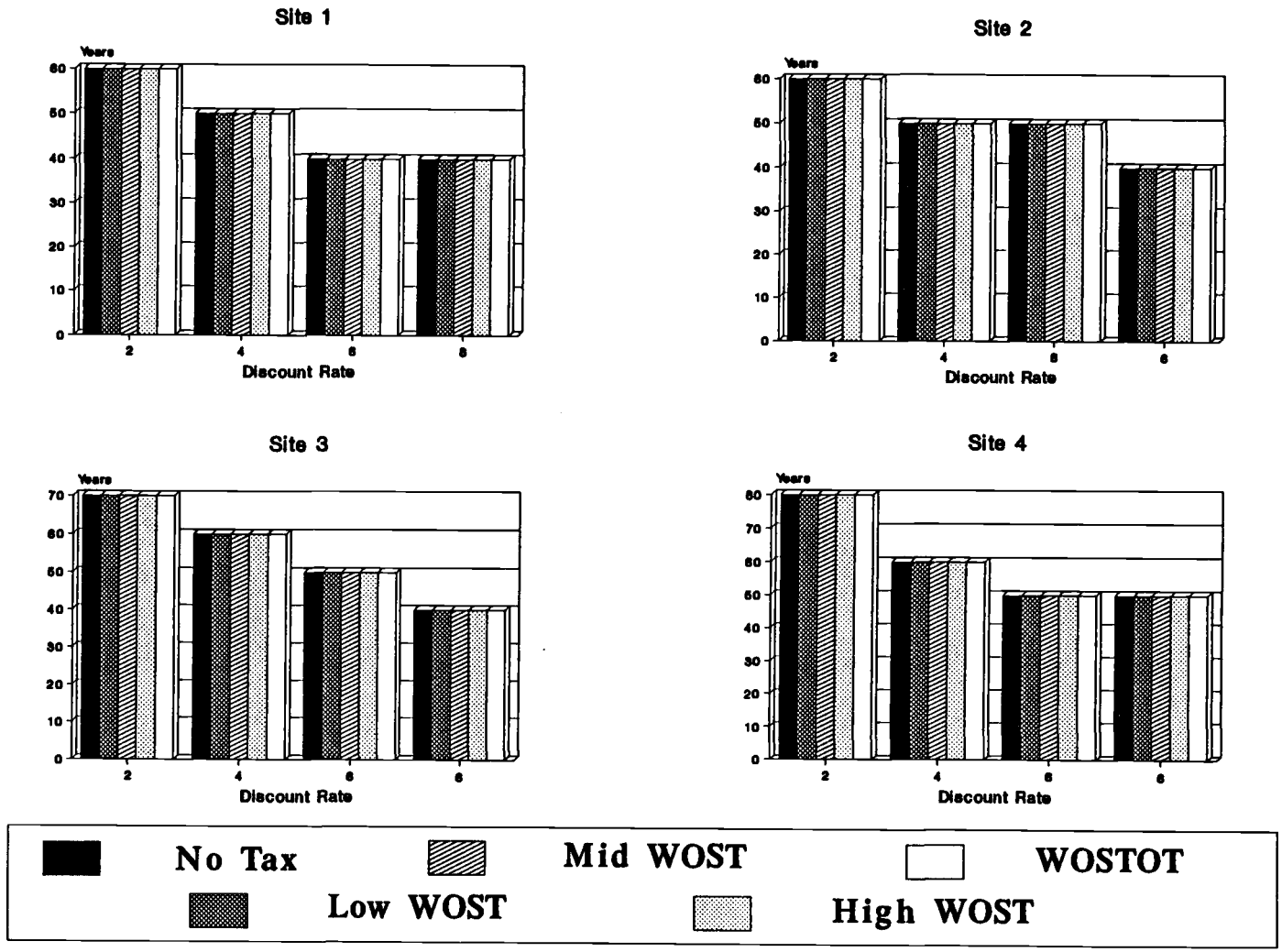


Figure 4. Effects of Changing Discount Rate on Optimal Rotation Age

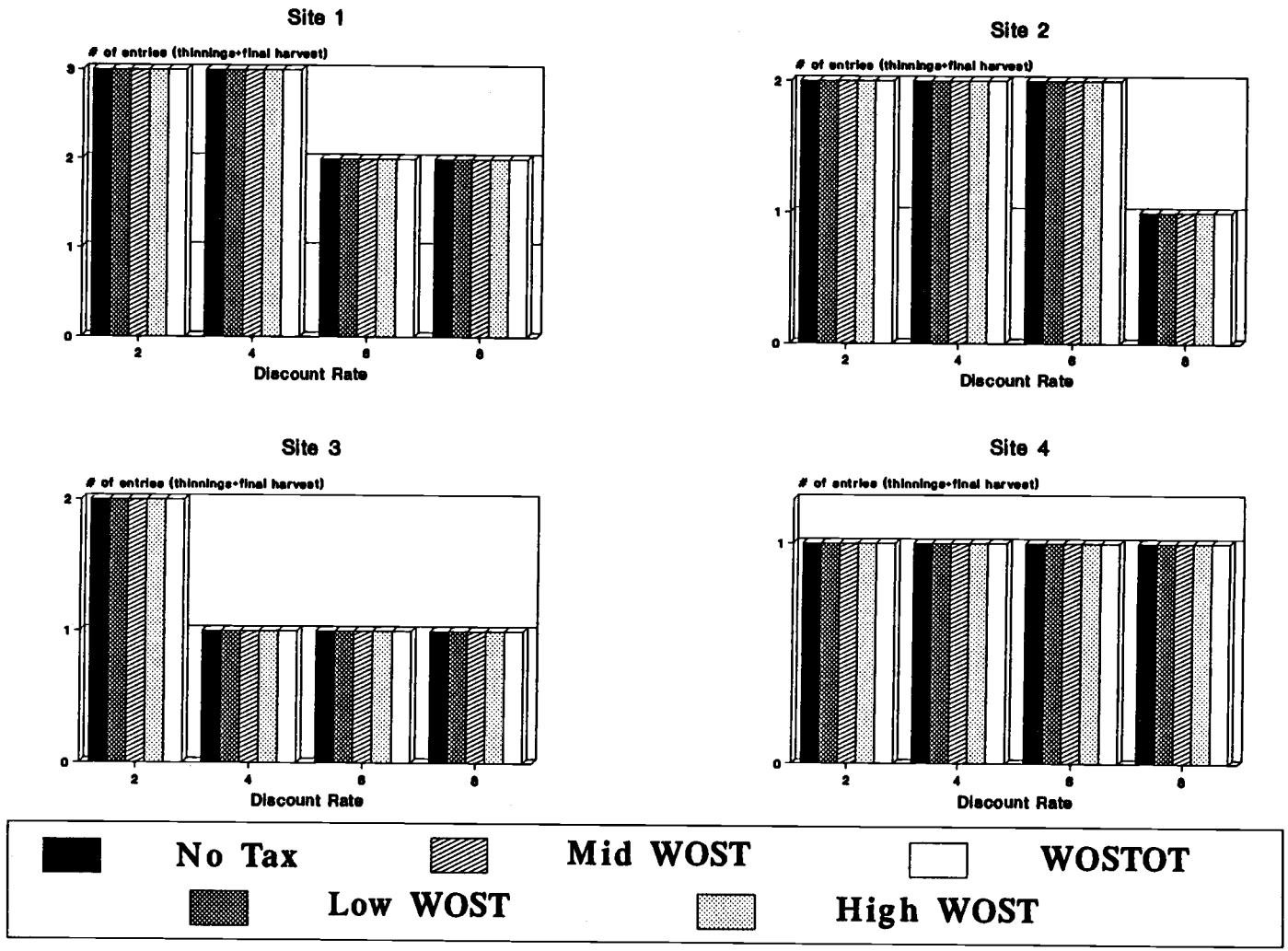


Figure 5. Effects of Changing Discount Rate on # of Stand Entries

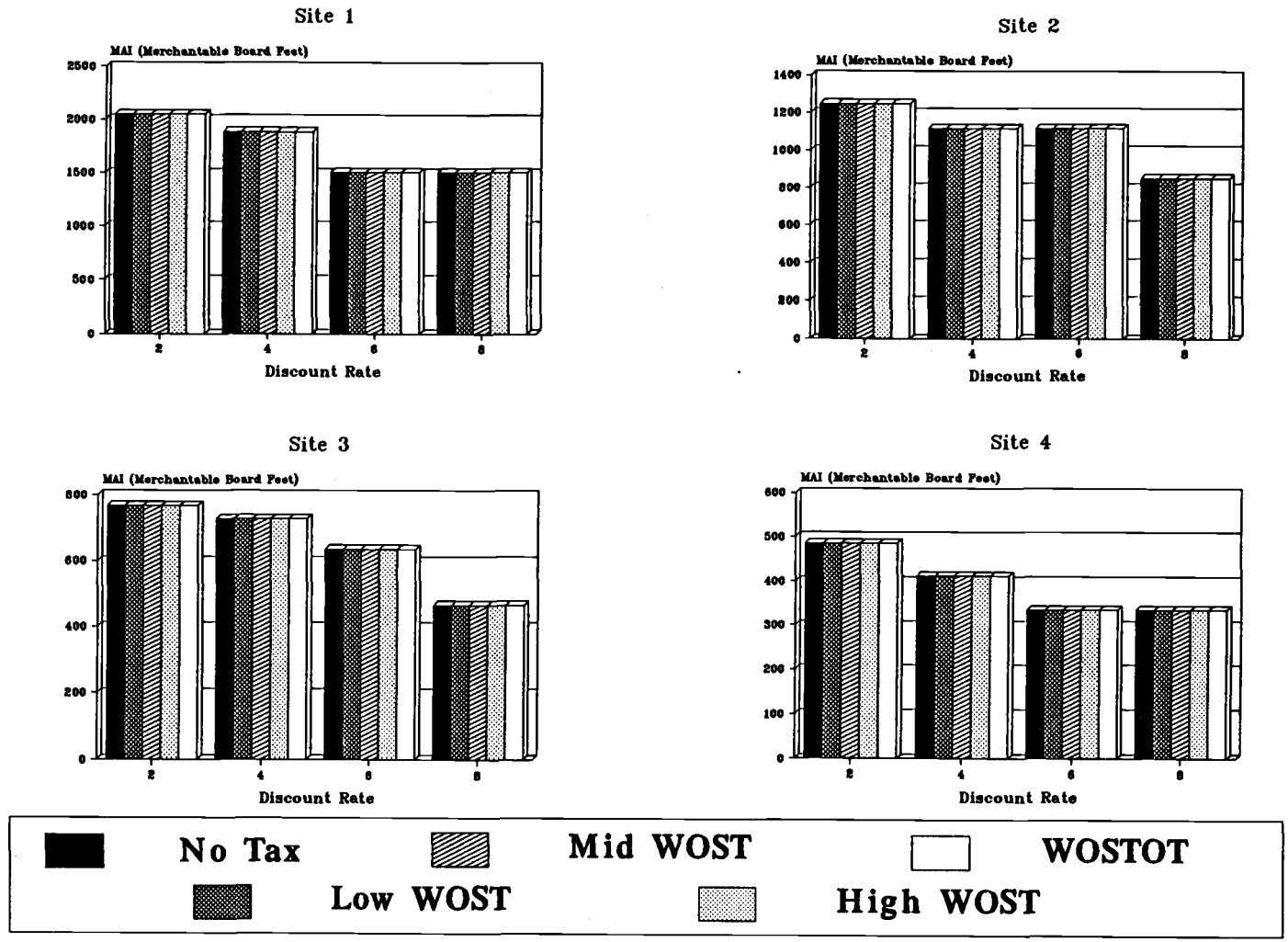


Figure 6. Effects of Changing Discount Rate on MAI

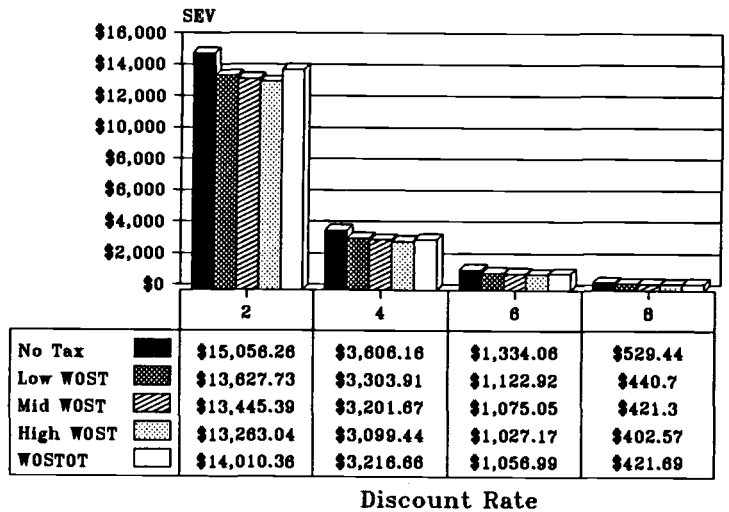
SEVs and Site Burdens -

Next, the study will address the second objective - are WOST and WOSTOT equitable with respect to each other? By definition, all taxes must reduce the optimal SEV obtainable with no taxes, and this is indeed the case in these simulations. By a similar logic, WOST low SEVs must be greater than WOST mid SEVs, which in turn must be higher than WOST high SEVs. Again, initial SOS runs came up with some results that were not always consistent with these expectations on higher site lands (1 and 2) with high interest rates (6% and 8). The new runs of the MS-SOS model (see previous section) yielded higher SEVs and site burdens that are consistent with theoretical expectations.

Since the corrected simulation results have shown that all WOST and WOSTOT tax scenarios produce identical management regimes for each given combination of site and discount rate, the question being asked is, "How do SEVs under WOSTOT compare with those under different WOST options?"

Figures 7a and 7b show that, assuming a 2% discount rate, WOSTOT is the preferred tax option regardless of site quality, i.e. WOSTOT SEVs are always higher than WOST SEVs. Using a 4% discount rate, low WOST becomes the preferred alternative on higher sites (Sites I and II), while WOSTOT continues to be preferred on lower sites. When assuming 6%

Site 1



Site 2

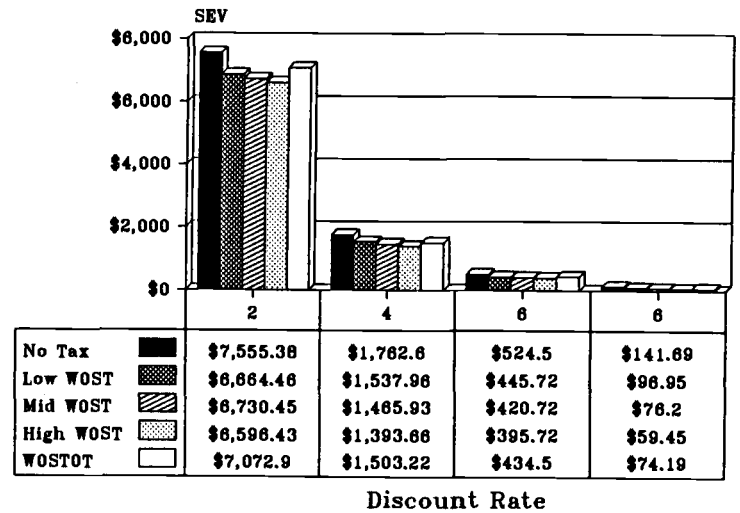
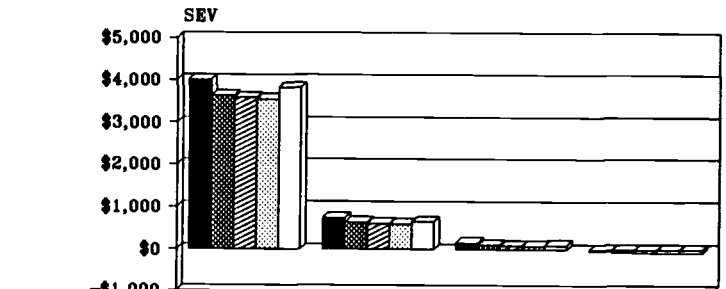


Figure 7a. Effects of Changing Discount Rate on SEV - Sites 1 and 2

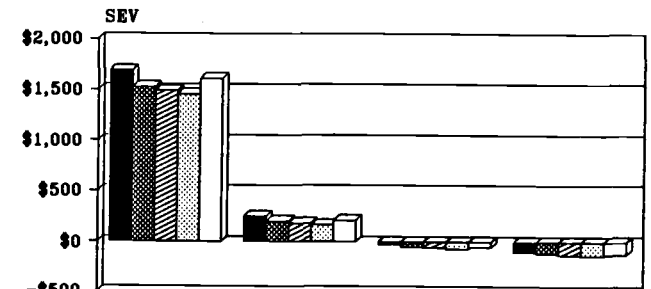
Site 3



	2	4	6	8
No Tax	$4,003.95	$743.67	$162.22	-$23.52
Low WOST	$3,633.74	$638.88	$110.99	-$55.02
Mid WOST	$3,588.74	$616.38	$95.99	-$66.27
High WOST	$3,543.74	$593.88	$80.99	-$77.52
WOSTOT	$3,820.95	$652.17	$101.22	-$69.27

Discount Rate

Site 4



	2	4	6	8
No Tax	$1,687.55	$251.26	-$22.8	-$101.73
Low WOST	$1,523.92	$203.47	-$45.34	-$115.22
Mid WOST	$1,488.92	$185.97	-$57	-$123.97
High WOST	$1,453.92	$168.47	-$68.67	-$132.72
WOSTOT	$1,606.55	$210.76	-$49.8	-$121.98

Discount Rate

Figure 7b. Effects of Changing Discount Rate on SEV - Sites 3 and 4

and 8% discount rates, WOSTOT SEVs fall in between low and high WOST SEVs on all sites, lower than mid WOST SEVs on site I lands, and higher than the mid WOST SEVs on sites II, III, and IV. WOSTOT tends to become the more preferred option as the site quality and discount rate decrease.

While these relationships can be discerned by examining Figures 7a and 7b, presenting the differences in SEVs as site burdens shows this relationship more clearly. Site burden is defined as the percent reduction in SEVs attributable to the different tax options, given a particular site and discount rate. The mathematical formulation for computing site burdens is shown below. (Klemperer 1974)

$$SiteBurden = \frac{SEV_{beforetax} - SEV_{aftertax}}{SEV_{beforetax}}$$

In examining site burdens, it is important to remember they are a **percentage** reduction in SEV. As a result, lands with high pretax SEVs (higher sites and lower discount rates) tend to have lower site burdens, while lands with lower pretax SEVs (lower sites and higher interest rates) tend to have higher site burdens. Under the WOSTOT tax system assuming a 6% discount rate, for example, site 1 lands assuming a have a much greater absolute reduction in SEVs ($1,334.08 - $ 1058.99 = $275.09) than site 3 lands

($162.22 - $ 101.22= $61.00). The opposite is true of the site burdens however, with a 20.6% site burden on site 1 lands compared to a 37.6% site burden on site 3 lands. The same demonstration can be made holding site constant and comparing low and high discount rates. Site burden comparisons, therefore, should only be made between different tax options assuming a specific site and interest rate. Comparisons of site burdens across site and interest rates are not meaningful in the context in which they are used here.

Given a site and discount rate, the larger the tax attributable site burden, the greater the tax impacts on SEV, and the less preferable that tax option becomes to the land owner. Figure 8 shows the differences in positive site burdens attributable to the different tax options, under different discount rates (negative site burdens are not shown).

When using a 2% discount rate, WOSTOT imposes a smaller site burden than any of the WOST options on all site classes. Assuming a 4% discount rate, it can be seen that WOSTOT site burdens are; (1) roughly equivalent to mid WOST site burdens on site 1 land, (2) between low and mid site WOST site burdens on site 2 lands, and (3) lower than low WOST on site 3 and 4 lands. At a 6% discount rate, WOSTOT site burdens are; (1) comparable to mid to high WOST site

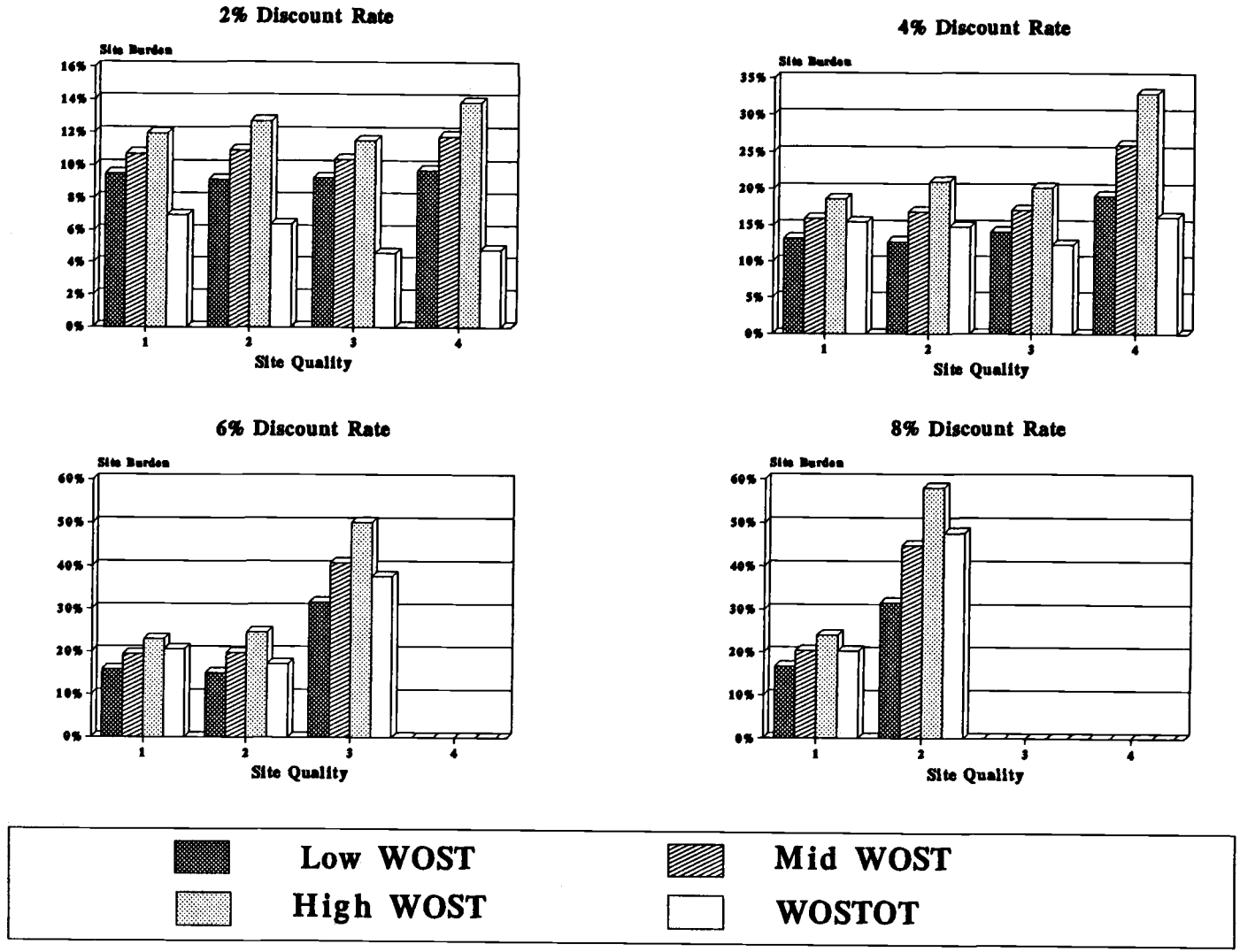


Figure 8. Effects of Changing Site Quality on Positive Site Burdens

burdens on site 1 lands, and (2) between low and mid WOST site burdens on site 2, 3, and 4 lands. Finally, at an 8% discount rate, WOSTOT site burdens are between mid and high WOST site burdens on sites 1, 2, and 3, and between low and mid WOST site burdens on site 4 lands.

It is clear from these graphs that WOSTOT is most likely to be preferred on lower site lands assuming lower interest rates, and less preferred on higher site lands at high interest rates.

The third study objective is to determine whether WOST or WOSTOT taxes tends to retain marginal lands in forest production, i.e. does one tax option yield a positive SEV where other scenarios yield negative SEVs? Negative SEVs occur on site III lands, assuming an 8% discount rate, and on site IV lands assuming both a 6% and 8% discount rate (Figure 7b). Since the no-tax option also yields negative SEVs, none of the tax options can induce these land owners to manage their lands for timber production, as they are already losing money without ever paying any taxes. If one were willing to lose money to manage for timber production in these cases, the low WOST option would be preferred, having the least negative values. Mid WOST and WOSTOT SEVs are roughly comparable under these assumptions, while high WOST option would be the worst in all instances.

DISCUSSION

The analysis demonstrates that optimal forest management regimes do not differ under WOST or WOSTOT with respect to rotation age, timing and intensity of thinnings, or merchantable MAI. Results also show that neither tax option is preferred for retention of marginal lands for forest uses. Since there are no management or land-use impacts attributable to either taxing system, the next question to be asked is, "Which small NIPF land owners are likely to elect to be taxed under WOSTOT rather than WOST, and why?"

Simulation results suggest at least three factors that might contribute to small NIPFs selecting the WOSTOT tax option. First, land owners in areas with relatively high WOST land values are more likely to find WOSTOT preferable. Second, WOSTOT appears to provide more favorable tax treatment (given a particular discount rate) on lower site lands when compared to WOST. Third, land owners with a relatively low time preference for money (i.e., those individuals with relatively low discount rate) should prefer the WOSTOT option.

The discussion begins with an overview of private forestland ownerships in Western Oregon. The analysis then focuses on WOST and WOSTOT ownership patterns in Western Oregon. These patterns are examined to see if they are

consistent with the simulation results. Other factors that might influence the selection of a tax system by small NIPFs are discussed. Finally, the public policy implications of the WOST and WOSTOT systems are discussed.

Private Forestland Ownership in Western Oregon -

Roughly one half of the total 11,119,000 acres of commercial timberland in Western Oregon - excluding reserved forestlands - are privately owned. Over two thirds of those privately owned forestlands (4,048,000 acres) are forest industry lands.[3] Of the remaining 1,858,300 acres in "small" NIPF ownerships, farmers own 40% (743,300 acres) while the remaining 60% (1,115,000 acres) is primarily owned by individuals, "...for reasons including aesthetics, recreation, fishing and hunting, and for appreciation of investment capital," (Gedney 1988). Figure 9 shows total private forestland ownership in Western Oregon by type of tax paid. Only 10% of small NIPF land is taxed under WOSTOT. Based on the simulation results, one would expect that the majority of WOSTOT lands would be located in counties that have relatively high WOST FLVs and/or on lower quality sites.

---

[3] Includes 500,000 acres of "like forest industry" lands -- forest land owners who, although not owning a mill, manage their timberland similarly to the forest industry.

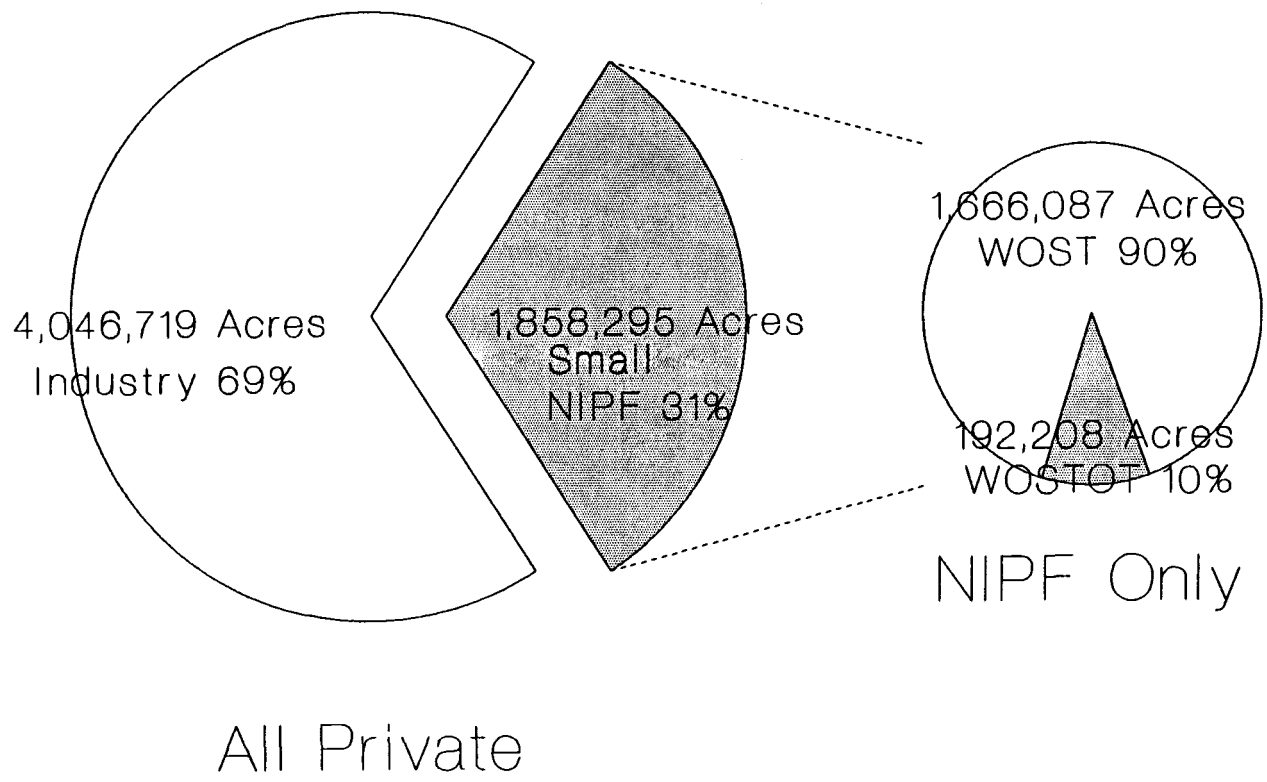


Figure 9. Private Commercial Forest Land Ownership in Western Oregon

Source: Gedney 1988, Oregon Department of Forestry 1990

WOST and WOSTOT Land Ownership Patterns in Western Oregon -

Table 6 shows Western Oregon small NIPF land ownerships by county and type of timber tax paid (Gedney et.al., 1986a, 1986b, 1987; OSDF 1991), ranked in order of acreages in WOSTOT.

Table 6. Western Oregon NIPF Ownerships by County and Timber Tax System

Counties	WOST Market Areas	WOSTOT (10.26% of Total NIPF)			WOST (89.75% of Total NIPF)		
		Acres	%	Rank	Acres	%	Rank
Clackamas	1	36,849	19.19%	1	113,151	6.74	5
Washington	1	24,820	12.92%	2	63,180	3.76	10
Lane	1	20,440	10.64%	3	205,560	12.24	2
Columbia	1	17,719	9.23%	4	60,281	3.59	11
Linn	1	13,263	6.91%	5	89,737	5.34	7
Yamhill	1	12,739	6.63%	6	67,261	4.00	9
Marion	1	12,011	6.25%	7	56,989	3.39	13
Benton	1	10,256	5.34%	8	45,744	2.72	14
Jackson	3	9,482	4.94%	9	146,518	8.72	3
Polk	1	9,225	4.80%	10	44,775	2.67	15
Lincoln	1	6,110	3.18%	11	58,890	3.51	12
Josephine	3	4,766	2.48%	12	107,234	6.38	6
Douglas	2	4,502	2.34%	13	287,498	17.11	1
Clatsop	1	3,278	1.71%	14	34,722	2.07	17
Hood River	1	1,734	0.90%	15	12,266	0.73	19
Tillamook	1	1,566	0.82%	16	34,434	2.05	18
Coos	4	1,542	0.80%	17	139,458	8.30	4
Multnomah	1	1,529	0.80%	18	35,471	2.11	16
Curry	4	226	0.12%	19	76,774	4.57	8
Total		192,057	100%		1,679,943	100%	

Nine of top ten counties (in terms of percent of total WOSTOT acreages) are located in WOST market area one, comprising 82% of the total acreage under WOSTOT. Over 50% of WOSTOT lands are located in the top 4 counties; Clackamas, Washington, Lane, and Columbia. Counties in market areas 2, 3, and 4 tend to have relatively few acres in WOSTOT.

Figure 10 shows the geographical location of the WOST market areas. Referring back to Tables 2a and 2b (WOST FLVs by market area, land class, and value area), WOST market area 1 almost always has higher FLVs (mid to high WOST values) in all site classes than the other WOST market areas. Market areas 2 (Douglas county) and 4 (Coos and Curry counties) have the lowest FLVs. Market area 3 (Jackson and Josephine counties) has FLVs that fall in between those of market area 1 and market areas 2 and 4, on lower site lands[4].

The results shown in Table 6 confirm that WOSTOT is most used in counties with the highest WOST FLVs (market area 1). Within these counties, it seems likely that lands under the WOSTOT option would be located in the value areas with the highest FLVs, although this cannot be demonstrated with the available data. Somewhat surprisingly, however, all the market area one coastal counties as well as Multnomah

---

[4] All private forest land in Jackson and Josephine counties is site class III or lower.

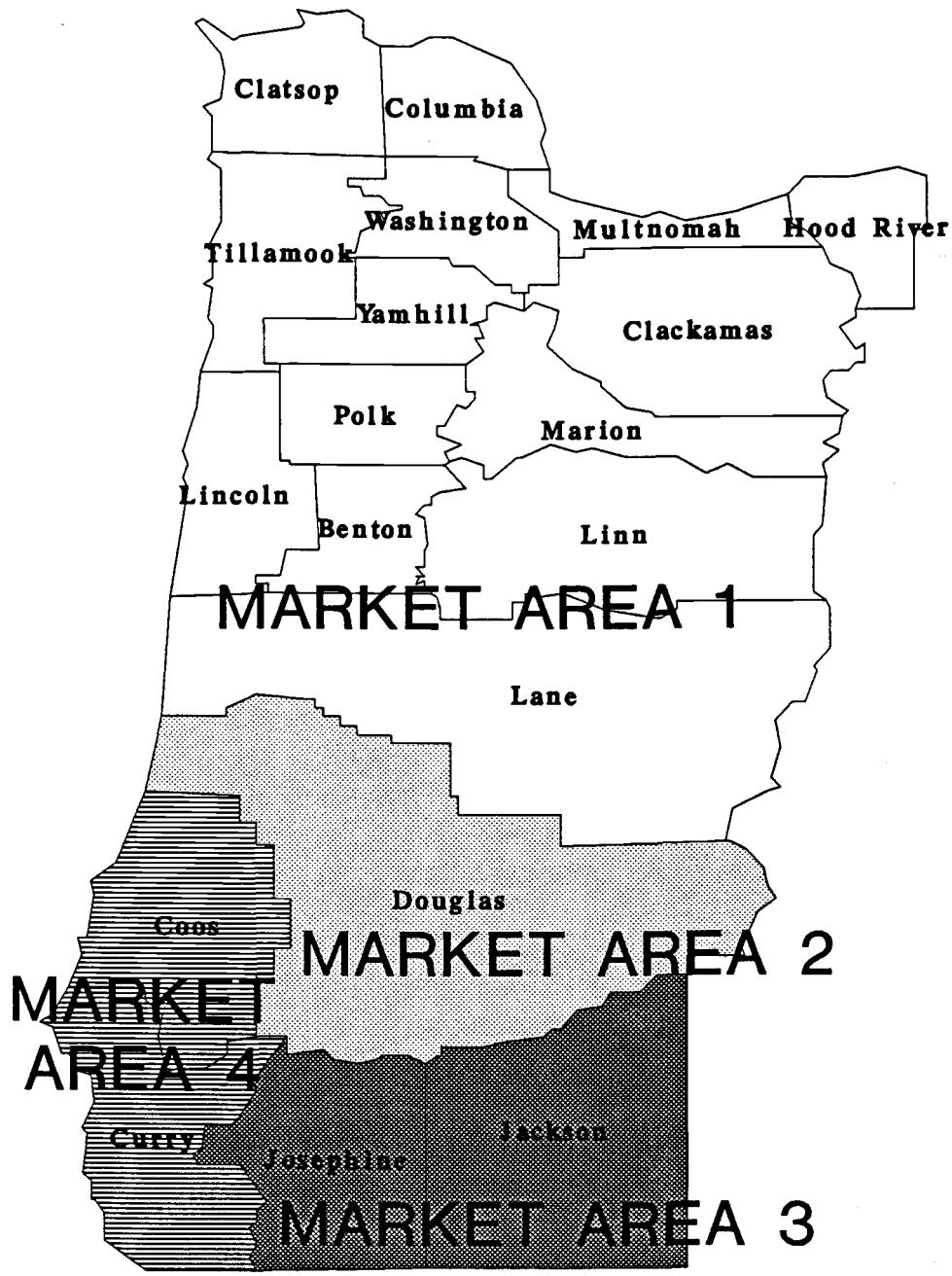


Figure 10. WOST Market Areas

and Hood River counties, have a relatively small percentage of the total WOSTOT lands.

While Table 6 shows the total contributions of each county to WOSTOT acreages, it does not show how the total number of NIPF acres in each county influences the rankings. Lane county, for example, is likely to have more acres in WOSTOT than Hood River because there are more than 20 times as many NIPF acres in the county. To examine the popularity of the WOSTOT tax within each individual county, percentage of total acres allocated to WOSTOT vs WOST within each county are examined. The results are shown in Table 7.

The WOSTOT option is still most popular in the market area 1 inland counties (including Hood River). Market area 1 coastal counties (this time including Lane county), Multnomah county, and market area 3 counties still rank in the bottom half of counties favoring WOSTOT. WOSTOT, as expected, is least preferred in market areas 2 and 4 (Douglas, Curry, and Coos counties).

The discussion thus far still does not explain why relatively few land owners in coastal counties and Multnomah county in market area 1 use the WOSTOT tax option.

One factor influencing the choice between WOST and WOSTOT in a particular county is the level and range of WOST FLVs in each site class. Referring back to figure 10, those

Table 7. Percent of Western Oregon NIPF WOST and WOSTOT Within Individual Counties

Counties	WOST Market Areas	WOSTOT		WOST NIPF		TOTAL NIPF	
		% of County Total	Rank	% of County Total	Rank	Acres (100%)	Rank
Washington	1	28.20%	1	71.80%	19	88,000	8
Clackamas	1	24.57%	2	75.43%	18	150,000	4
Columbia	1	22.72%	3	77.28%	17	78,000	10
Benton	1	18.31%	4	81.69%	16	56,000	14
Marion	1	17.41%	5	82.59%	15	69,000	12
Polk	1	17.08%	6	82.92%	14	54,000	15
Yamhill	1	15.92%	7	84.08%	13	80,000	9
Linn	1	12.88%	8	87.12%	12	103,000	7
Hood River	1	12.39%	9	87.61%	11	14,000	19
Lincoln	1	9.40%	10	90.60%	10	65,000	13
Lane	1	9.04%	11	90.96%	9	226,000	2
Clatsop	1	8.63%	12	91.37%	8	38,000	16
Jackson	3	6.08%	13	93.92%	7	156,000	3
Tillamook	1	4.35%	14	95.65%	6	36,000	18
Josephine	3	4.26%	15	95.74%	5	112,000	6
Multnomah	1	4.13%	16	95.87%	4	37,000	17
Douglas	2	1.54%	17	98.46%	3	292,000	1
Coos	4	1.09%	18	98.91%	2	141,000	5
Curry	4	0.29%	19	99.71%	1	77,000	11

land owners who find themselves in counties with the very highest WOST value areas (high WOST FLVs) should elect to be taxed under WOSTOT, while those with mid or low FLVs would be more inclined to prefer WOST (assuming a discount rate of 4% or higher). It is consistent with the findings so far to suggest that WOSTOT may be relatively unpopular in the

market 1 costal counties because they have lower WOST FLVs than other market area 1 counties. Since it is well accepted that forestlands on the west side of the Coast Range (in the coastal counties of market area 1) are among the most productive forestlands in the world, the analysis will focus primarily on high site FLVs in market area 1 counties.

Table 8 shows the level and range of WOST FLVs for higher site lands (WOST land classes FA and FB) in market area 1 counties, arranged in descending order of average FLVs for FA and FB lands (the same order for both land classes). With the exception of Multnomah county, Table 8 demonstrates that WOSTOT is generally most used in those counties that have the highest average WOST land values on higher site lands (the inland counties).

Multnomah county is anomalous, in that it is highly populated (Portland). It is reasonable to believe that owners in Multnomah county are basing the selection of their forest taxation system on criteria other than timber production. For example, some lands that are being taxed as designated forestland may be owned for reasons than other than timber production, e.g. speculative reasons (future rural homesites or other development), recreational properties, etc. If these stands are understocked or under-

Table 8. Market Area 1 High Site WOST FLVs

Rank	Rank in		WOST Land Class					
	Table 7		FA - FLVs			FB - FLVs		
		Counties	Hi	Low	AVG	Hi	Low	AVG
1	3	Columbia	322	300	311	265	231	254
2	14	Multnomah	322	300	311	265	231	248
3	7	Yamhill	322	285	304	265	231	248
4	1	Washington	322	285	302	265	231	242
5	2	Clackamas	322	276	298	265	208	236
6	6	Polk	322	276	294	265	211	236
7	4	Benton	322	276	294	265	211	236
8	12	Clatsop	322	276	294	265	202	233
9	5	Marion	322	247	285	265	195	228
10	10	Lincoln	285	276	282	231	216	226
11	13	Tillamook	322	276	287	265	208	225
12	8	Linn	322	247	283	231	189	224
13	11	Lane	322	253	277	265	195	216
14	9	Hood River	-	-	-	-	-	-

managed, land owners would likely find WOST more attractive, as the annual taxes are lower (compared to WOSTOT), and the total tax burden less if future harvests are likely to be low or nonexistent.

Other Factors Affecting the Decision to Select WOSTOT -

While the results of the simulations yield useful information and insights, they cannot account for all possible factors that are considered by landowners in deciding which taxing system to select. Other considerations that are not easily included in a modeling framework are

discussed below.

Management Intensity - The SEVs and site burdens yielded by the simulations are based on optimal management regimes for timber production. In reality, many NIPFs, for a variety of reasons, do not mange their lands to optimize for timber production. As has been previously noted, more intensive management by NIPFs could substantially increase the future timber supply (Sessions et.al. 1989). A major argument used before the 1991 state legislature by the Oregon Small Woodlands Association (OSWA) for retaining the WOSTOT system is that it tends to encourage intensive management (Carlson, 1991). Since the WOSTOT tax is a fixed annual cost (regardless of stocking or management intensities), site burdens are lowest for those managers who maximize their per acre net revenues. Additional returns to more intensive management are not taxed (unlike WOST). Since WOSTOT is optional, those landowners who elect to be taxed under WOSTOT are likely to be those who manage their forestlands more intensively. Those land owners who are less interested in intensive forest management would be more likely to use the WOST option, as the annual taxes are generally lower and the yield tax can be postponed indefinitely.

Harvesting Decisions - The simulation results demonstrate that neither WOSTOT nor WOST affect the timing

or intensities of thinnings or final harvests under an optimal management regime. Cash flow concerns may, however, affect harvest decisions. Since WOSTOT taxes are due annually, while revenues are received only periodically, there may be a tendency for WOSTOT owners to harvest prematurely to meet immediate cash flow requirements imposed by annual taxes. Under WOST, on the other hand, revenues coincide with the tax bill, and owners are less likely to base harvesting decisions on cash flow requirements under the lower WOST land taxes.

Magnitude of Tax Savings - For small woodlot owners with small parcels on lower site lands, meager potential tax savings may not justify the time and effort necessary to learn about and compare possible tax options. Land owners with a high time preference for money, as well as those whose primary objectives do not include timber management, would likely select lower annual WOST land taxes, considering the yield tax insignificant and too far in the future to factor into their decisions.

"Tax Switching" - The modeling approach used assumes that landowners do not switch between the two tax systems. Since there is currently no penalty for switching between the WOST and WOSTOT systems (Sutherland 1983), it appears that some NIPFs may be able to pay fewer taxes by switching back and forth between WOST and WOSTOT. Generally, WOST is

more advantageous at the beginning of a rotation (lower annual taxes, except on site 5 lands), while WOSTOT would be more advantageous at the end of a rotation (no yield tax). A tax minimizing strategy in this circumstance would be to put bare land under WOST, and grow timber up to the upper limits acceptable for entry into WOSTOT (less than 8" DBH or less than 40 years old). The land would then be switched into WOSTOT for the remainder of the rotation (thereby avoiding yield taxes on any commercial thinnings and final harvest), and then switched back into WOST at the time of regeneration. The same logic applies for those purchasing land with standing timber, as long as it is initially below the WOSTOT limits. This assumes, of course, that there are no costs associated with switching from one tax to another. It is possible that the costs to the land owner of switching from one tax system to another (in terms of both time and money) may exceed the benefit of the potential tax savings.

Ballot Measure 5 - On November 6, 1990, Oregonians voted for the passage of Ballot Measure 5. Measure 5 created a constitutional limit on state and local property taxes. When fully phased in (1995-96), the limits are ½% for schools and 1% for all other uses. Because of a number of uncertainties as to how Measure 5 relates to timber taxes, the Legislature temporarily redefined the WOST yield tax as a tax on the privilege of harvesting timber, exempting it

from Measure 5 limits. These changes, however, sunset on January 1, 1994. The excise tax rates were initially set below the old severance tax rates, and are further reduced through June 30, 1994 (Table 9).

Table 9. Post-Measure 5 Timber Excise Tax Rates

Timber Harvested Between -	WOST Yield Tax Rate
[Prior Tax Rates]	6.50%
July 1, 1991 through June 30, 1992	5.85%
July 1, 1992 through June 30, 1993	5.30%
July 1, 1993 through June 30, 1994	4.70%

The lowering of WOST yield tax rates will clearly make WOST more preferable than the original analysis would indicate. By allowing WOST landowners to keep more of their thinning and harvest revenues, site burdens are lowered across the board for all WOST lands. This was clearly intended to be only a temporary solution to the issue, as indicated by the sunset provision. The 1993 legislature will be responsible for coming up with more definitive solutions to how Measure 5 limits will affect timber taxation. Depending on the outcomes, those solutions may have significant impacts on how small NIPF landowners elect to be taxed.

Public Policy Considerations and NIPF Timber Taxation -

This study has focused predominantly on the impacts of

timber taxation from the vantage point of the small NIPF landowner. The discussion is incomplete, however, without considering the public policy impacts of the different timber tax systems. In this final section, issues relating to WOST and WOSTOT are examined from the vantage point of state and local taxing authorities.

Historically, public policy goals have played an important part in shaping the timber tax climate. Some of the most important goals considered in formulating timber tax laws have been: (1) equity - timber lands should have tax burdens similar to other productive enterprises, and different timber tax systems should bear similar tax burdens; (2) neutrality - taxes should not distort land-use patterns, driving commercial timberland into other less productive uses; (3) production - taxes should encourage correct rotation lengths and intensive forest management; (4) consistency - taxes should provide an even, predictable flow of tax revenues; and (5) fiscal efficiency - taxes should be implemented such that they meet other taxation goals in an efficient manner, maximizing net tax revenues (gross revenues-administration costs). These issues warrant some consideration, and are discussed below.

Equity - Comparing the equity of timber tax systems with taxes on other types of real property is beyond the scope of this study. Comparing the equity of WOST and WOSTOT

was one of the objectives of the study, however. The results and discussion have shown that while WOSTOT site burdens tend to be roughly comparable to mid WOST site burdens in general, some small NIPF tax payers may find certain tax advantages under the WOSTOT option. A particular concern to taxing authorities should be the "loophole" created by switching from one tax system to another, which, from a tax revenues vantage point at least, is inequitable and should be closed in the tax law or regulations.

Neutrality - Another objective of the study was to examine the neutrality of WOST and WOSTOT tax systems. Simulation results show that both tax systems are neutral with respect to land use, i.e., neither tax option has a site burden that is confiscatory (lowers positive pretax SEVs below 0).

Production - The third objective of the study was to examine if WOST and/or WOSTOT affected optimal timber management regimes. Simulation results show that both WOST and WOSTOT encourage correct rotation lengths, and neither influences optimal management practices. As noted previously in the discussion, however, WOSTOT might in some instances foster premature harvesting to meet cash flow requirements imposed by annual land taxes. On the other hand, it was noted that WOSTOT may encourage more intensive management by not taxing harvests.

Until 1991, WOSTOT regulations contained more stringent reforestation requirements than WOST regulations. In addition to the requirements for compliance with the state Forest Practices Act (to which both WOST and WOSTOT lands were subject), the WOSTOT regulations provided for periodic follow-up surveys after 5 years to ensure that regenerated stands are in fact "free to grow" and that established stands comply with WOSTOT requirements. This may have had some (depending on administration costs) net benefit to the state in terms of increased future timber supply. This potential benefit, however, is not properly attributed to the WOSTOT tax system, but rather to the accompanying regulations. Amendments to the Forest Practices Act by the 1991 legislature, however, now require replanting on **all** harvested lands of at least 200 TPA, within one year of logging. Follow up surveys are also now mandated on all reforested lands, to ensure that stands are free to grow 5 years after planting.

Consistency - While WOSTOT provides predictable annual tax revenues (from a given land base) WOST tax revenues may vary widely from year to year, depending on the harvest and stumpage values. The state has instituted a revenue distribution system that moderates these annual fluctuations. Local governments may be particularly vulnerable to reductions in WOST tax revenues in times of

recessionary downturns, when stumpage values (and associated tax revenues) tend to fall.

In the long term, WOST tax revenues are dependent on the sustainable level of harvest. These levels may rise in some counties and fall in others, depending on existing age class distributions and management intensities. WOSTOT taxes, on the other hand, are based on the productive timberland base, and tax revenues are not dependent on harvest levels. Withdrawals of forestlands from the timberland base precipitated by increased regulation (e.g., buffer strips) or mandated by the law or the courts (e.g., endangered species habitat) can permanently lower both WOSTOT and WOST tax revenues, (1) by reducing the taxable land base (WOSTOT), and (2) reducing future taxable timber production (WOST).

Fiscal Efficiency - The study does not address this issue directly, i.e., which system is likely to generate higher discounted per acre net tax revenues (capitalized total tax revenues - capitalized costs of administering tax system). From a public policy perspective, however, it is an important issue. While the two tax systems might (or might not) generate roughly comparable capitalized gross per acre tax revenues over a rotation, one might have substantially higher administration costs than another. One expense that is incurred under WOSTOT, for example, is conducting an

annual inventory of the taxable land base. As mentioned previously, forestlands that are forced out of production must, on equity grounds, be excluded from taxation as commercial forestland. This requires each county assessor to annually inventory all forested land in the county, to determine which acres are taxable as timberlands. While this issue is beyond the scope of this study, it will likely be important to legislators in their attempts to grapple with changes in current tax laws during the 1993 legislative session.

CONCLUSIONS

The study examines timber tax options available to small NIPF land owners in Western Oregon, the Western Oregon Land and Severance Tax (WOST), and the Western Oregon Small Tract Optional Tax (WOSTOT). The WOSTOT timber tax option was passed in 1961 to provide some tax relief from an ad valorem land and timber tax system for small NIPF land owners, and to encourage them to carry stands to their full economic rotation age. Timber taxes on most other forestlands remained relatively unchanged until the WOST timber tax system was passed in 1977. The WOST tax option also is accepted as promoting correct economic rotation ages. Since WOSTOT was retained in spite of the passage of WOST, it was hypothesized that some group of small NIPF land owners must find some tax advantage in being taxed under the optional WOSTOT system, rather than the otherwise mandatory WOST system.

The study focused on addressing four specific objectives; (1) given the different timing and magnitude of WOSTOT and WOST taxes, how do they compare in accomplishing the their common stated objective of fostering timber production, (2) are the two tax systems equitable relative to each other, (3) are the two tax systems neutral with respect to land use, and (4) which NIPF landowners are likely to use WOSTOT rather than WOST, and why?

Utilizing the Stand Optimization System (SOS) dynamic programming optimization model, the different timber tax systems were compared, examining if and how they affected; (1) timber production, including the timing and intensity of thinnings and final harvest rotation age, as well as merchantable **m**ean **a**nnual **i**ncrement (MAI), and (2) **S**oil **E**xpectation **V**alues (SEVs) and site burdens.

The results of the simulations showed no timber production or land-use impacts could be attributed to either timber tax system. It was found, however, that the tax systems were not always equitable, i.e., certain NIPF landowners were likely to find WOSTOT provided preferential tax treatment (higher SEVs and lower site burdens) when compared to WOST. Those taxpayers most likely to benefit under the WOSTOT system; (1) were in high WOST land tax zones, (2) had lower site lands, and (3) had low discount rates, or time preferences for money.

Examining NIPF land ownerships by county and tax type indicated that the most important consideration in deciding whether to be taxed under WOST or WOSTOT was probably the level of WOST land values, with those owners in counties with high WOST land values being those most likely to select WOSTOT.

While the results of the simulations yield useful information and insights, they cannot account for all

possible factors that are considered by landowners in deciding which taxing system to select. Other issues addressed include; how the selection of a timber tax system relates to anticipated management intensities, possible cash flow effects on harvesting decisions, the importance of the magnitude of tax savings in selecting a timber tax system, tax switching as a tax minimizing strategy, and the effects of Ballot Measure 5 on NIPF timber taxes.

Finally, the two timber tax systems were examined from the perspective of the taxing entities. Public policy issues relating to the WOST and WOSTOT tax systems that were addressed included; (1) equity, (2) neutrality, (3) production, (4) consistency, and (5) fiscal efficiency.

It is hoped that the results of this study will be of use to: (1) the legislature and other policy makers, particularly if it becomes necessary to revamp timber taxes in light of ballot measure 5; (2) small western Oregon NIPFs who may be confused by the different tax options available; (3) the Oregon Department of Forestry (administrators of WOSTOT); and (4) the Oregon Department of Revenue (administrators of WOST).

BIBLIOGRAPHY

Adams, D.M. and R.W. Haynes. 1990. Public Policies, Private Resources, and the Future of the Douglas-Fir Region Forest Economy. Western Journal of Applied Forestry. 5:64-69.

Alig, R.J., K.J. Lee, and R.J. Moulton. 1990. Likelihood of Timber Management on Nonindustrial Private Forests: Evidence from Research Studies. USDA Forest Service. Southeastern Forest Experiment Station. General Technical Report SE-60. Ashville, North Carolina. 17 p.

Arney, J.D. 1985. A Modeling Strategy for the Growth Projection of Managed Stands. Canadian Journal of Forest Research. 15:511-518.

Barrett, J.W. 1980. Regional Silviculture of the United States. John Wiley and Sons, New York. 551p.

Bentick, B.L. 1979. The Impact of Taxation and Valuation Practices on the Timing and Efficiency of Land Use. The Journal of Political Economy. 87:859-68.

Bentick B.L. 1980. Property and Income Taxation in Rural Industries with Different Rotation Periods. National Tax Journal. 33:219-25.

Birch, T.W., D.G. Lewis, and H.F. Kaiser. 1982. The Private Forest Landowners of the United States. USDA Forest Service. Resource Bulletin WO-1. Washington, D.C. 64 p.

Buongiorno, J. and J.K. Gilless. 1987. Forest Management and Economics. Macmillan, New York. 285 p.

Carlson, G. 1991. Personal communication.

Chang, S.J. 1982. An Economic Analysis of Forest Taxation's Impact on Optimal Rotation Age. Land Economics. 58:310-23.

Chang, S.J. 1983. Rotation Age, Management Intensity, and the Economic Factors of Timber Production: Do Changes in Stumpage, Price, Interest Rate, Regeneration Cost, and Forest Taxation Matter? Forest Science. 29:267-78.

Clark, C.W. 1976. Mathematical Bioeconomics - The Optimal Management of Renewable Resources. John Wiley and Sons, New York. 352 p.

Daniel, T.W., J.A. Helms and F.S.Baker. 1979. Principles of Silviculture. 2nd ed. McGraw-Hill, New York. 500p.

Davis, L.S. and K.N. Johnson. 1987. Forest Management. 3rd ed. McGraw-Hill, New York. 790 p.

Dowdle, B. 1980. Some Problems in the Theory of Forestry Property Taxation. p. 93-111. In State Taxation of Forest and Land Resources: Symposium Proceedings. W. Knedlick ed. Lincoln Institute of Land Policy. Cambridge, Massachusetts.

Drew, T.J. and J.W. Flewelling. 1979. Stand Density Management: An Alternative Approach and its Application to Douglas-Fir Plantations. Forest Science. 25:518-532.

Duerr, W.A. 1960. Fundamentals of Forestry Economics. McGraw Hill, New York. 579 p.

Dykstra, D.P. 1984. Mathematical Programming for Natural Resource Management. McGraw Hill, New York. 318 p.

Fairchild, F.R. 1908. The Taxation of Timberlands in the United States. p. 69-82 in National Tax Association Proceedings of 2nd National Conference.

Fairchild, F.R. 1935. Forest Taxation in the United States. U.S.D.A. Miscellaneous Publication 218. Washington, D.C.

Faustmann, M. 1849. On the determination of the value which forest land and immature stands possess for forestry. p. 27-55. In Institute Paper 42. M. Gane ed. Commonwealth Forestry Institute, University of Oxford, U.K.

Fisher, I. 1930. The Theory of Interest. MacMillian Company, New York.

Gamponia, V. and R. Mendehlson. 1987. The Economic Efficiency of Forest Taxes. Forest Science. 33:367-377.

Gaffney, M. 1978. An Overview of Forest Taxation: Pros and Cons of Alternative Forest Taxes. p. 4-16 in Proceedings of the Forest Taxation Symposium. Virginia Polytechnic Institute and State University FWS 2-78. Blacksburg, Virginia.

Gedney, D.R. 1988. The Private Timber Resource. p. 53-7 in Proceedings of the 1988 Southern Forest Economics Workshop. ed. R.C. Abt. Orlando, Florida.

Gedney, D.R., P.M. Basset, M.A. Mei. 1986a. Timber Resources for Non-Federal Forest Land in Southwest Oregon. USDA Forest Service. Pacific Northwest Research Station. Resource Bulletin PNW-138. Portland, Oregon. 26 p.

Gedney, D.R., P.M. Basset, M.A. Mei. 1986b. Timber Resources for Non-Federal Forest Land in Northwest Oregon. USDA Forest Service. Pacific Northwest Research Station. Resource Bulletin PNW-140. Portland, Oregon. 26 p.

Gedney, D.R., P.M. Basset, M.A. Mei. 1987. Timber Resources for Non-Federal Forest Land in West-Central Oregon. USDA Forest Service. Pacific Northwest Research Station. Resource Bulletin PNW-143. Portland, Oregon. 26 p.

Greber, B.J., K.N. Johnson and G. Lettman. 1990. Conservation Plans for the Northern Spotted Owl and Other Forest Management Proposals in Oregon: The Economics of Changing Timber Availability. Forest Research Laboratory, Oregon State University. Corvallis, Oregon. Papers in Forest Policy 1. 50 p.

Gregory, G.R. 1987. Resource Economics For Foresters. 2nd ed. John Wiley & Sons, New York. 477 p.

Heaps, T. 1981. The Qualitative Theory of Optimal Rotations. Canadian Journal of Economics. 14:686-99.

Henke, Joseph T. 1969. Taxation of Timber and Timberlands in Oregon. Bureau of Governmental Research and Service, University of Oregon, Eugene, Oregon.

Hickman, C.A. 1982. Emerging Patterns of Forest Property and Yield Taxes. P. 52-65 in Proceedings Forest Taxation Symposium II. Virginia Polytechnic Institute and State University FWS 4-82. Blacksburg, Virginia.

Hickman, C.A. 1989.Inconsistent Forest Property Tax Policies Within Selected Southern States. U.S.D.A. Forest Service. Southern Forest Experiment Station. Research Paper SO-253. New Orleans, Louisiana. 7p.

King, J.E. 1966. Site Index Curves for Douglas-fir in the Pacific Northwest. Weyerhaeuser Company. Forestry Research Center. Weyerhaeuser Forestry Paper 8. Centralia, Washington. 49p.

Klemperer, W.D. 1974. Forests and the Property Tax - A Reexamination. National Tax Journal. 27:645-651.

Klemperer, W.D. 1975. Evaluating Forest Tax Alternatives for Oregon. Prepared for the Oregon Legislative Interim Committee on Revenue. Salem, Oregon. 244 p.

Klemperer, W.D. 1976a. Impacts of Tax Alternatives on Forest Land Values and Investment. Land Economics. 52:135-157.

Klemperer, W.D. 1976b. Economic Analysis Applied to Forestry: Does It Short-Change Future Generations? Journal of Forestry. 74:609-611.

Klemperer, W.D. 1977. Unmodified Forest Property Tax - Is it Fair? Journal of Forestry 75:650-652.

Klemperer, W.D. 1978. An Analysis of Forest Tax Equity Guides. Forest Science. 24:318-326.

Klemperer, W.D. 1982. An Analysis of Selected Property Tax Exemptions for Timber. Land Economics. 58:293-309.

Kronrad, G.D. and J.E. de Steiguer. 1983. Relationships between the discount rates and investment lengths among nonindustrial private forest landowners. p. 109-112 in Nonindustrial Private Forests: A review of Economic and Policy Studies. J.P. Royer ed. School of Forestry and Environmental Studies, Duke University. Durham, N.C.

Lindholm, R.W. 1973. Taxation of Timber Resources to Maximize Equity and Wood Fiber Production (an Oregon Case Study). Bureau of Business and Economic Research. Business Publication 5. University of Oregon. Eugene, Oregon. 91p.

Long, J.N., J.B. McCarter, and S.B. Jack. 1988. A Modified Density Management Diagram for Costal Douglas-Fir. Western Journal of Applied Forestry. 3:88-89.

MacClean, C.D. 1988. Opportunities for Increasing Productivity on Nonindustrial Private Forest Land. p. 251-3 in Proceedings of the 1988 Southern Forest Economics Workshop. ed. R.C. Abt. Orlando, Florida.

Manning, G.H. and E.F. Thompson. 1969. Forest Property Taxation: Another Look. Journal of Forestry. 67:556-59.

Martell, D.L. 1980. The Optimal Rotation of a Flammable Forest Stand. Canadian Journal of Forest Research. 10:33-4.

McDonell, N.R. 1978. The Ad Valorem Tax on Forest Property. P. 92-97 in Proceedings Forest Taxation Symposium. Virginia Polytechnic Institute and State University FWS 2-78. Blacksburg, Virginia.

Meeks, G. Jr. 1982. State Incentives for Nonindustrial Private Forestry. Journal of Forestry. 80:18-82.

Nautiyal, J.C. and K. Fowler. 1980. Optimum Forest Rotation in an Imperfect Stumpage Market. Land Economics. 56:213-16.

Nautiyal, J.C. and J.S. Williams. 1990. Response of Optimal Rotation and Management Intensity to One-Time Changes in Stumpage Price, Management Cost, and Discount Rate. Forest Science. 36:212-23.

Niemi, K.C. 1978. The Land Owner Through a Forester's Eyes. p. 65-71 in Proceedings Forest Taxation Symposium. Virginia Polytechnic Institute and State University FWS 2-78. Blacksburg, Virginia.

Noguchi, Y. 1982. On the Neutrality of the Property Tax. Land Economics. 58:383-85.

Oregon State Department of Forestry. 1990. Unpublished.

Oregon State Department of Revenue. 1991. Unpublished.

Oregon State Legislative Revenue Office. 1986a. Revenue Form Timber in Oregon. Research Report 2-86. Salem, Oregon. 10p.

Oregon State Legislative Revenue Office. 1986b. Distribution of Oregon Timber Severance Tax Receipts. Research Report 6-86. Salem, Oregon. 8p.

Oregon State Legislative Revenue Office. 1986c. History of Oregon Timber Taxes. Research Report 7-86. Salem, Oregon. 9p.

Oregon Revised Statutes. 1989a. Chapter 321.710.

Oregon Revised Statutes. 1989b. Chapter 321.765

Pasour, E.C. and D.L. Holley. 1976. An Economic Analysis of the Case Against Ad Valorem Property Taxation in Forestry. National Tax Journal 29:155-63.

Pearse, P. 1967. The Optimal Forest Rotation. Forest Chronicle. 43:178-95.

Row, C., H.F. Kaiser, and J. Sessions. 1981. Discount Rate for Long-term Forest Service Investments. Journal of Forestry. 79:367-369.

Sachet, J.K.A., D.G. Briggs, and R. D. Fight. 1989. Tree Value System: Users Guide. U.S.D.A. Forest Service. Pacific Northwest Research Station. General Technical Report PNW-GTR-234. Portland, Oregon. 45 p.

Samuelson, P.A. 1976. Economics of Forestry in an Evolving Society. Econ. Inquiry. 14(4):466-492.

Sessions, J., K.N. Johnson, J. Beuter, B. Greber, and G. Lettman. 1989. Timber for Oregon's Tomorrow: The 1989 Update. Forest Research Laboratory. Oregon State University. Corvallis, Oregon. 183 p.

Siegel, W.C. 1982. The Tax Climate. Chapter 26 in Forest Resource Management. W.A. Duerr, D.E. Teeguarden, N.B. Christiansen, S. Guttenberg, eds. p. 363-380. Oregon State University Book Stores. Corvallis, Oregon.

Silberberg, E. 1990. The Structure of Economics: A Mathematical Analysis. McGraw Hill, New York. 686p.

Smith, D.M. 1986. The Practice of Silviculture. 8th ed. John Wiley and Sons, New York. 527 p.

Special Committee on Timber Taxation. 1937. Oregon's Timber Taxation Problems. Table No. 4, p.28.

Stier, J.C. and S.J. Chang. Land Use Implications of the Ad Valorem Property Tax: The Role of Tax Incidence. Forest Science. 29:702-12.

Sutherland, C.F. Jr. 1983. Forest Property Taxation in Western Oregon. Extension Circular 1136. Oregon State University. Corvallis, Oregon.

Timber Tax Journal. 1984. Annual Survey of State Forest Tax Law Developments. Volume 20. Washington, D.C.

Trestrail, R.W. 1969. Forests and the Property Tax - Unsound Accepted Theory. National Tax Journal 22:347-356.

Wilson, S. and P. Malone. 1948. Instability of Forest Land Ownership in Western Oregon. Pacific Northwest Forest Range and Research Station. Portland, Oregon.

Yoshimoto, A. 1987. An Efficient Optimizing Model for Determining Thinning Regime and Rotation Age Using the Stand Projection System Growth Simulator. MS Thesis, Oregon State University. Corvallis, Oregon. 96p.

Yoshimoto, A., G.L. Paredes, and J.D.Brodie. 1988. Efficient Optimization of an Individual Tree Growth Model. p. 154-162 in The 1988 Symposium on System Analysis is Forest Resources. USDA Forest Service Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-161. Fort Collins, Colorado.