

Sta. Barbara talk on TYPIS

Mason

Gaffney

Yield tax, equiv. rates.

$$\tau = \theta$$

$$\tau = s(1-\tau) \tau c / (1-e^{-im})$$

$$\theta = s\left(n - \frac{cy}{s}\right) = sn - cy$$

$$s(1-\tau) - \tau c / (1-e^{-im}) = s\left(n - \frac{cy}{s}\right)$$

Solve for τ

$$s - \tau\left[s + \frac{c}{1-e^{-im}}\right] = s\left(n - \frac{cy}{s}\right)$$

$$\tau\left[s + \frac{c}{1-e^{-im}}\right] = s\left[1 - n + \frac{cy}{s}\right]$$

$$\tau = \frac{s\left[1 - \left(n - \frac{cy}{s}\right)\right]}{s + \frac{c}{1-e^{-im}}} = \frac{1 - \left(n - \frac{cy}{s}\right)}{1 + \frac{c/s}{1-e^{-im}}}$$

$$c/s = 1,$$

m

τ

10

$$\frac{1 - .84 + .17}{1 + \frac{1}{1/2}} = \frac{.33}{3} = .11$$

~~50~~

50

$$\frac{1 - .62 + .40}{1 + \frac{1}{31/32}} = \frac{.79}{2.03} = .389$$

100

$$\frac{1 - .39 + .63}{2} = .62$$

Inc. Tax, eq. rate.

$$\pi = 0$$

$$\pi = S - r(C + S)$$

$$0 = S \left[r - \frac{C}{S} \right]$$

where $p = .01$ for $r + \psi$

$$S - r(C + S) = S r - C \psi$$

$$S(1 - r) + C \psi = r(C + S)$$

$$r = \frac{S(1 - r) + C \psi}{C + S} = \frac{1 - r + \frac{C}{S} \psi}{\frac{C}{S} + 1}$$

$$\text{For } C/S = 0, \quad r = 1 - r$$

$$\text{For } C/S = 1, \quad m = 50, \quad r = \frac{1 - \overset{.62}{\cancel{.38}} + .40}{2} = .39$$

$$m = 10, \quad r = \frac{1 - .84 + .17}{2} = .16$$

$$m = 100, \quad r = \frac{1 - .39 + .63}{2} = .62$$

$$\psi = \left[\frac{e^{pm} - 1}{e^{pm} - e^{-im}} \right] \frac{e^{im}}{e^{im}} = \frac{e^{(i+p)m} - e^{im}}{e^{(i+p)m} - 1}$$

$$\mathcal{R} = \frac{e^{im} - 1}{e^{(i+p)m} - 1}$$

$$\psi + \mathcal{R} \equiv 1$$

$$\theta = \frac{R \cdot C e^{(i+p)m}}{e^{(i+p)m} - 1} = \frac{s(e^{im} - 1) + C(e^{im} - e^{(i+p)m})}{e^{(i+p)m} - 1}$$

$$= s \frac{e^{im} - 1}{e^{(i+p)m} - 1} - C \frac{e^{pm} - 1}{e^{pm} - e^{-im}}$$

$$R + \psi \stackrel{?}{=} 1$$

$$\frac{e^{im+pm} - \cancel{e^{pm}} + e^{-im} + e^{pm+(im)+pm} - e^{(i+p)m} - \cancel{e^{pm}} + \cancel{e^{im}}}{e^{(i+p)m+pm} - e^{pm} - e^{\cancel{im}+pm-\cancel{im}} + e^{-im}} = 1$$

$$\cancel{e^{(i+p)m}} - \cancel{2e^{pm}} + \cancel{e^{-im}} + \cancel{e^{2pm+im}} - \cancel{e^{(i+p)m}} \stackrel{?}{=}$$

$$\cancel{e^{im+2pm}} - \cancel{2e^{pm}} + \cancel{e^{-im}}$$

$$\text{QED, } R + \psi = 1$$

$$\text{So, } \theta/s = R - C/s(1-R)$$

$$\theta = sR - C + RC = R(s+C) - C$$

$$\frac{\theta}{s} = R \left(1 + \frac{C}{s}\right) - \frac{C}{s}$$

Yield Tax Case

x = time

t = tax rate

$x_0(t)$ optimum maturity (year m)

$c_0(t)$ optimum stocking

$$\text{Max } (1-t) R(x, c) e^{-ix} - C - S$$

$$\text{F.O.C. (1)} (1-t) R_x e^{-ix} - i(1-t) R e^{-ix} = 0$$

$$(2) (1-t) R_c e^{-ix} - 1 = 0$$

or ~~$R_x = i$~~

$$(1') R_x(x_0(t), c_0(t)) - i R(x_0(t), c_0(t)) = 0$$

$$(2') (1-t) R_c(x_0(t), c_0(t)) - e^{ix} = 0$$

Differentiate implicitly

$$\begin{pmatrix} R_{xx} - i R_x & R_{cx} - i R_c \\ R_{cx} - i e^{ix} & R_{cc} \end{pmatrix} \begin{pmatrix} \frac{dx_0}{dt} \\ \frac{dc_0}{dt} \end{pmatrix} = \begin{pmatrix} 0 \\ R_c \end{pmatrix}$$

$$\Delta = \det \begin{pmatrix} R_{xx} - i R_x & R_{cx} - i R_c \\ R_{cx} - i e^{ix} & R_{cc} \end{pmatrix} \quad (1) \Delta > 0 \text{ since } \text{matrix} \text{ must be neg. definite}$$

$$(2) R_{xx} - i R_x < 0 \text{ since matrix " " " "}$$

KEY ASSUMPTION

$$(3) \text{ Assume } \frac{d}{dc} (R_x - i R) < 0 \text{ i.e. lower reproduction} \Rightarrow \text{longer maturity}$$

$$\begin{pmatrix} \frac{dx_0}{dt} \\ \frac{dc_0}{dt} \end{pmatrix} = \frac{1}{\Delta} \begin{pmatrix} R_{cc} & -(R_{cx} - i R_c) \\ -(R_{cc} - i e^{ix}) & R_{xx} - i R_x \end{pmatrix} \begin{pmatrix} 0 \\ R_c \end{pmatrix}$$

$$\frac{dx_0}{dt} = - \frac{(R_{cx} - i R_c) R_c}{\Delta} > 0$$

$$\frac{dc_0}{dt} = \frac{(R_{xx} - i R_x) R_c}{\Delta} < 0$$

Your desired results.

Jack Marshall

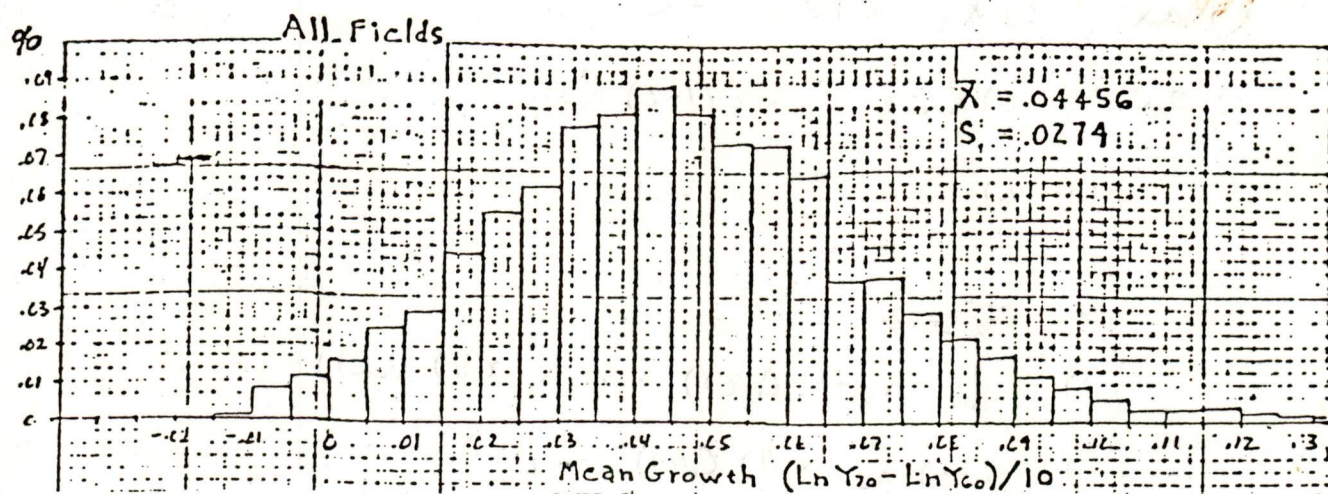


Figure 3 Relative Frequency of Gross Mean Growth, $(\ln Y_{70} - \ln Y_{60}) / 10$

"Taxes on Yield, etc." by M.G.

UCSB, Dec. 2, 1975

Prologue: Signif. of subject is broader than title. Like Wicksell, take as micro-cosm of whole ec. Show substa. effects, factor input substa. Shows effects of like taxes.

Intro: Support for using yield tax — to replace property tax,
(sometimes in conjunction with ~~tax~~ site tax.)

In closed ec., g.e., prop. tax looks pretty good.

Is a Haig-Simons inc. tax. Ralph, Stockfish.

Harberger, Mieszkowski, Saffrey, & sometimes Thomson.
Tax lodges in lower i, if uniform & universal.

Re revenue sharing, is relevant framework.

But is levied in open ec., by counties & states.

(and on some capt., not other). For their decisions,

need relevant assumptions. K mobile, labor pretty

mobile (high turnover), land fixed. So land is residual
inputer — a classical approach anyway. Max. DCF.

If deal w. special forest taxes, can expand land

when get lower taxes, but even this won't affect

imputations so long as demand, L labor & K, are

fully elastic.

Using open ec. assms., I find:

Yield tax not neutral, has excess burdens of 2 kinds: long cycles, & reduces stocking.

Propty. tax not as good as in closed ec., but somewhat better than yield tax.

Inc. tax not greatly better than yield tax, except for short cycles.

Site taxes best:

- by expensing
- by assessing land

Shows how to calculate equivalent tax rates.

I. Yield Tax.

Eggs. 1-5

Bias indicated when $\frac{\sigma}{s} < 1 - \tau$. (5)

Defects.

① Leverage, excess burden, invisible high-grading.

No deduction of costs. So, reduce C , spread out, use more land for labor. ~~also~~

If reduce C to 0, $\frac{\sigma}{s} = 1 - \tau$.

② Bias vs. short cycles

a. Overall. This is harder on good S than poor, b/c. of faster cycles there.

b. Subcycles, i.e. late invts. in T.S.I. E.g. $i + .38$.

Due to deferral of tax. So keeping K tied up

longer is made to look better; but high C is not.

Doubly ~~Further~~ discouraged are ΔC to speed growth.

Show graphs here

Some of the effects may be inferred from Table 2 Graphs.

③ 1 & 2 add up to a bias to subst. ~~time~~ ^{land & K} for labor.

If use less labor for stocking, either:

~~Time means land & K.~~ a) Requires more land - time to stock equally well, so there is less labor, more land - time, and same K , ~~but~~ tied up longer.

~~Spreading out means land for labor. So does~~

b) Stocking is worse, substituting land for ~~longer cycles.~~ labor and K .

→

Both use less labor, and less often. Prop. tax, use less labor, but more often.

④ The "longer cycles" just referred to in ② are between ^{stocking} ~~planting~~ & cutting, where "stocking" is a definite event, a datable event.

In addition, when $\sigma = 0$, there may be an indefinite delay in starting, at no cost to owner, even though social cost is high. Complete downtime for land. (Same problem arises w. prop. tax on trees, and w. Inc. Tax.)

The owner becomes something like Gale Johnson's share tenant, who has no holding cost of land, spreads out.

There is no constraint. (Same problem as imposing a royalty on mineral producer.)

When $\sigma > 0$ but not very much, the constraint is weak. So owners may acquire & hold vast cutovers, and

get around to restocking very slowly. More likely, let them restock themselves, in their own time, if they will.

At ends of cycles, suppressing S has little effect that happens bcs $\sigma < S$ are small.

This is where most analysts, e.g. Pearce, have looked. ~~And is it OK~~

But at beginning, suppressing S has great effect, bcs. S is large w.r.t. C .

(So, V is OK for old-growth, one-time.)
yield tax

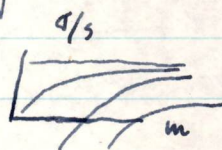
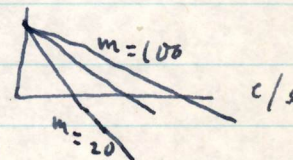
Avoidance responses prevent making $\sigma < 0$. Owner has option to ~~can actually make $\sigma < 0$, but~~ lower C to 0,

and still get a crop by natural regen. [But this takes an uncertain time, and the time is virtually free.]

Due to natural restocking, we know there is a trade off of land for labor. Fu. of labor is largely to advance yields, not just to create or increase them.

~~show~~

Show graphs on board



II. Property Tax

Base is $B_n = \text{inv. value} > \text{liqu. value}$.

Future taxes lower B_n . Residual rent & S bear

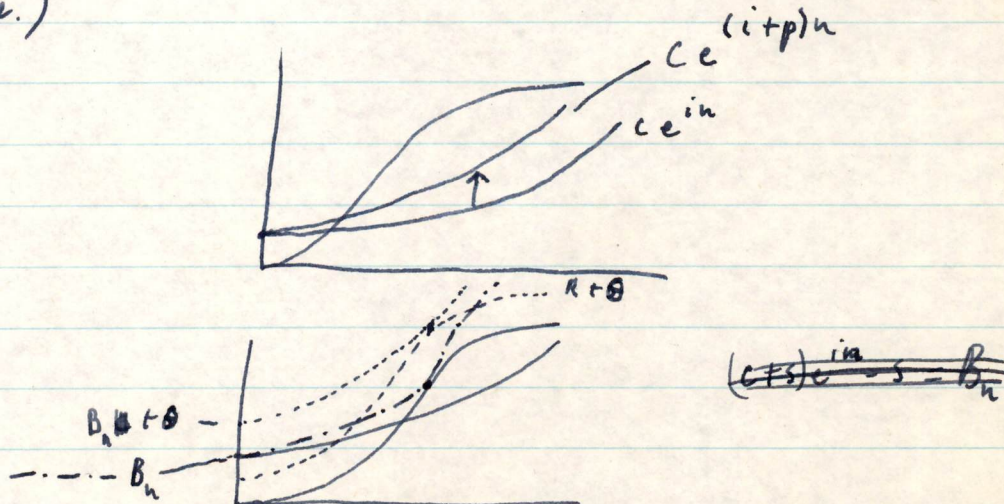
this. (if there is any). S is the cushion that lets taxes be

levied. (B_n ^{begins and} ends up near same value in either case. p subs. later growth for earlier growth of base.)

Equ. 6, 7

Shows Leverage $\rightarrow$

$$B_n = (C + \theta) e^{(i+p)n} - \theta$$



(When p cuts into S , B_n starts up slower, curls up fast at end, like Boulding)

(There are ~~concave upwards~~ ^{straight} yield tax curves are concave downwards)

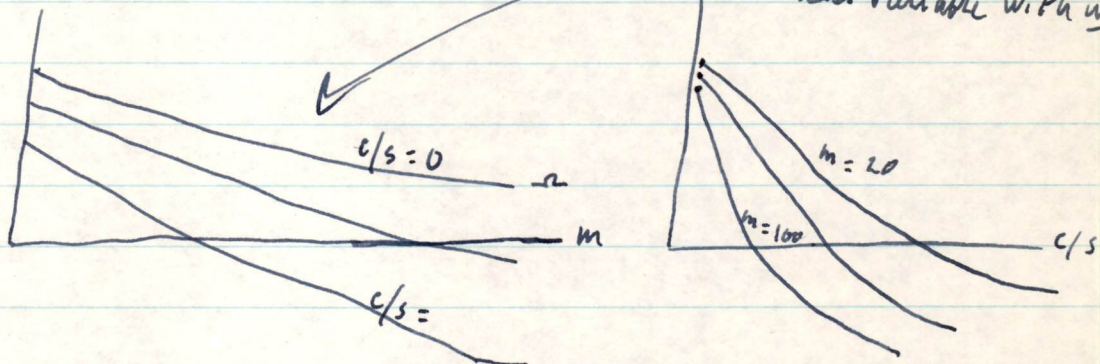
Eqs. 8, 9, 10, 11.

Res. of this, bias vs.

c/s is ~~more constant~~ less variable with m .

θ/s

Graphs.



To avoid yield tax, mostly reduce C . Even when m low. So, cuts down on restocking.

To avoid prop. tax, both reduce C & shorten m . Criticism has focused on lowering m , but that is unbalanced criticism. Lowering m offers an alternative to lowering C .

W.v.t. labor, prop. tax less harmful, bcs. shortens cycles.

opt. { Yield tax subs. land-derived K for labor-derived K ;
 & holds it longer. Also subs. land for labor.
 Yield-tax is worse on problem of the barren front-end.
 Prop. tax is easier on C ; but harder on long waiting.

Avoiding yield tax also causes avoiding other taxes:

payroll, income, sales, logging — makes fiscal deserts.

Avoiding property tax is turnover, drives you into other

taxes. Thus, to raise same revenue, high yield tax

rate required -- higher than if we just compare

the two taxes in a vacuum.

Capn. effect softens biases, & is often overlooked.

See graph when $C/S = 0$.

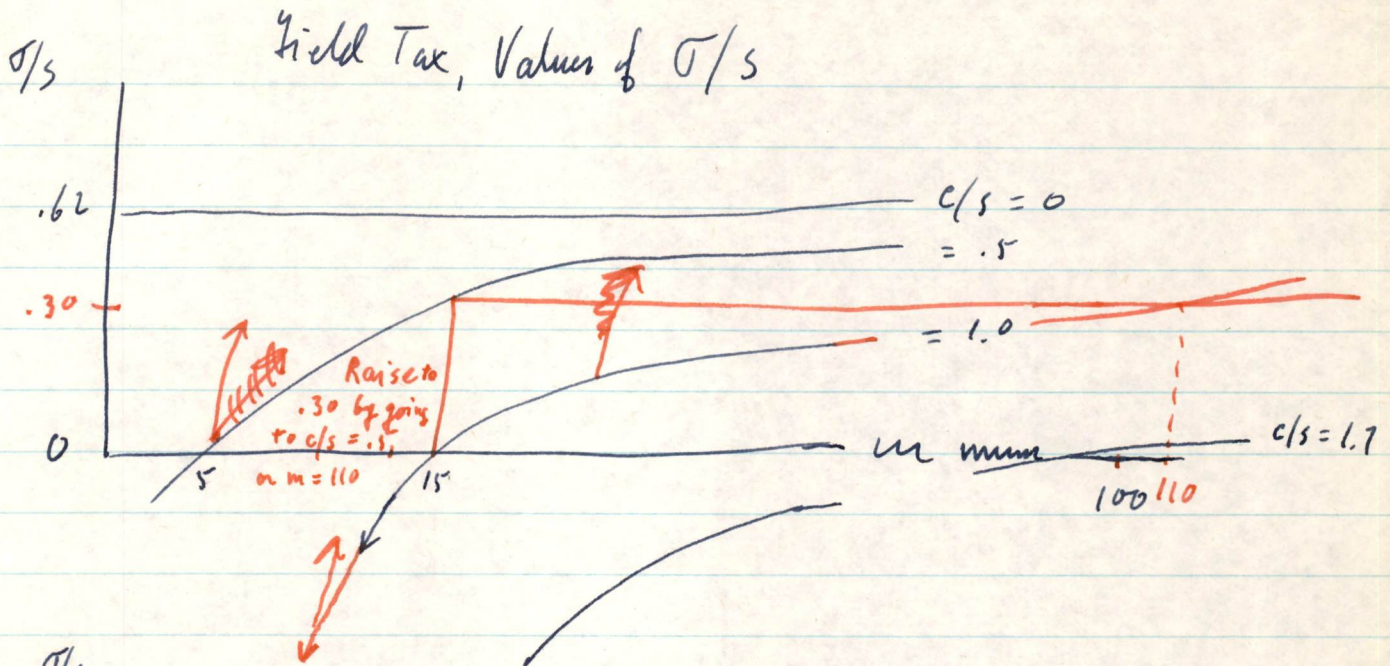
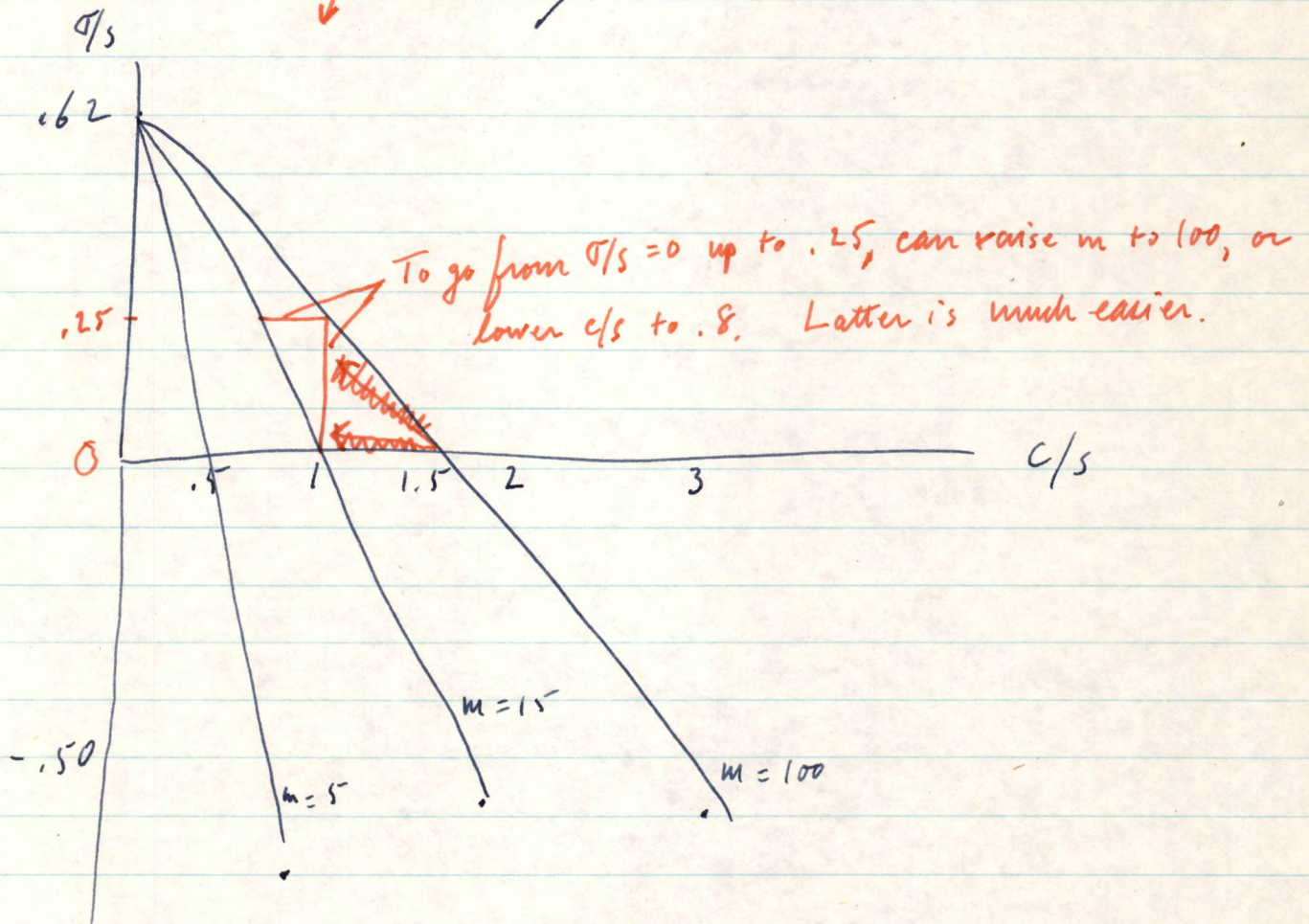
$$\frac{\theta}{s} = \Omega, \text{ never } < 0$$

(~~the~~ $\frac{\theta}{s}$ never negative either, when $C=0$. However, is very sensitive to C for low m .
Costs more now to carry a tree of given value, but

tree is worth less -- bcs. ~~begin~~ a is lower & there is

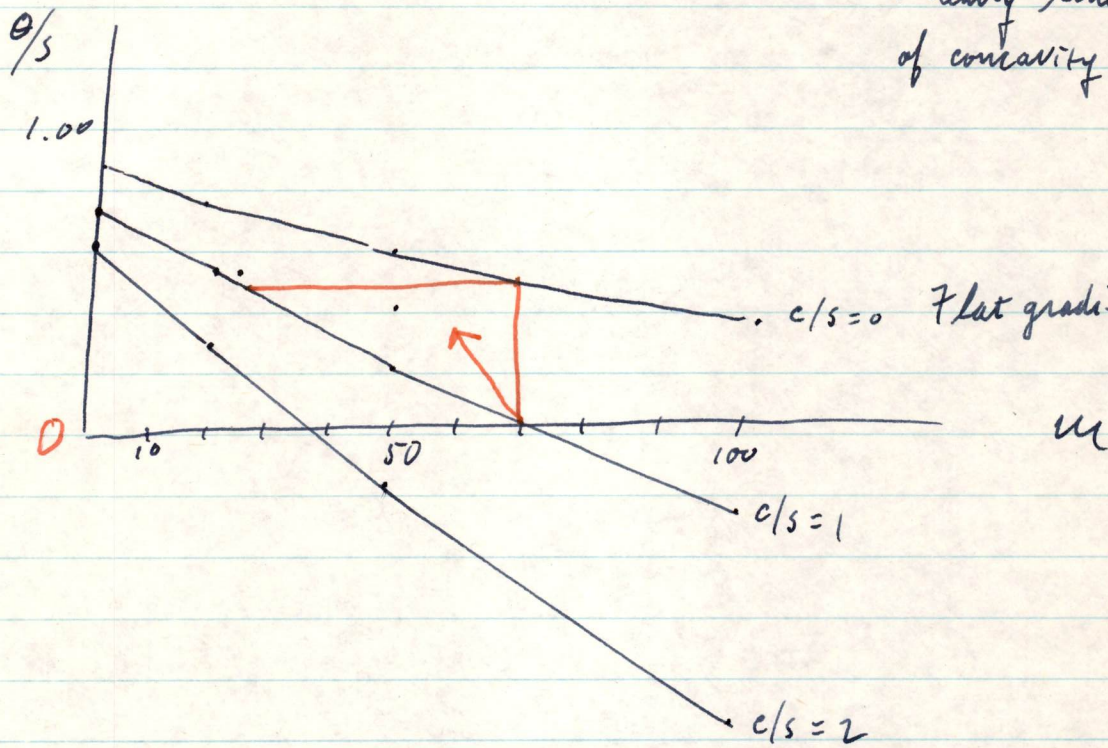
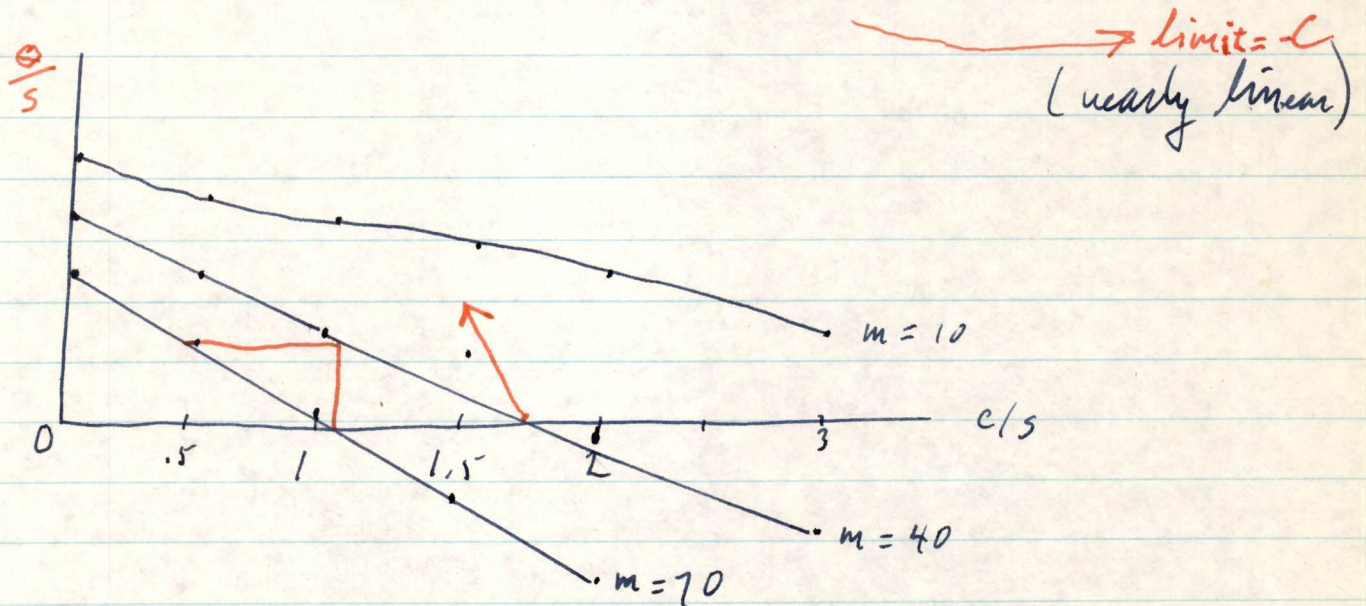
less land-derived value.

Result: tempers shortening bias of tax.



Values of θ/s

(nearly linear --- a trace of concavity upwards.)



Notes on effects of various forest taxes on

Discounted Cash Flow (DCF) or Site Value.

M. Gaffney, Dec. 7, 1978, (Pearl Harbor Day + 37)

at U. of Conn.

S = Site Value (same as DCF in perpetuity)

R = Revenue receipts from stumpage, net

m = years from planting to cutting at maturity

i = interest rate

C = Cost of planting, beginning of year 0

I. Yield Tax

t = tax rate applied to R_m once, at maturity

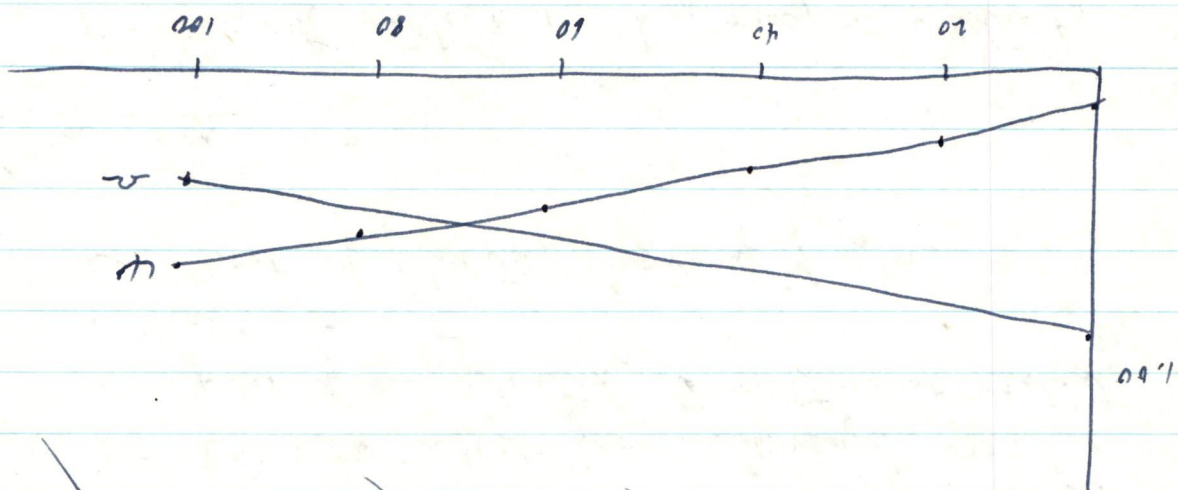
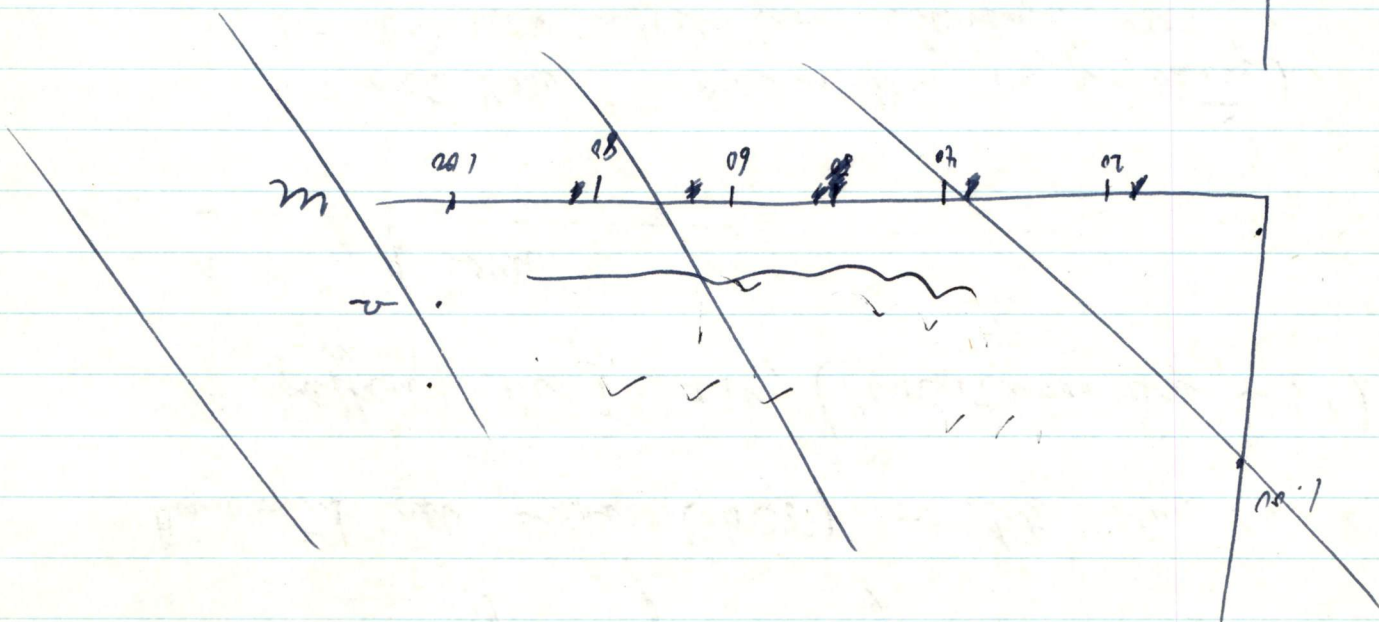
$$e^{im}(C + S) = R + S \quad (1)$$

$$S = \frac{R - Ce^{im}}{e^{im} - 1} \quad \text{"Faustmann Formula"} \quad (2)$$

σ = Site value after yield tax

$$\sigma = \frac{R(1-t) - Ce^{im}}{e^{im} - 1} \quad (4)$$

Note: equation numbers not completely sequential, because taken from longer MS.



Substituting (1) in (4), (first solve (1) for R)

$$\sigma = S(1-t) - \frac{tC}{1-e^{-im}}$$

Divide by S:

$$\sigma/S = 1 - t \left[1 + \frac{C/S}{1-e^{-im}} \right] \quad (5)$$

II. Property Tax (on tree capital, exempting site value.)
Let

p = property tax rate on value of timber inventory

θ = site value after property tax

$$\theta = \frac{R - Ce^{(i+p)m}}{e^{(i+p)m} - 1} \quad (7)$$

Using (1), dividing by S, and gathering terms:

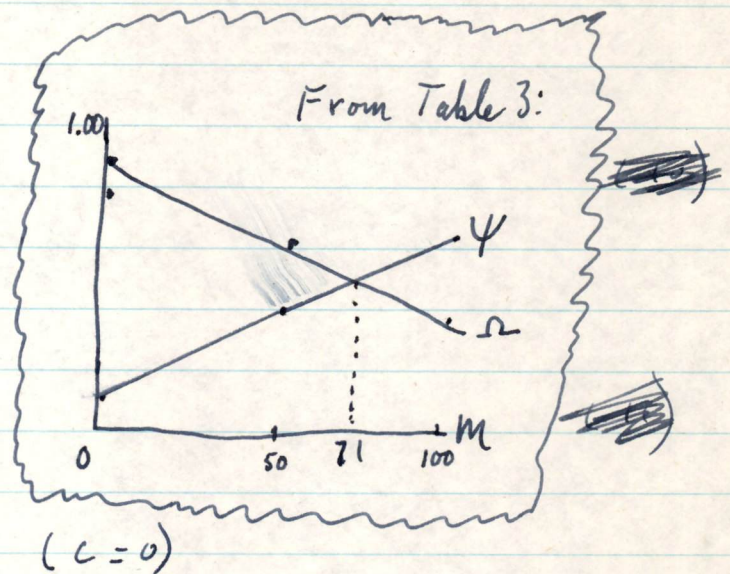
$$\theta/S = \frac{e^{im} - 1}{e^{(i+p)m} - 1} - C/S \frac{e^{pm} - 1}{e^{pm} - e^{-im}} \quad (9)$$

$$\equiv \Omega - \frac{C}{S} \Psi \quad (\text{see next page})$$

where

$$(10) \quad \Omega = \frac{e^{im} - 1}{e^{(i+p)m} - 1}$$

$$(11) \quad \Psi = \frac{e^{pm} - 1}{e^{pm} - e^{-im}}$$



Equivalent Rates:

$$s(1-\hat{t}) = s - \Omega$$

$$\hat{t} = 1 - \Omega = .38$$

$$(m = 50)$$

$$(p = .01)$$

$$(12)$$

Result not sensitive to c/s.

III. Income Tax

Let

r = Income tax rate on timber stumpage

Π = Site value after tax on income

$$\Pi = \frac{R(1-r) - Ce^{im} + rC}{e^{im} - 1} \quad (14)$$

Using (1)

$$\pi = \frac{S(e^{im} - 1) - r(C + S)(e^{im} - 1)}{e^{im} - 1} = S - r(C + S)$$

$$\frac{\pi}{S} = 1 - r(1 + C/S) \quad (15)$$

Equivalent Rate - see p. 4 A

IV. Effect of Expensing Costs

Let ~~z~~

u = Tax rate on ~~site value~~ yield, when costs are expensed

Γ = Site value after above tax

$$\Gamma = \frac{R(1-u) - Ce^{im} + uCe^{im}}{e^{im} - 1} = S(1-u)$$

$$\frac{\Gamma}{S} = 1 - u \quad (16)$$

Equivalent Rates:

$$1 - \hat{u} = \Omega - C/S \Psi$$

$$\hat{u} = 1 - \Omega + C/S \Psi \quad (17)$$

- 4 A -

Income tax rate and yield tax rate, equivalency.

Yield tax: $\sigma = S - t \left[S + \frac{C}{1 - e^{-im}} \right]$

Income tax: $\pi = S - r [S + C]$

$\pi = \sigma$ when

$$r(S + C) = t \left[S + \frac{C}{1 - e^{-im}} \right]$$

$$r = t \frac{S + \frac{C}{1 - e^{-im}}}{S + C}$$

For high m and low C/s ~~they~~ $r \approx t$

For low m and high C/s, $r > t$

E.g., $m = 10$, $i = .07$, $C/s = 2$

$$r \approx \frac{5}{3} t$$

V. Site Value Tax ("Productivity" Tax)

Let

$$w = \text{Tax}_{\text{rate}} \text{ on site value}$$

$$\phi = \text{Site value after above tax}$$

$$\phi = S - \frac{\phi w}{i} \quad ; \quad \phi \left(\frac{i+w}{i} \right) = S$$

$$\frac{\phi}{S} = \frac{i}{i+w} \quad (18)$$

Equivalent Rates:

$$\text{For } m = 50, p = .01,$$

$$\frac{i}{i+\hat{w}} = r - \frac{c}{s} \psi \quad \left[r - \frac{c}{s} \psi > 0 \right]$$

$$\hat{w} = i \left[\frac{1}{r - \frac{c}{s} \psi} - 1 \right] \quad (19)$$

$$\text{For } c/s = 1 \text{ and } m = 50$$

$$\hat{w} = .07 \left[\frac{1}{.62 - .40} - 1 \right] = .25 \quad (20)$$

$\hat{w}$ is an increasing function of both c/s and m , so the "equivalent" rate varies.

It is very sensitive to both.

At $m = 50$, if c/s drops to 0,

$$\hat{w} = .07 \left(\frac{1}{.62} - 1 \right) = .07 (.61) = .043$$

At $c/s = 1$,

m	$\hat{w}$
50	.25
20	.057

Basically, this says the equivalent land tax rate is very high where land has little value, and low elsewhere.

~~6~~
But note that $\hat{w}$ is an increasing function of c/s .
 ~~$w = 1 c/s$~~ If $c/s = 0$, $m = 50$,

$$w = .07 \left[\frac{1}{.62} - 1 \right] = .07 (.613) = .043$$

$$\text{If } c/s = 1, \text{ but } m = 20$$

$$w = .07 \left[\frac{1}{.78 - .23} - 1 \right] = .07 (.818) = ~~.057~~$$

$$\text{If } c/s = .5, \text{ } m = 20$$

$$w = .07 \left[\frac{1}{.78 - .11} - 1 \right] = .07 (.493) = .035$$

Etc.

Finding "equivalent" tax rates.

$m = 50$, $p = .01$, find t when $r = 0$.

Eqn. 12. $t = .38$

For $m = 70$, $t = .48$

$m = 20$, $t = .22$

All t 's shd. be higher due to loss of other taxes, caused by use of yield tax.

Yield tax w/ t prop. tax lowers C some and freq. of C and R a lot.

Opt. Summary, p. 24 (Optional)

Two frequent objections to prop. tax turn out to be weak.

a) Taxes over time exceed value. Overlooks capx. (also suggests speaker has been overlooking i , which is much higher.)

b) Cash flow problems, peculation, bcs. of deferred cash.

cf. Bldgs.

- tree taxes come later
- easier to normalize forests
- much forest K is land-derived
- owners sort themselves out

W. prop. tax, no clash of interests at harvest time.

III. Prop. income & site income.

A. Prop. income. Egn. 14, 15.

Cf. 5 & 15. Same after $m > 30$, i.e. $\pi \approx \sigma$

T. & G. called this neutral under these assms.,
Same as Fig. 1, B.

but neglected remaining bias vs. C/S . Higher
rate required ^{than yield tax,} offsetting gains. Less bias vs. m , & traded for more
bias vs. C/S .

Bias to waste front-end land downtime remains.

(And if we go to Closed ec., can show intertemporal bias.)

B. Site income. Egn. 16

1. Expenses

$u = .98$, where $C/S = 1.5$

Insurmountable moral hazard

2. SVT Egn. 18

Capn. effect. Thus high rate required, but
No excess burden; no downtime.

not what it seems. And where C/S is low, eq. rate is
also low.

Table 2:

Values of ∇/S (from Eqn. 5), for $i = .07$, $t = .38$.
 ∇/S is site value after a harvest tax, expressed
as a percentage of the value with no tax.⁵

$$\nabla/S = 1 - t(1 + \frac{C/S}{1 - e^{-im}})$$

∇/S									
m		- -	- -	- -	- -	- -	- -	- -	
	C/S=0	.5	1.	1.5	2	3	5	10	
1	.62	-2.09	-4.8	-7.52	-10.2	-17.7	-26	-54	
5	.62	-.03	-.69	-1.34	-2.0	-3.3	-5.9	-12.5	
10	.62	.23	-.16	-.54	-.93	-1.7	-3.3	-7.1	
15	.62	.32	.03	-.27	-.57	-1.2	-2.4	-5.3	
20	.62	.36	.11	-.15	-.41	-.94	-1.95	-4.51	
30	.62	.40	.18	-.03	-.25	-.71	-1.57	-3.75	
40	.62	.41	.21	.01	-.20	-.61	-1.42	-3.45	
50	.62	.42	.23	.03	-.16	-.55	-1.34	-3.29	
60	.62	.42	.23	.04	-.16	-.54	-1.32	-3.26	
70	.62	.43	.24	.04	-.15	-.52	-1.30	-3.22	
80	.62	.43	.24	.05	-.14	-.52	-1.28	-3.18	
90	.62	.43	.24	.05	-.14	-.52	-1.28	-3.18	
100	.62	.43	.24	.05	-.14	-.52	-1.28	-3.18	

5

A harvest tax of 38% is comparable to a property tax of 1%. See under "II, Property Tax."

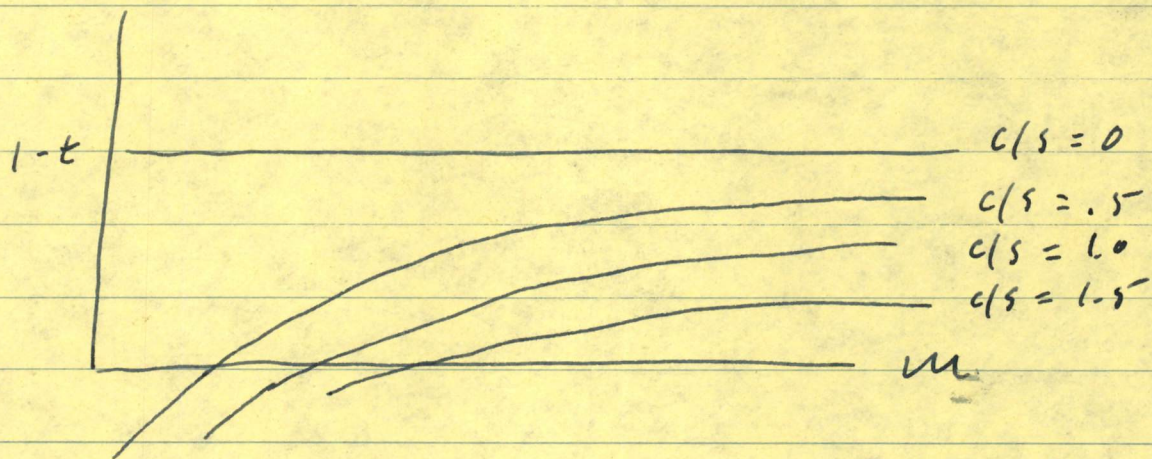
Values of Θ/S (from Eqn. 9) for $i = .07$, $p = .01$

$$\Theta/S = \Omega - \frac{C}{S} \Psi$$

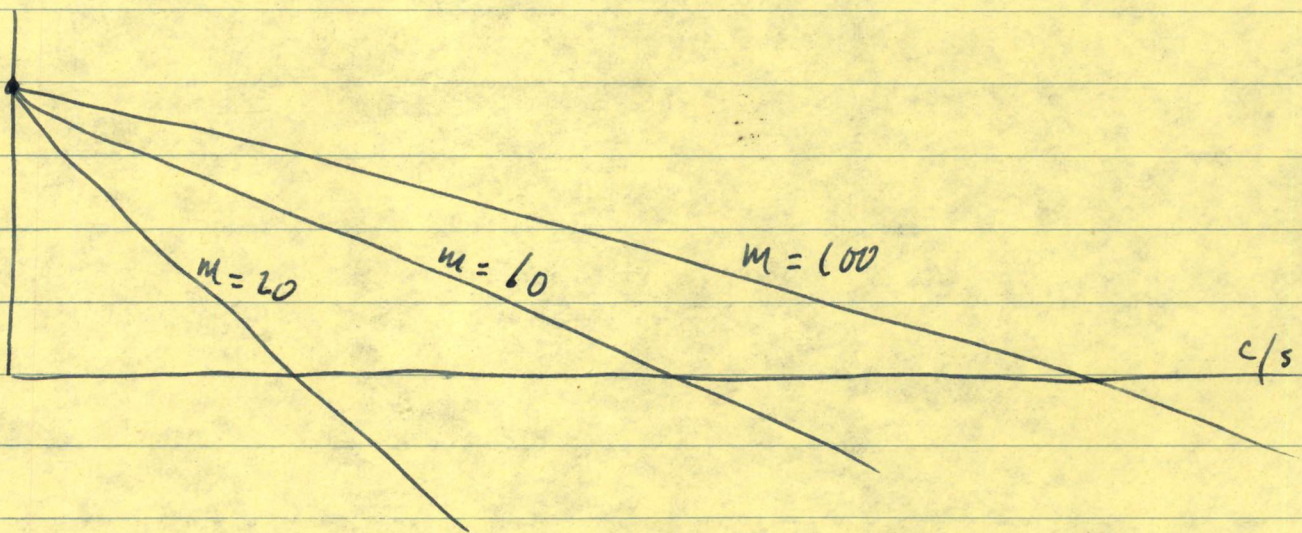
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Show on Board.

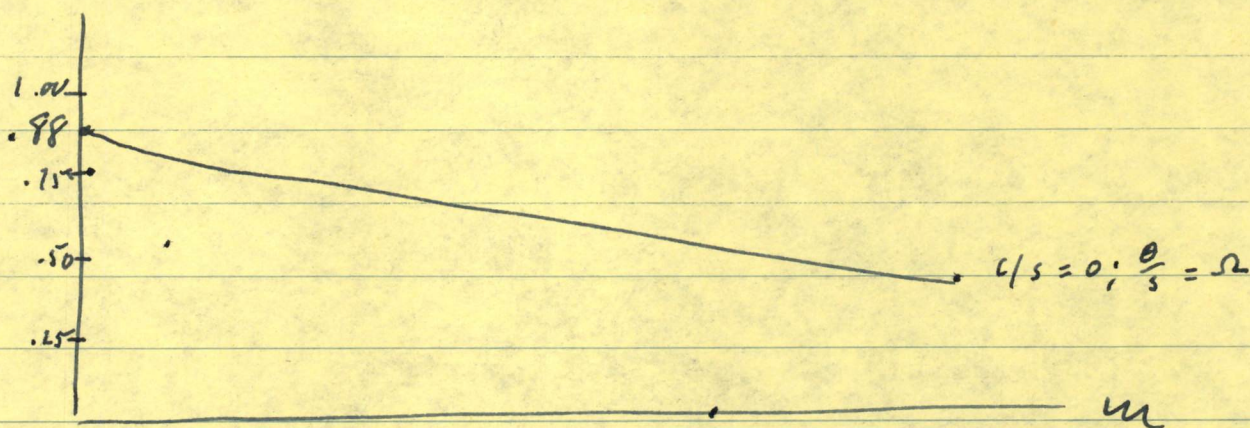
1. A. Values of σ/s with m . Table 2 (distributed.)



1 B. Values of σ/s with c/s



2.A Values of θ/s with u . Table 3 (distributed)



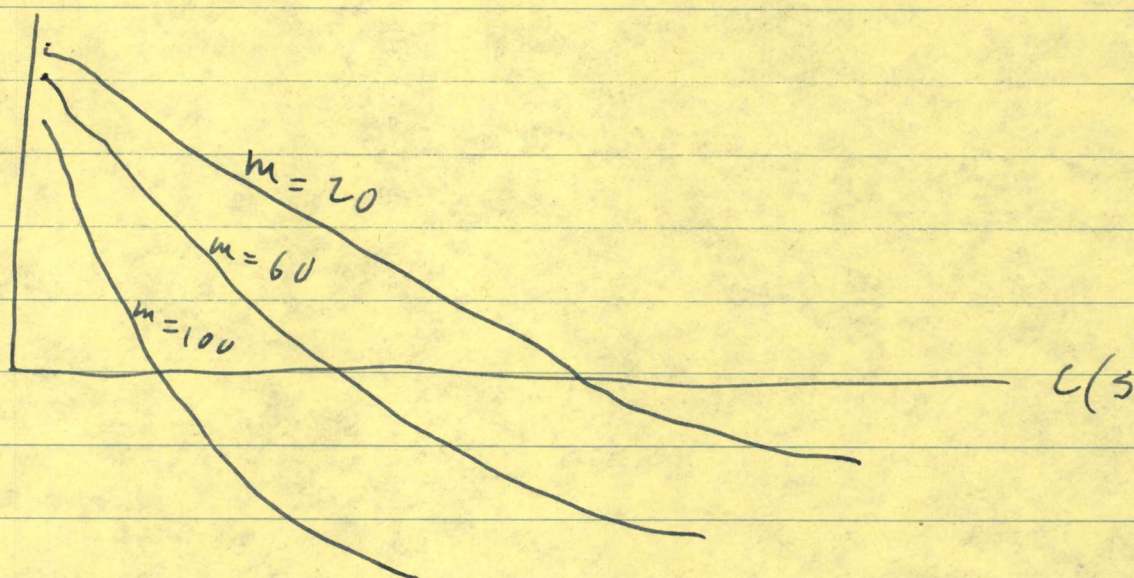
Ω is ~~curves~~ ~~are~~ nearly straight; (perhaps slightly concave upwards)

~~the~~ Add $\frac{c}{s} \psi$, and curves become ^{very slightly} concave downwards.

But w/in accuracy of table, both curves are virtually straight lines. ($c/s = 0$, and $c/s = 1$)

For $c/s = 0$, prop. tax is less biased than yield tax. No negative values.

2. B. Values of θ/s with c/s



- Less incentive to lower c/s . Values do not converge at $c=0$
- shorter lives are higher-valued.

Notes on effects of various forest taxes on Discounted Cash Flow (DCF) or Site Value.

M. Gaffney, Dec. 7, 1978, (Pearl Harbor Day + 37)

at U. of Conn.

S = Site Value (same as DCF in perpetuity)

R = Revenue receipts from stumpage, net

m = years from planting to cutting at maturity

i = interest rate

C = Cost of planting, beginning of year 0

I. Yield Tax

t = tax rate applied to R_m once, at maturity

$$e^{im}(C + S) = R + S \quad (1)$$

$$S = \frac{R - Ce^{im}}{e^{im} - 1} \quad \text{"Faustmann Formula"} \quad (2)$$

σ = Site value after yield tax

$$\sigma = \frac{R(1-t) - Ce^{im}}{e^{im} - 1} \quad (4)$$

Note: equation numbers not completely sequential, because taken from longer MS.

Substituting (1) in (4), (first solve (1) for R)

$$\sigma = S(1-t) - \frac{tC}{1-e^{-im}}$$

Divide by S:

$$\sigma/S = 1 - t \left[1 + \frac{C/S}{1-e^{-im}} \right] \quad (5)$$

II. Property Tax (on tree capital, exempting site value.)
Let

p = property tax rate on value of timber inventory

θ = site value after property tax

$$\theta = \frac{R - Ce^{(i+p)m}}{e^{(i+p)m} - 1} \quad (7)$$

Using (1), dividing by S, and gathering terms:

$$\theta/S = \frac{e^{im} - 1}{e^{(i+p)m} - 1} - C/S \frac{e^{pm} - 1}{e^{pm} - e^{-im}} \quad (9)$$

$$\equiv \Omega - C/S \psi$$

(see next page)

where

$$(10) \quad \Omega = \frac{e^{im} - 1}{e^{(i+p)m} - 1}$$

$$(11) \quad \Psi = \frac{e^{pm} - 1}{e^{pm} - e^{-im}}$$

Equivalent Rates:

$$S(1 - \hat{t}) = S - \Omega$$

$$\hat{t} = 1 - \Omega = .38$$

(C = 0)

(m = 50)

(p = .01)

(12)

Result not sensitive to C/S.

III. Income Tax

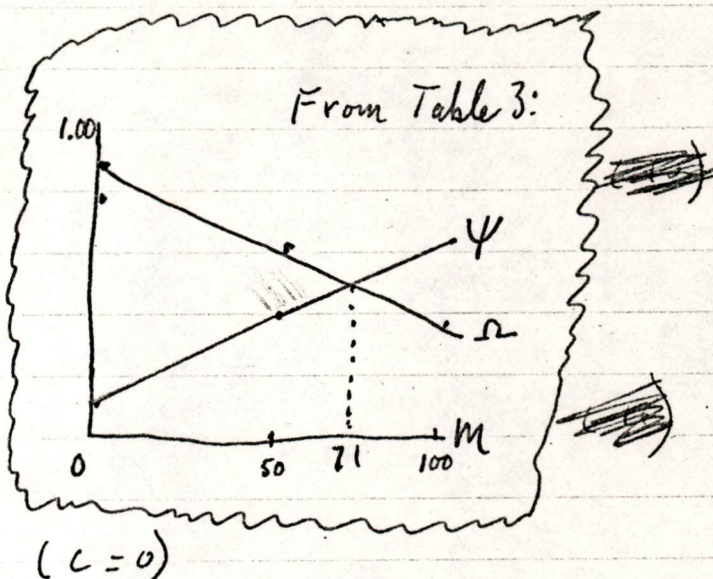
Let

r = Income tax rate on timber stumpage

π = Site value after tax on income

$$\pi = \frac{R(1-r) - Ce^{im} + rC}{e^{im} - 1}$$

(14)



Using (1)

$$\pi = \frac{S(e^{im} - 1) - r(C + S)(e^{im} - 1)}{e^{im} - 1} = S - r(C + S)$$

$$\frac{\pi}{S} = 1 - r(1 + C/S) \quad (15)$$

Equivalent Rate - see p. 4 A

IV. Effect of Expensing Costs

Let

u = Tax rate on ~~site value~~ yield, when costs are expensed

Γ = Site value after above tax

$$\Gamma = \frac{R(1-u) - Ce^{im} + uCe^{im}}{e^{im} - 1} = S(1-u)$$

$$\frac{\Gamma}{S} = 1 - u \quad (16)$$

Equivalent Rates:

$$1 - \hat{u} = \Omega - C/S \Psi$$

$$\hat{u} = 1 - \Omega + C/S \Psi \quad (17)$$

- 4 A -

Income tax rate and yield tax rate, equivalency.

Yield tax: $\sigma = S - t \left[S + \frac{C}{1 - e^{-im}} \right]$

Income tax: $\pi = S - r [S + C]$

$\pi = \sigma$ when

$$r(S + C) = t \left[S + \frac{C}{1 - e^{-im}} \right]$$

$$r = t \frac{S + \frac{C}{1 - e^{-im}}}{S + C}$$

For high m and low C/s ~~then~~ $r \approx t$

For low m and high C/s, $r > t$

E.g., $m = 10$, $i = .07$, $C/s = 2$

$$r \approx \frac{5}{3} t$$

V. Site Value Tax ("Productivity" Tax)

Let

$$w = \text{Tax}_{\text{rate}} \text{ on site value}$$

$$\phi = \text{Site value after above tax}$$

$$\phi = S - \frac{\phi w}{i} \quad ; \quad \phi \left(\frac{i+w}{i} \right) = S$$

$$\frac{\phi}{S} = \frac{i}{i+w}$$

(18)

Equivalent Rates:

$$\text{For } m = 50, p = .01,$$

$$\frac{i}{i+\hat{w}} = r - \frac{c}{s} \psi$$

$$\left[r - \frac{c}{s} \psi > 0 \right]$$

$$\hat{w} = i \left[\frac{1}{r - \frac{c}{s} \psi} - 1 \right]$$

(19)

$$\text{For } c/s = 1 \text{ and } m = 50$$

$$\hat{w} = .07 \left[\frac{1}{.62 - .40} - 1 \right] = .25$$

(20)

$\hat{w}$ is an increasing function of both c/s and m , so the "equivalent" rate varies.

It is very sensitive to both.

At $m = 50$, if c/s drops to 0,

$$\hat{w} = .07 \left(\frac{1}{.62} - 1 \right) = .07 (.61) = .043$$

At $c/s = 1$,

m	$\hat{w}$
50	.25
20	.057

Basically, this says the equivalent land tax rate is very high where land has little value, and low elsewhere.

Table 2:

Values of ∇/S (from Eqn. 5), for $i = .07$, $t = .38$.
 ∇/S is site value after a harvest tax, expressed
as a percentage of the value with no tax.⁵

$$\nabla/S = 1 - t(1 + \frac{C/S}{1 - e^{-im}})$$

∇/S									
m		- -	- -	- -	- -	- -	- -	- -	
	C/S=0	.5	1.	1.5	2	3	5	10	
1	.62	-2.09	-4.8	-7.52	-10.2	-17.7	-26	-54	
5	.62	-.03	-.69	-1.34	-2.0	-3.3	-5.9	-12.5	
10	.62	.23	-.16	-.54	-.93	-1.7	-3.3	-7.1	
15	.62	.32	.03	-.27	-.57	-1.2	-2.4	-5.3	
20	.62	.36	.11	-.15	-.41	-.94	-1.95	-4.51	
30	.62	.40	.18	-.03	-.25	-.71	-1.57	-3.75	
40	.62	.41	.21	.01	-.20	-.61	-1.42	-3.45	
50	.62	.42	.23	.03	-.16	-.55	-1.34	-3.29	
60	.62	.42	.23	.04	-.16	-.54	-1.32	-3.26	
70	.62	.43	.24	.04	-.15	-.52	-1.30	-3.22	
80	.62	.43	.24	.05	-.14	-.52	-1.28	-3.18	
90	.62	.43	.24	.05	-.14	-.52	-1.28	-3.18	
100	.62	.43	.24	.05	-.14	-.52	-1.28	-3.18	

⁵ A harvest tax of 38% is comparable to a property tax of 1%. See under "II, Property Tax."

Values of Θ/S (from Eqn. 9) for $i = .07$, $p = .01$
 Θ is site value after a property tax; and Θ/S is Θ
expressed as a percentage of the value with no tax

_____ θ/s _____

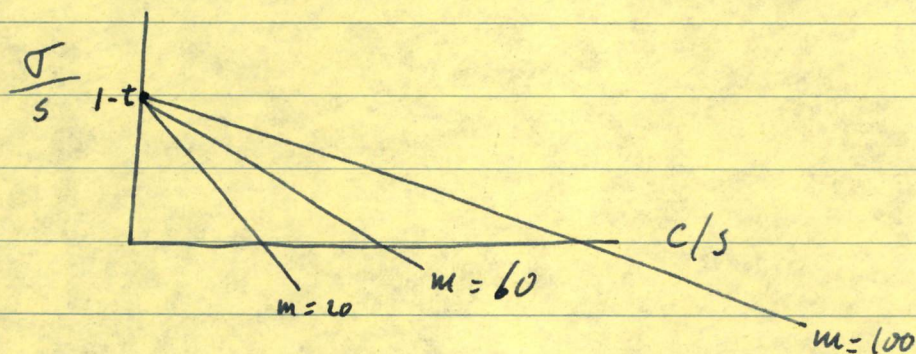
[illegible]

I. Yield Tax. Egm. 1-5

Bias indicated because $\frac{\sigma}{s} \neq 1-t$ (s)

Biases:

1. Bias against c/s . See Table 2



a. Bias vs. C , on any site

b. Bias to acquire more & better land.

Same as sharecropper

" " mineral lessee w. hi royalty rate

2. Bias vs. quick turnaround, short rotations.



a. Over whole cycle.

Hand on:

- Genetic improvement
- Pulpwood; firewood
- Faster-growing species (poplar; Kuan trees)
- C_0 designed to speed restocking + maturity
- Better sites, exply. input, effort there.

b. Subcycles, near harvest

T.S.I., thinning, fertilizing,

Non-deductible harvest costs, e.g. bad chances.

c. Acreally

Harvest on good land. Int. input.

Causes timber sprawl.

d. Beginnings. Downtime at start of cycle.

Math. refers to stocking as a datable event, but natural restocking can take 30 yrs.

If σ pushed below 0 w. high C , owner reduces C .
No pressure to use -- no cost to him.

Most analysts have looked at end of cycles, found little effect. But at beginning, large effects.

e. Harvesting.

Fisc has a large equity built up.
Owner only has $R(1-t)$

High-grading results. Might not result if publican followed loggers into woods; but scale is outside the woods.

Cf. prop. tax, owner has pd. his dues, by harvest time, ~~the~~ stumpage is all his.

f. Other taxes. Payroll, exple -- at harvest time. Yield tax slows these down.

II. Property Tax - Trees only.

Base is B_n or Inv. Value. -- $>$ liqu. value.

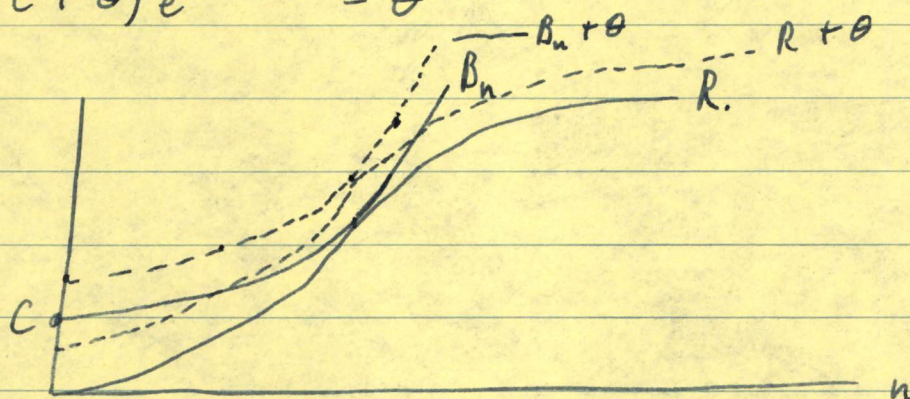
Unusual feature: antic. future taxes are disc. back into lower B_n .

But cost of C_0 can't fall (w/o reducing R_m)
so reduced value shows up 2 other places:

1. $\theta < \delta$ -- which we expected anyway.

2. Lower B_n bec. part of B_n is land-derived.

$$B_n = (C + \theta) e^{(i+p)n} - \theta$$



B_n begins at some value, C_0 , w or w/o tax.
It ends nearly the same (a little earlier w. tax.)
But in between, ~~q~~ p makes it grow slower at first,
then faster.

See Eqs. 8, 9, 10, 11.

θ/s in Table 3. Graph effects.

Prop. tax is slightly more temperate than yield tax.

1. ~~Yield~~ Bias vs. C/s is moderated at shorter cycles -- & they require higher C .

So you can apply capt. intensively -- so long as it rolls over quickly.

2. Where prop. tax is biased vs C/s -- in m -- the bias is milder than yield tax bias vs. C/s at low m .

3. ~~Yield tax~~ Yield tax loses all bias vs. short m if $C/s = 0$, a strong incentive to lower C .

Prop. tax retains bias vs. long m , even if $C = 0$.
(Bcs. of tax on land-derived K .) Gives less incentive to eliminate or reduce C .

4. By reducing m , prop. tax drives you into other taxes at end-points (the usual kind, that shoot everything that moves.)

5. ~~to~~ To avoid yield tax, mostly reduce C -- which usually lengthens m , which also avoids tax.

But to avoid prop. tax, shorten m , which requires more C .

6. There is less bias against better land, where m is lesser.
This acts against forestry sprawl, which is a problem anyway - long roads,
invading steep erosive land of low restockability.

Criticisms of prop. tax often overlook capex. effect.

Is said that taxes with interest exceed R .

This is inherently dubious. But in present model, it
implies $\theta \leq 0$, when $C = 0$

But $\theta = s\Omega$ when $C = 0$, and $\Omega > 0$

B_n falls bcs. θ falls and B_n contains less
land-derived value.

