

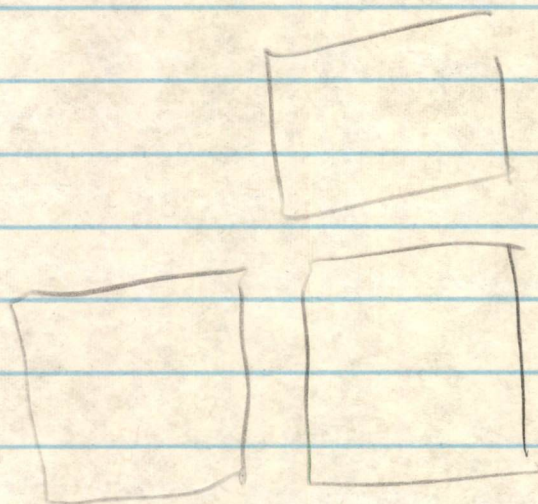
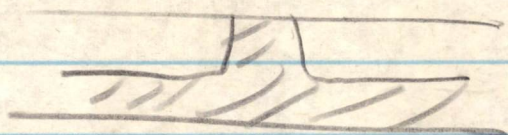
Taxes & land ripening

New point

Bldg. taxes reduce % growth rate of development value of land, and thus retard opt. dev. date.

Land taxes are neutral:

- a. Res. indep. of dev. date
- b. Res. they Δ % growth rate of dev. value by same amt as they Δ CC.



Growth factors in l.v.

$$A-1. S = \frac{1}{1+i} + \frac{1+g}{(1+i)^2} + \dots$$

$$= \frac{1}{1+i} \times \frac{1}{1 - \frac{1+g}{1+i}} = \frac{1}{i-g}$$

$$B \quad S = \frac{1}{1+i} + \frac{1}{(1+i)(1+g)} + \dots$$

$$= \frac{1}{1+i} \times \frac{1}{1 - \frac{1}{(1+i)(1+g)}} = \frac{1}{1+i - \frac{1}{1+g}} = \frac{1-g}{1+i-g-gi-1}$$

$$= \frac{1-g}{i-g-gi} = \frac{1-g}{i(1-g)-g} = \frac{1}{i - \frac{g}{1-g}}$$

$$C. S = \frac{1}{1+i-g} + \frac{1}{(1+i-g)^2} + \dots = \frac{1}{1+i-g} \cdot \frac{1}{1 - \frac{1}{1+i-g}}$$

$$= \frac{1}{i-g} \quad \text{Same as (A)!}$$

But if you begin A with ~~1~~ in first term,
then A is slightly ~~smaller~~ larger.

~~$$A-2. S = \frac{1}{(1+i)(1+g)}$$~~

$$A-2. S = \frac{1+g}{1+i} + \left(\frac{1+g}{1+i}\right)^2 + \dots = \frac{1+g}{1+i} \cdot \frac{1}{1 - \frac{1+g}{1+i}} = \frac{1}{\frac{1+gi}{1+g} - 1}$$

$$= \frac{1+g}{i-g}$$

symmetry of growth + decay factors, $g + d$

$$1. \sum_{i=1}^{\infty}$$

Ex. 162, Home ends

1. Decay factors as geometric progressions.

There are three simple ways to express the decay of cash flow in the PV formula.

$$A. \quad PV = \frac{1}{1+i} + \frac{1-d}{(1+i)^2} + \frac{(1-d)^2}{(1+i)^3} + \dots + \frac{(1-d)^{n-1}}{(1+i)^n}$$

This one decays much faster than the other two.

$$B. \quad PV = \frac{1}{1+i+d} + \frac{1}{(1+i+d)^2} + \dots + \frac{1}{(1+i+d)^n}$$

This one is simplest to handle, you just add d to i and keep everything else the same. It is awkward in the first term, because you have to begin decay there right off.

(B) is a lazy approximation to (C), and generally very close.

$$c. \quad PV = \frac{1}{1+i} + \frac{1}{(1+d)(1+i)^2} + \frac{1}{(1+d)^2(1+i)^3} + \dots$$

$$\dots + \frac{1}{(1+d)^{n-1}(1+i)^n}$$

Note that $(1+i)(1+d) = 1 + i + d + di$.
 Normally, di is very small, e.g. 10% of 5%
 $= \frac{1}{2}$ of one %, so (C) decays only barely faster
 than (B).

Which of these decay factors to use, if any,
 depends on which one best fits the cash flow
 path of the asset you are valuing. If none fits,
 you have to go at it one year at a time,
 which is harder. Their present purpose
 is to show us general patterns of cash
 flow decay, and their implications for
 asset valuation and replacement periods.

1/ If $PV = \sum_1^N (1+i+d)^{-t}$ then

$$S = \frac{1}{1+i+d} \frac{1 - (1+i+d)^{-N}}{1 - \frac{1}{1+i+d}} = \frac{1 - (1+i+d)^{-N}}{i+d}$$

2/ If $PV = \sum_1^N (1+i+c)^{-t}$

$$S = \frac{1 - (1+i+c)^{-N}}{i+c}$$

3/ If $PV = \sum_1^N (1+i-g)^{-t}$... but why would it?

~~What~~ What is PV of $1+g$?

$$P = \frac{1+g}{1+i} \approx \frac{1}{1+i-g}$$

cf. values of $\sum_1^{\infty} \left(\frac{1+g}{1+i}\right)^n$ and $\sum_1^{\infty} \left(\frac{1}{1+i-g}\right)^n$

$$\sum_1^{\infty} \left(\frac{1+g}{1+i}\right)^n = \frac{1+g}{1+i} \frac{1}{1 - \frac{1+g}{1+i}} = \frac{1+g}{1+i-1-g} = \frac{1+g}{i-g}$$

$$\sum_1^{\infty} \frac{1}{1+i-g} \approx \frac{1}{i-g} \cdot \frac{1}{1 - \frac{1}{i-g}} = \frac{1}{i-g-1} = \frac{1}{i-g}$$

A surprisingly small difference! Going to infinity ~~is not~~ makes them nearly the same!

Analogy: PV not much affected by slight error when n is large.

$$P = \frac{1 - I^{-n}}{i}$$

Are we capitalizing gV ?

$$V = \frac{a}{i - g}$$

$$V = \frac{a + Vg}{i}$$

~~$$V = \frac{a - Vi}{-g} = \frac{Vi - a}{g}$$~~

$$V = \frac{a}{i + t}$$

$$V = \frac{a - Vt}{i}$$

$$V = \frac{a}{i + d}$$

$$V = \frac{a - Vd}{i}$$

When $V = \frac{a}{i + t - g}$

Then $V = \frac{a - tV + gV}{i}$

Here, we are cap'g tV , even tho V will rise!

$$V = \frac{a}{i} + \frac{g}{i} V$$

$$V = \frac{a}{i} - \frac{t}{i} V$$

In the case of $\frac{a}{i}$, it's the relationship of a/i that ~~you~~ counts.

In the case of $\frac{g}{i}$, it's the relationship of g/i that counts. Bcs, g is a π_0 , subtracted from i .

Writers on ripening coats.

Ely

Simpson & Burton

Weimer & Hoyt?

Rose

Maup, Don

Mieszowski

Vickrey?

Tideman

Mills

Bentick

Smith? (wrote for Lincoln)

Fisher

Cornick

Capozza &

Hirshleifer?

Works cited by Ge-ping Chang

Turborg

H. G. Brown

J. B. Clark

Titman, AER, ca. 1986?

Al Adenid

Even on DCF, there is a net gain to be made, and a year's delay pushes that one year ~~ahead~~ "back".

Even when $DCF_1 < 0$, $PVP > 0$ (but w/o using cycle 1).

See RIMS

If there is only cycle 1, then and there are early yrs. of neg. c.f., and you can reduce them by retarding, there is a net gain.

When there are inf. cycles, you might? No, ~~you~~ can end cycle 1 as soon, with higher net gain, by skipping yrs. of neg. c.f. Even if $K=0$.

When you annualize the c.f. this point may be observed. $a_c > 0$ seems to warrant hdg. But $\frac{\Delta DCF}{DCF} > i$

says no. And this must be so. Bcs. DCF grows by i ~~as~~ just bcs. future + c.f. draw nearer. And by more yet by elimg neg. c.f., + deferring K_0 .

Note my faith that all these approaches must harmonize consistently. Laws of universe are harmonious. Math teaches this. What made this be so?

Why can human mind understand things that

Had no survival value when evolution stopped?
(C. R. Wallace).

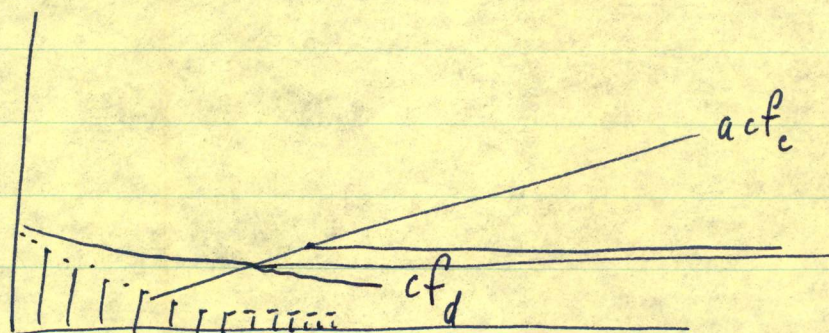
So the argul. condn. $a_0 < a_c$ is not always
right, when a_c is rising.

You can figure a_c 3 ways:

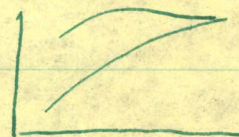
- c.f. current year.
 - a from cycle 1
 - a " all future cycles, same
- as PVP x i.

Intertemporal allocn. of land use.

PV =



Why will a be higher if you start one year later? You avoid one year of losses. With rising demand, - rising rents - whatever you build is at first too big, then too small.
(My Seattle talk, relevant?)

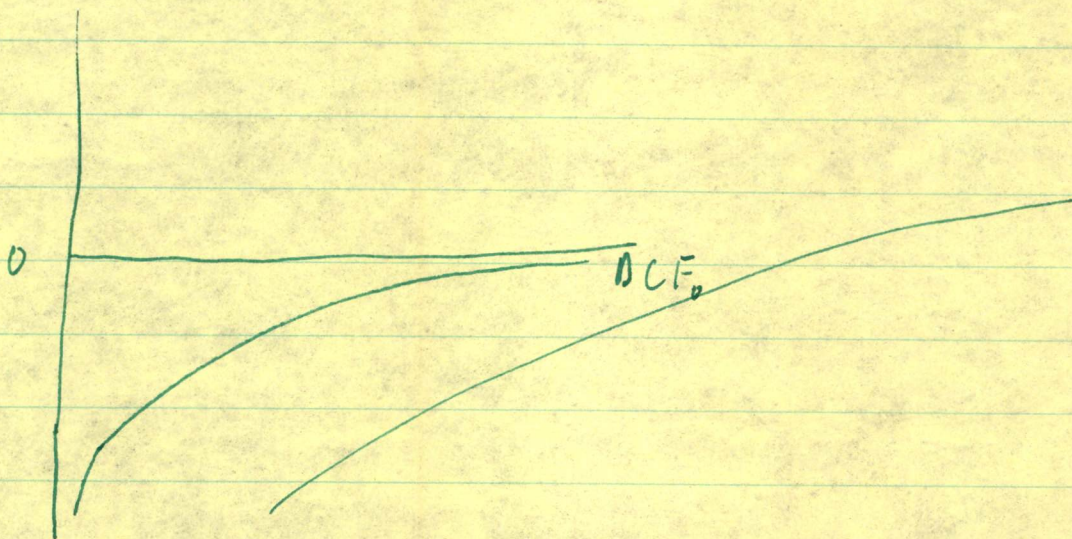


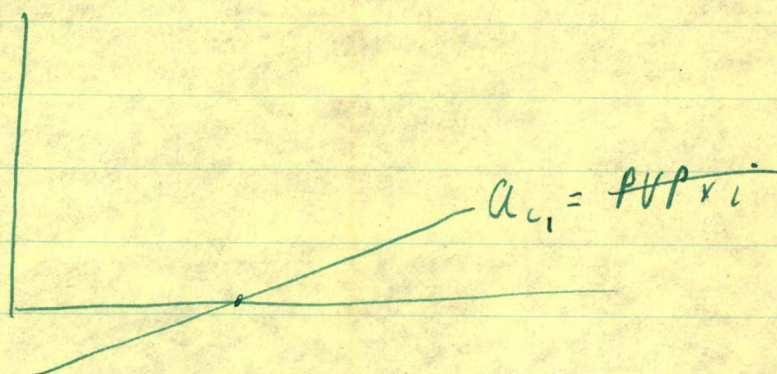
With perpetually rising rents you don't avoid this problem by delay.

Begin w. zero rent from developer; secure tenure.
A year arrives when a use of n yrs. will yield + rent.

2

But this may consist of zero or negative c.f. for some years, ff. by + ones. What is lost by waiting for more + ones? Year one in perp.





$$a_c = \frac{PVC}{1 - I^{-n}} i$$

$$PVP = \frac{PVC}{1 - I^{-n}} = PVC_1 + PVC_2 + \dots$$

Why is a_{c_1} rising? Res. ~~of~~ c.f. rising.
 By delaying one year you are raising PVC_1 by taking one year from C_2 , etc. For this you pay one year's interest.

Thus the social cost is not loss of a_1 , but $i \times PVP$. You are deferring all future uses, after C_1 .

Some deferral may still be justified. PVP may be low; $\frac{\Delta PVP}{PVP}$ may $> i$.

$\sum (PV)_n \cdot (PI) = a$ is same as getting level flow of a
for n yrs.

$\therefore$ any picking at less than a , whenever rec'd,
lowers value below a .

Ripening costs. More than one model needed b/c of diff scenarios (1)

$$V = G_1 + G_2 + \dots + G_\infty$$

$$= a_1 \frac{1 - I^{-n}}{i} + a_2 \frac{1 - I^{-n}}{i} I^{-n} \\ + a_3 \frac{1 - I^{-n}}{i} I^{-2n}$$

$$= a \frac{I^n - 1}{i} (I^{-n} + I^{-2n} + \dots + I^{-\infty})$$

$$= a \frac{I^n - 1}{i} \left(I^{-n} \frac{1}{1 - I^{-n}} \right) = a \frac{I^n - 1}{i} \frac{1}{I^n - 1} = \frac{a}{i} \quad (1)$$

$$V = a_1 \frac{I^n - 1}{i} I^{-n} + a_2 \frac{I^n - 1}{i} (1+g) I^{-2n} \\ + a_3 \frac{I^n - 1}{i} (1+g)^2 I^{-3n} + \dots$$

$$= a \frac{I^n - 1}{i} \left[I^{-n} \frac{1}{1 - (1+g) I^{-n}} \right]$$

$$= a \frac{I^n - 1}{i} \left[\frac{1}{I^n - (1+g)} \right] = \frac{a}{i} \frac{I^n - 1}{I^n - 1 - g} \quad (2)$$

In (2), V is a decrig fn. of n . But this is too simple!

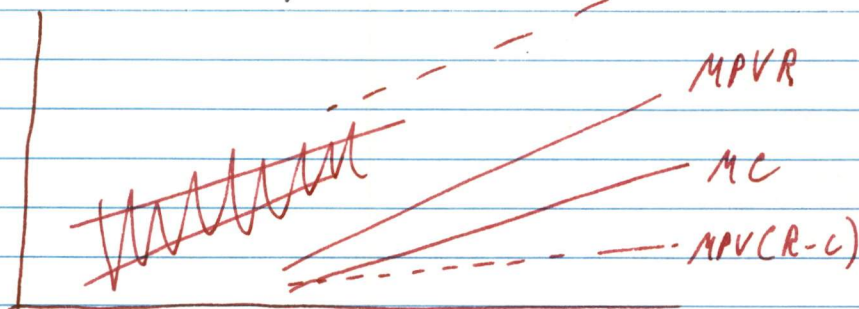
Naturally, if higher future inc. comes sooner, you get higher V . But qn is, how shd. indiv. best time help when faced w. higher rising opps.

A. Rising steadily

B. " in steps

Used

Save for derivative, $p - 2 - 1.Q. = \frac{MC}{MPVR}$



As land ripens to more intensive use, I hypothesize it moves to higher I.Q.

Bldg. taxes reduce advantage of higher I.Q. Then they would slow ^{absolute} growth ~~rate~~ of MPV(R-C). Well, they slow absolute growth simply by growing, as MC grows. ^{if it grows} Question is, how do they affect $\frac{\Delta MPV}{MPV}$?

$$MPV = MPVR - MC(1+T)$$

T is a factor showing PV of future bldg. taxes.

$$I.Q. = \frac{MC}{MPVR}$$

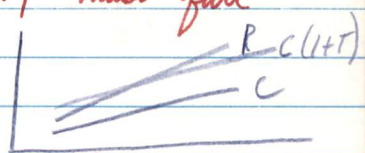
$$MPVR \cdot I.Q. = MC$$

$$\frac{\Delta MPV}{MPV} = \frac{\Delta MPVR - \Delta MC(1+T)}{MPVR - MC(1+T)} = \frac{\Delta MPVR [1 - \cancel{\Delta I.Q.} (1+T)]}{MPVR [1 - I.Q. (1+T)]}$$

If the base = 0, it is because $1 - I.Q. (1+T) \leq 0$

$$I.Q. \geq \frac{1}{1+T}$$

For base to rise above 0, i.g. $(1+T)$ must fall below unity. That is, i.g. must fall.



Now if T brings MPV down to zero, that does not mean an infinite rate of return. $1+$ may also bring down ΔMPV to 0, or below 0 if i.g. is rising.

So my M.S. is wrong.



Trend of i.g. depends on what one is waiting for. It may be greater demand for given improvement. This would lower i.g. The incentive to wait for greater demand for some C is enhanced.

But incentive to wait for higher i.g. is reduced. So you'd get premature underimprovement there.

Next step is to consider avoidance reactions, reduction of C and i.g.

$$\Delta MC \stackrel{?}{=} \Delta MPV \cdot \Delta i.g. =$$

$$i.g. = \frac{MC}{MPV} = \frac{C}{R}$$

$$(1) \quad \frac{d i.g.}{d n} = \frac{v \frac{d u}{d n} - u \frac{d v}{d n}}{v^2} = \frac{R \frac{d C}{d n} - C \frac{d R}{d n}}{R^2} = \frac{1}{R} \left[\frac{d C}{d n} - i.g. \frac{d R}{d n} \right]$$

$$\frac{\Delta V}{V} = \frac{\Delta R - \Delta C(1+i)}{R[1-i.g.(1+i)]} \quad (2)$$

$$i.g. = \frac{c}{R}$$

$$\Delta C = R \cdot i.g.$$

$$V = R - C = R(1-i.g.) \quad (3)$$

$$\Delta V = \Delta R - \Delta C = \frac{dR}{dn} - \left[\frac{dR}{dn} i.g. + \frac{d(i.g.)}{dn} R \right] \quad (4)$$

$$\frac{d(i.g.)}{dn} = \frac{1}{R} \left[\frac{dC}{dn} - \frac{C}{R} \frac{dR}{dn} \right] \quad (1)$$

$$\Delta V = \frac{dR}{dn} \left(1 - \frac{C}{R}\right) - \frac{dC}{dn} + \frac{C}{R} \frac{dR}{dn} = \frac{dR}{dn} - \frac{dC}{dn} \quad (5)$$

$$\frac{\Delta V}{V} = \frac{\frac{dR}{dn} \left(1 - \frac{C}{R}\right) - R \frac{d}{dn} \left(\frac{C}{R}\right)}{R \left(1 - \frac{C}{R}\right)} \quad (6)$$

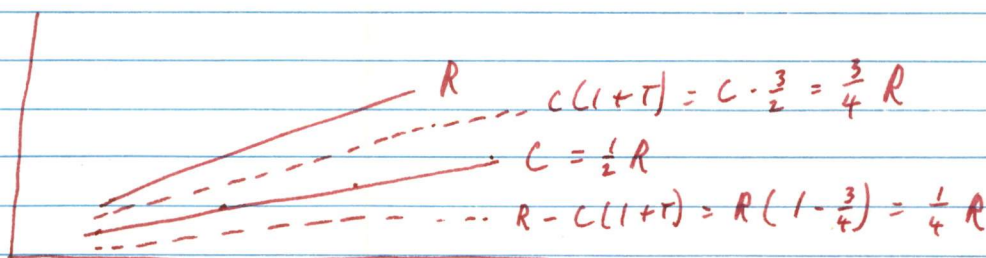
$$= \frac{\frac{dR}{dn}}{1 - \frac{C}{R}} - \frac{\frac{d}{dn} \left(\frac{C}{R}\right)}{1 - \frac{C}{R}} \quad (6)$$

(6) ~~is~~ says if $\Delta i.g. > 0$, it lowers $\frac{\Delta V}{V}$ ✓

(1) says $\Delta i.g. > 0$ if $\frac{\frac{dC}{dn}}{\frac{dR}{dn}} > \frac{C}{R}$ or $\frac{\frac{dC}{dn}}{C} > \frac{\frac{dR}{dn}}{R}$ ✓

But $\frac{\Delta C(1+T)}{C(1+T)} = \frac{\Delta C}{C}$

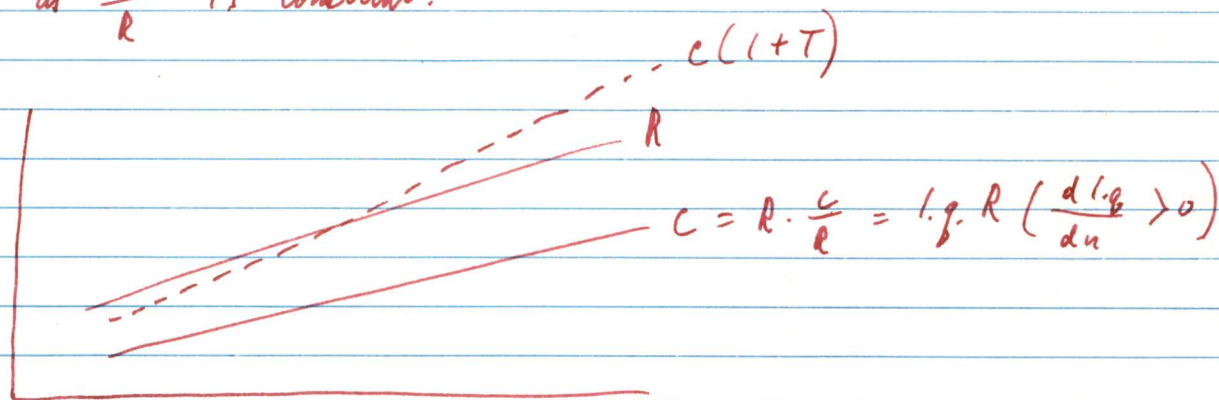
so maybe tax has no effect?



$\frac{\Delta p R}{p R} = \frac{\Delta R}{R}$

So all curves have same growth rate, so

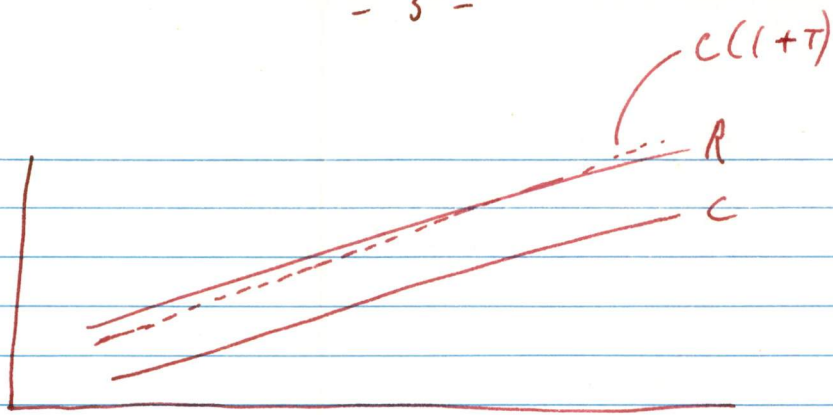
long as $\frac{C}{R}$ is constant.



If i.g. rises, $(R - C(1+T))$ will change from + to - eventually, as $C \rightarrow R$, and $C(1+T) > R$

But that says $\Delta C(1+T) > \Delta R$, so $\Delta V < 0$.

Seems extreme. There must be some in between. If $\frac{C}{R}$ rises to $= 1$, then we're done, but it can rise for a while to some opt. level and quit (because we build them)



E.g., if $R - C = \text{constant}$, then $\frac{C}{R}$ keeps rising, yet always $\frac{C}{R} < 1$.

However, $R - C(1+T)$ will become negative finally.
 $\Delta[R - C(1+T)] < 0$.

But this is not relevant. $\Delta(R - C) > 0$ in order to justify waiting. ~~Three things can make this happen~~
 cases:

1. $\Delta R > 0$, $\Delta C = 0$.
2. $\Delta R > \Delta C > 0$
3. $\Delta C < 0$

To compare $\frac{\Delta V}{V}$

and $\frac{\Delta V - T\Delta C}{V - TC}$

$$\frac{\Delta V - \Delta C \cdot T}{V - TC} > \frac{\Delta V}{V} \quad \text{when} \quad \frac{\Delta C \cdot T}{\Delta V} < \frac{TC}{V}$$

$$\frac{\Delta C}{C} < \frac{\Delta V}{V}$$

That is, bldg. taxes cause the % growth rate of l.v. (V)
to rise if $\frac{\Delta C}{C} < \frac{\Delta V}{V}$

and to fall if $\frac{\Delta C}{C} > \frac{\Delta V}{V}$

If $C = kR$, then $V = R - C = R - kR = R(1-k)$,

$$\text{and } \frac{\Delta C}{C} = \frac{\Delta R}{R} = \frac{\Delta V}{V}$$

But if $\frac{C}{R}$ is rising, then $\frac{\Delta C}{C} > \frac{\Delta V}{V}$, and bldg.

taxes cause the % growth rate of V to fall.

So bldg. taxes:

- ✓ Accelerate Ripeness when ^{further} ripening ^{would} mean higher $\frac{C}{R}$
- ✓ Defer Ripeness " " " " " " lower $\frac{C}{R}$

$$PVS = \sum_{n=0}^{\infty} R_n e^{-in} - C_0$$

$$PVS = PVG_1 + \frac{PVG_2}{e^{il}} + \frac{PVG_3}{e^{2il}} + \dots$$

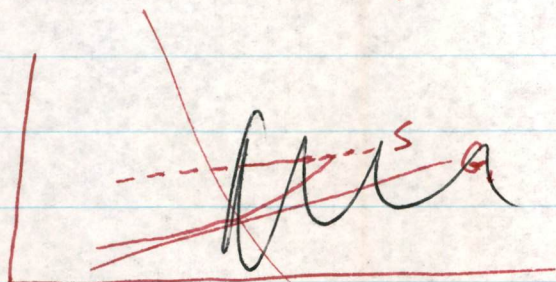
$$= PVG_1 + \frac{PVG(1+g)}{e^{il}} + \frac{PVG(1+g)^2}{e^{2il}} + \dots$$

$$= PVG \frac{1}{1 - \frac{1+g}{e^{il}}} = \frac{PVG}{1 - e^{-il}(1+g)}$$

~~$$PVG e^{il}$$~~

$PVS = i$ now covers only inc. + Δ , just as in simple Tidemann case, it could be shown. I surmise.

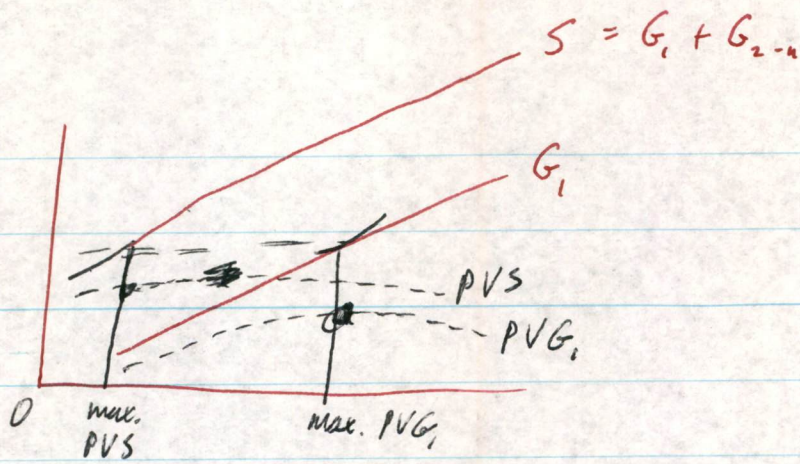
✓ No, the thing here is that G_1 is getting bigger. Approach of G_2 is not main cause of ΔS .



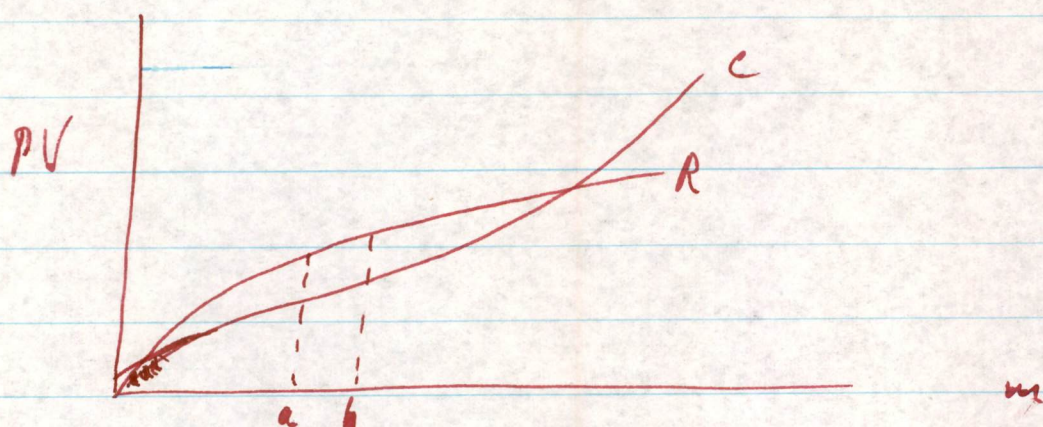
S grows slower than G_1 but:

- $G_{2..n}$ do not grow
- $S > G_1$, so % growth is less.

But only the % growth is reduced.



If G_{2-n} is unaffected by R date, then it causes earlier ~~&~~ ripeness.

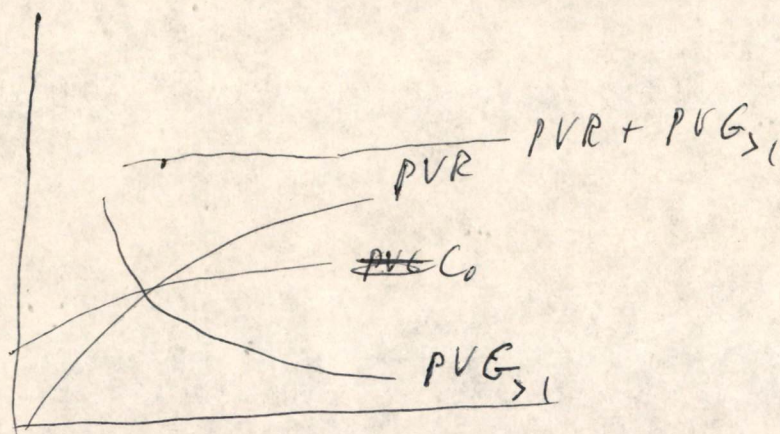
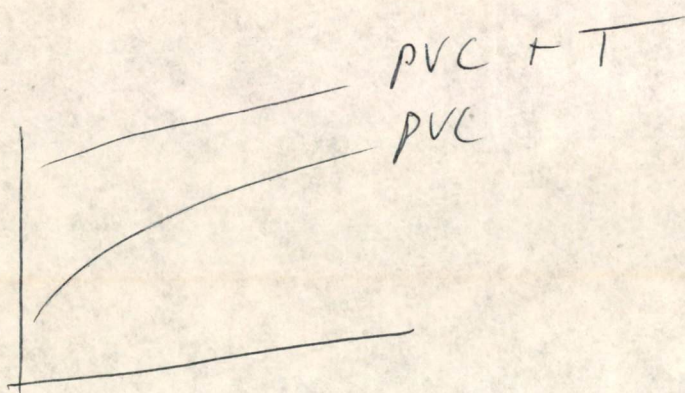


a --- Max ~~R~~ $\frac{R}{C}$, Min $\frac{C}{R} = 1.8$.

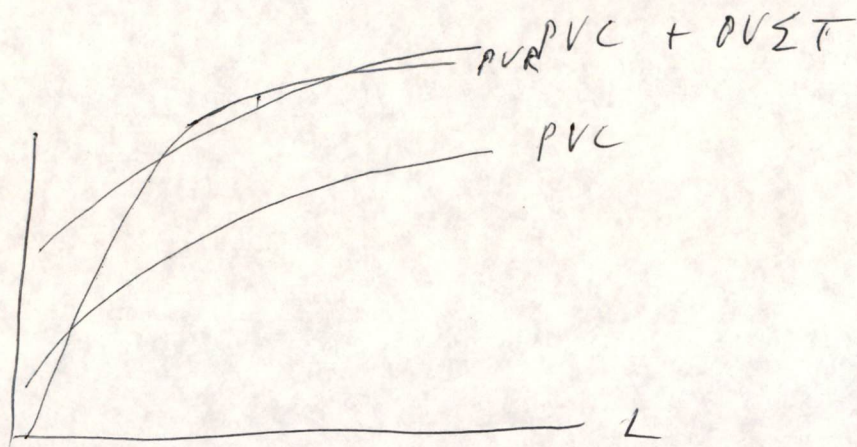
b --- Max $R - C$

(Be careful of this, based on G_1 only)

Tax on C, being higher on higher i.g., is higher on b, opt life, than on a.

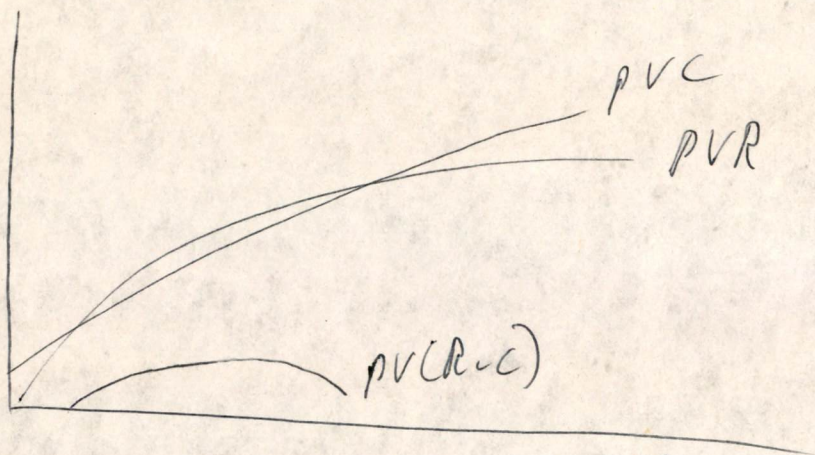
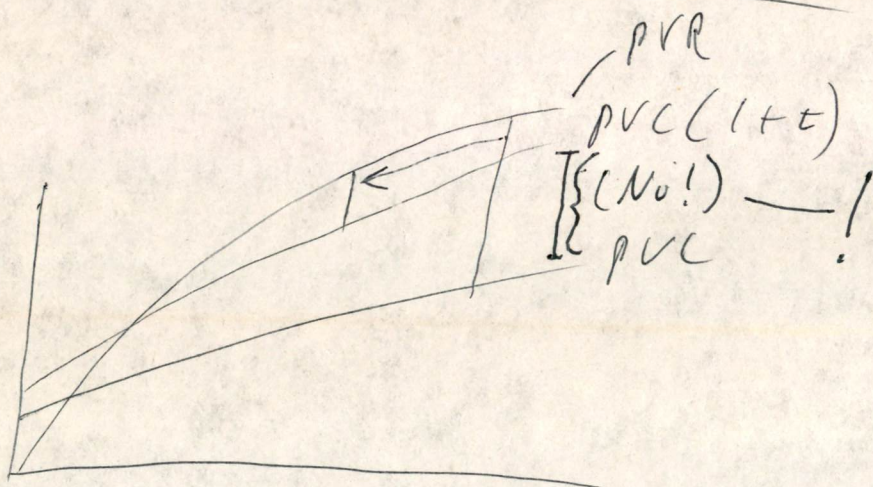


Prop. tax PV falls w. life -- or
at least doesn't rise in prop. Bas.
loaded toward present.

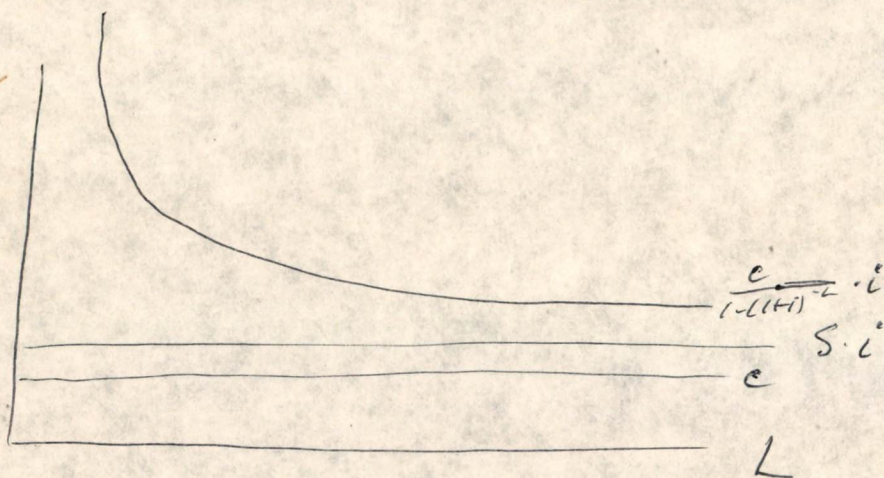


Max. for G_1 not affected

But weight of G_2 reduced, so
life lengthened.

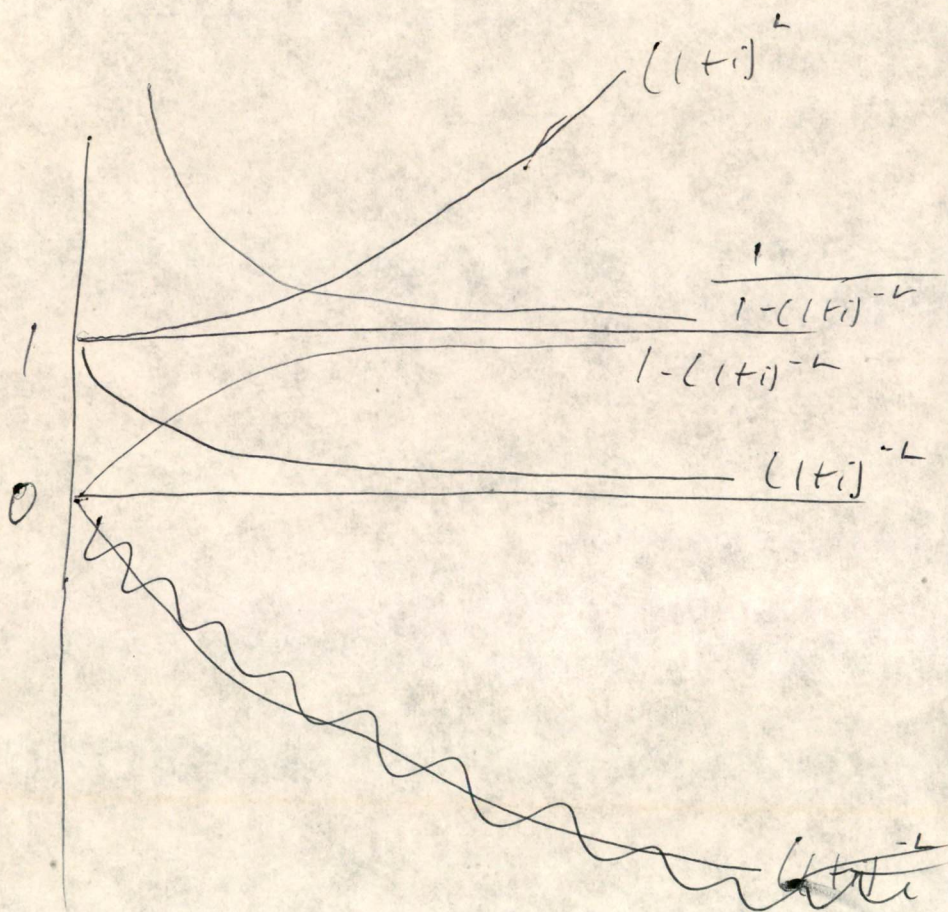


Shortens life?



$$c = \sum_0^L \left[\frac{c_n (1+i)^{-n}}{1 - (1+i)^{-L}} \right] \frac{i}{1 - (1+i)^{-L}} \quad ?$$

But ydy. empl. related to c is
 simple average, $\frac{\sum c}{L}$



$$S7 = i \left[S + \frac{C_0}{1 - (1+i)^{-L}} \right] \times C_i$$

$$\underline{L} \quad \frac{1 - (1+i)^{-L}}{i} \quad \frac{1/(1 - (1+i)^{-L})}{i}$$

$$1 \quad \frac{i}{1+i} \approx i = \frac{1}{20} \quad 20$$

$$14 \quad \frac{1}{2} \quad 2$$

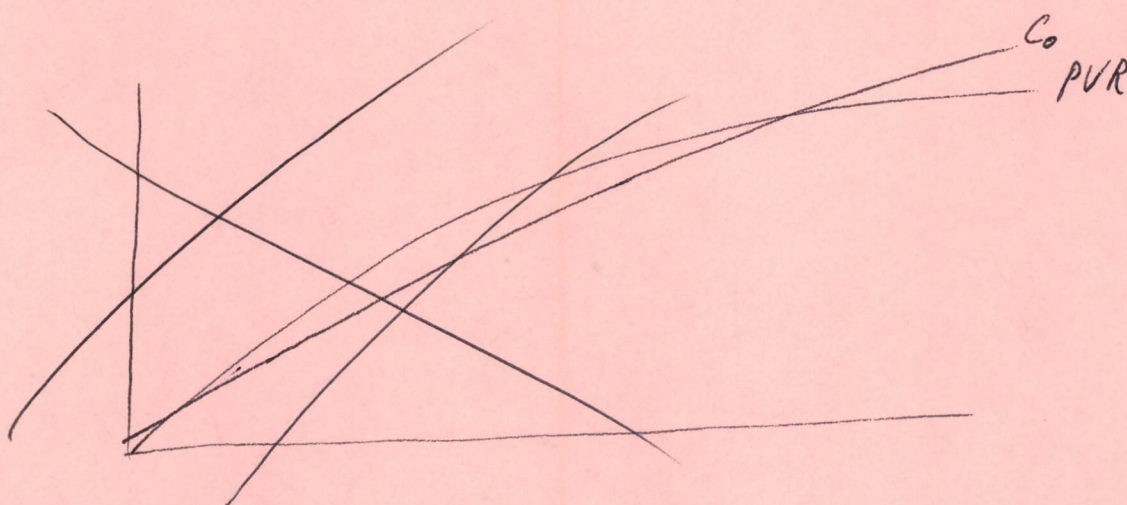
$$28 \quad \frac{3}{4} \quad 1.3 = \frac{4}{3}$$

$$42 \quad \frac{7}{8} \quad 8/7 = 1.14$$

Assms.

ΔL at const. S.F.

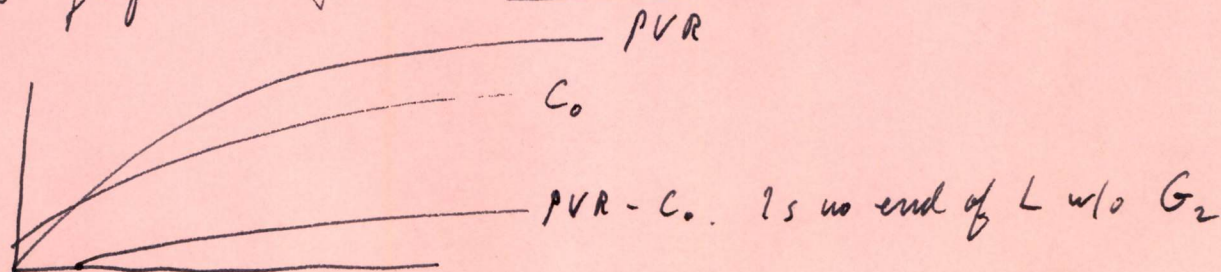
$$PVR = 57 \frac{1 - (1+i)^{-L}}{i}$$



✓ ΔC_0 is a longevity input. $\therefore$ it will pay bldg. over longer L . $\therefore$ PVT on it is greater than on base C .

So PVT rises more than $\propto C_0$. This much of effect, from G_1 , tends shorten L . At least, tends vs. inv'g. in durability.

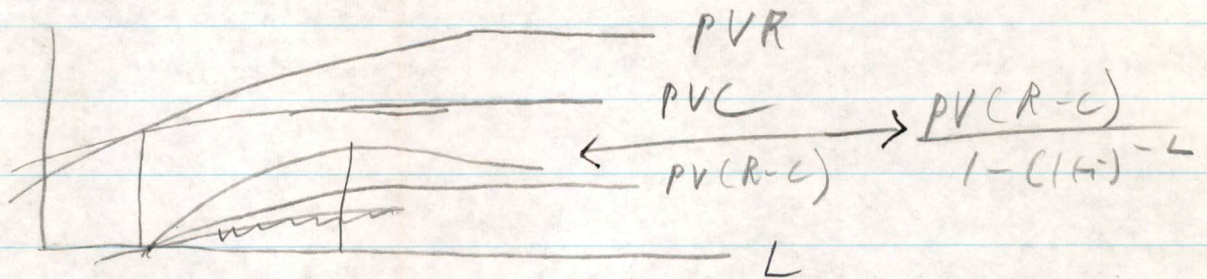
But graph wrong — is no closure.



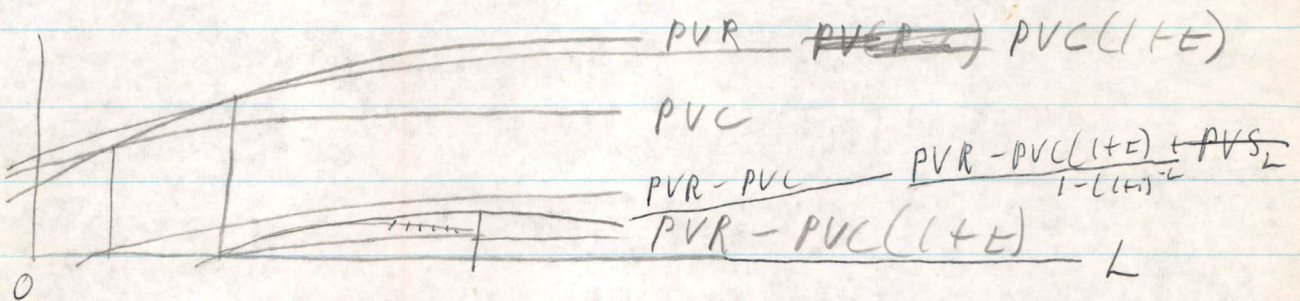
Problem:

Effect of land & bldg. taxes on life of bldg.

A. What det. ~~price~~ life?



B. Effect of bldg. tax



Tax Moves opt L to right. To p. 2.

✓ To expound, explain why max $\frac{PV(R-C)}{1 - (1+i)^{-L}}$, explain it

is max. $PV[(R-C) + S_L] \frac{1}{(1+i)^L}$. This is generally easier to follow, more intuitive, ^{allows} ~~Requires~~ redrawing graph if desired for S independent of L of G. (or leave it dependent, use same graph)

✓ ^{Re PVC,} To make pt., note that: a, PVC never stops rising bec. it includes o & m which go on just as R_n do.

b. If add soc. there go on faster, show public benefit is shorter L.

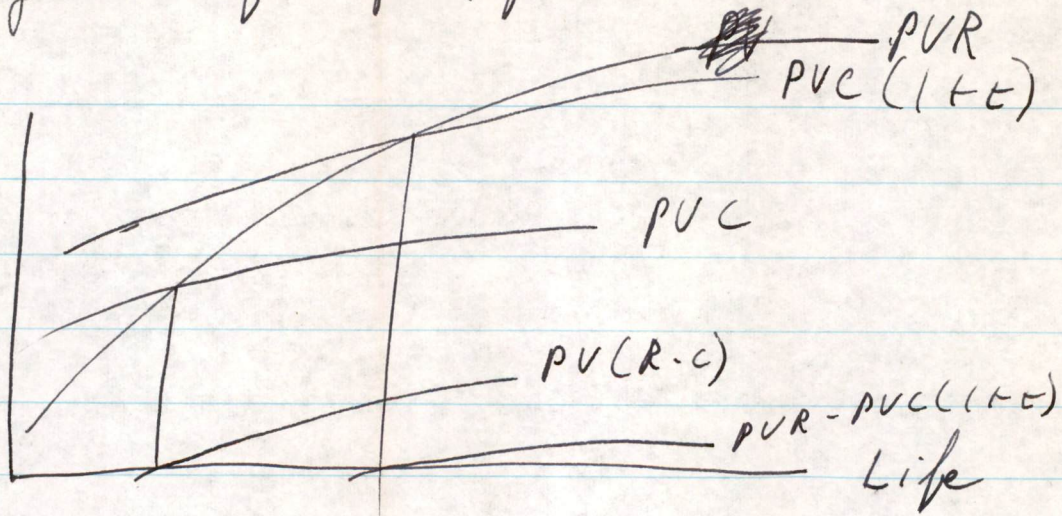
Bldg. tax - 2

~~How~~ H on bldg. tax moves opt. L to R.

a. Bldg. tax only a Co. Early longevity is bought by Co;
Later longevity by owner, not taxed.

Bldg. Tax lengthens life of bldg. (~~So add this to~~ (To which we may add it defers ripening of successor, thus doubly lengthening life.)

Fig. 1

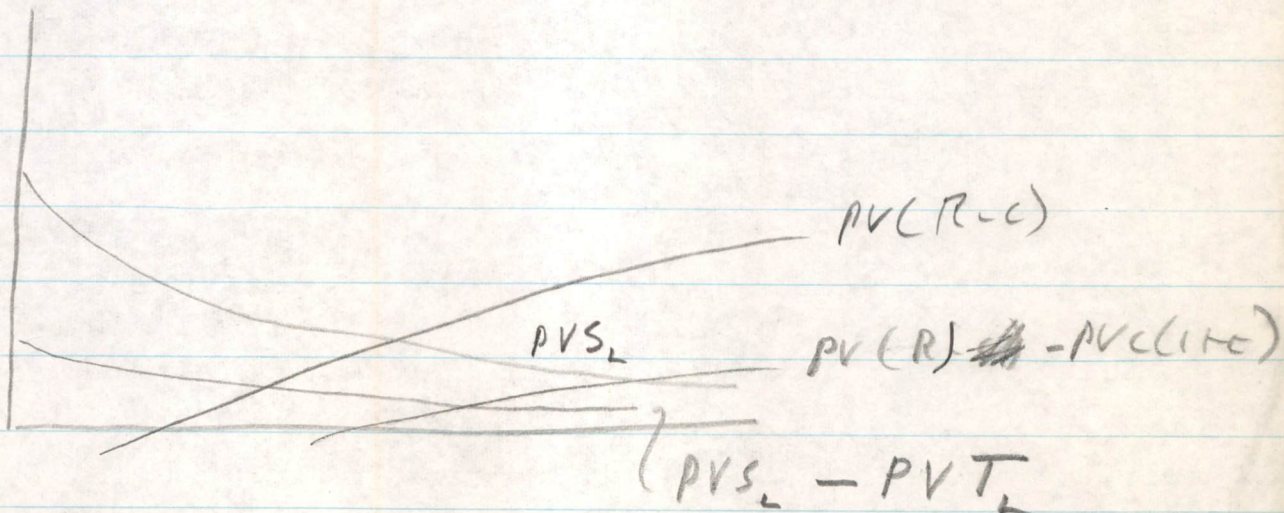


The fallacy that bldg. tax shortens life must be based on apply's reasoning to cost side & ignoring revenue side?

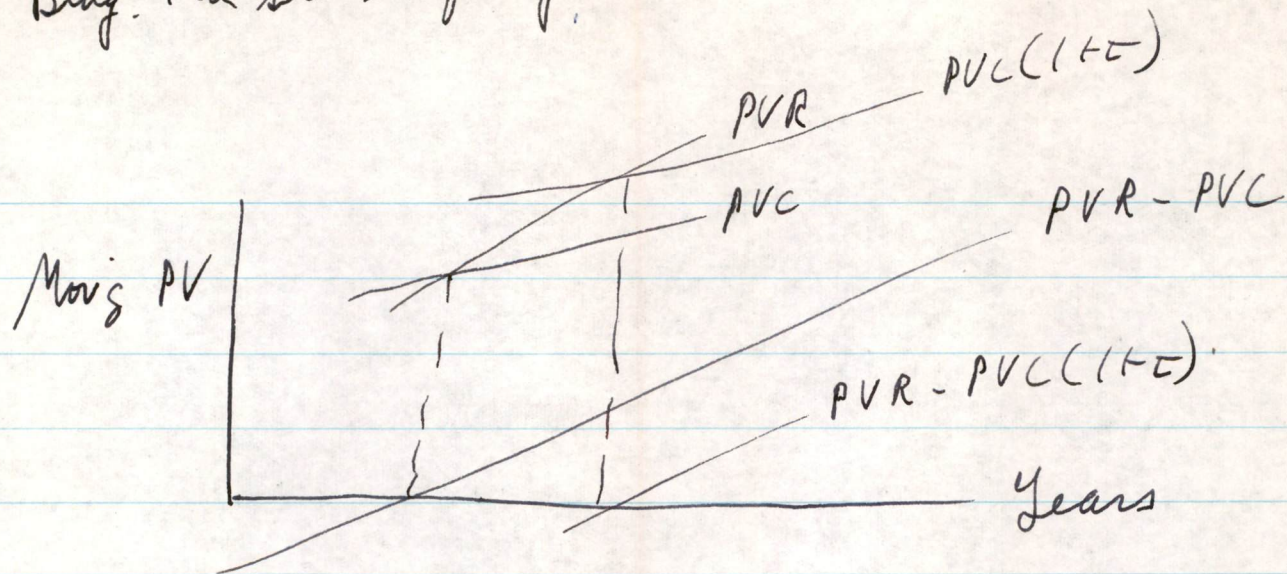
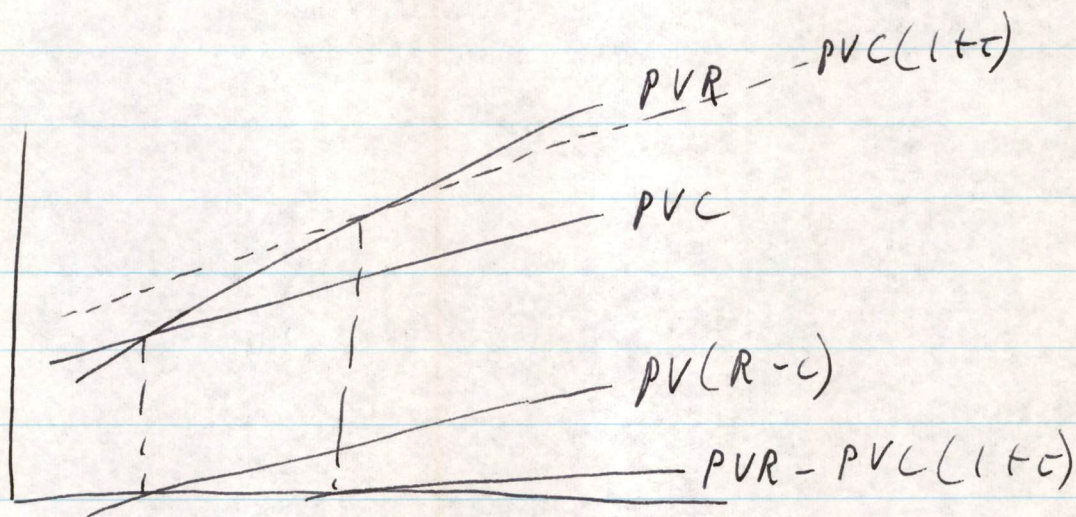
95 no det. there - both have $L = \infty$

Fig. 1 only shows G , & Bldg tax ~~also~~ lowers S , thus reducing the only factor ending L . This is crucial, bcs. if $MPVS_L$ be assumed same for each, then taxed G , lowers L .

Fig. 2



Bldg. tax slows ripening?



$1+t$ defers date of crossing equator.

But then lowers slope of $PV[R - C(1+t)]$

So land finally becomes ripe for a much less bldg.

- just as Ely said hastening would do!

Site ripening.

Tree has inv. value & lign. value.

Ripening S has ^{holding} ~~inv.~~ value based on dev. when ripe; vs. ~~an~~ an
"Immediate Use Value" ~~(IUV)~~ (IUV)
~~Immediate value~~ based on dev. now.

Often one can dev. now and also redev. when ripe, so

$$\text{Immediate Use Value (IUV)} > \text{Holding Value (HV)}$$

~~$$\text{Holding Value (HV)} < \text{Present Dev. Value (PDV)}$$~~

$$\text{Bcs, } IUV = HV + G_1$$

where G_1 is PV of 1st gen. use.

$$\frac{d(HV)}{dy} = i \cdot HV \quad (y \equiv \text{year}) \quad \text{But } G_{>1}' > G_{>1} \cdot i$$

where $G_{>1}$ is MPV of 2d et al. gen. use.

$$(\text{In a skum, } G_1 \equiv 0, \text{ and } S = HV = G_{>1} (1+i)^{-x}$$

This means no net site cost, bcs. $(HV)' = i \cdot HV$; $G_1 \cdot i = 0$.

Bldrs. anticipating neighborhood becoming skum, i.e. non-renewable, $\therefore$ add longevity.)

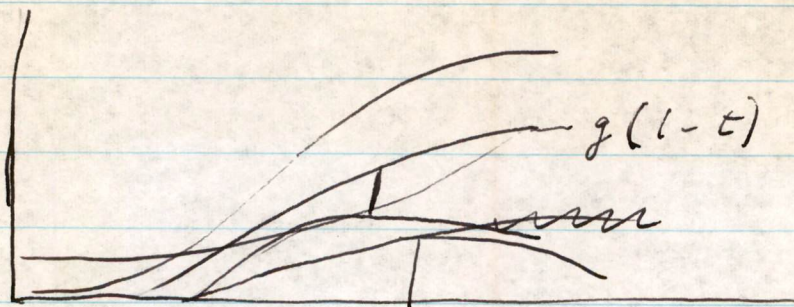
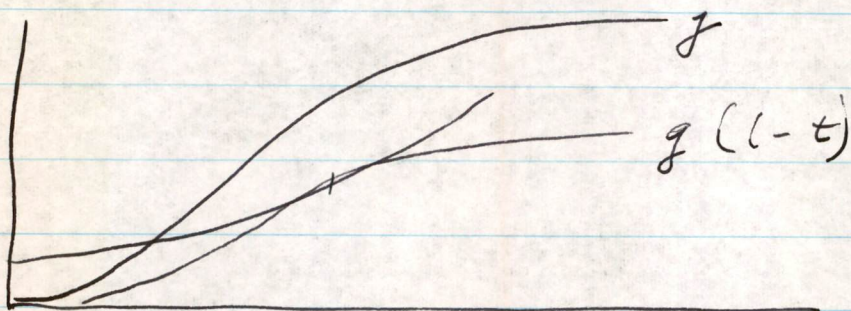
Bldrs. anticipating ripening situation at life-end
wd. bld. longer. "Ripening deadlock" wd. occur if

2
G. cd. not be squeezed in. Bldg. tax makes it

harder to squeeze in interim uses, bcs. requires longer
to break even. Thus creates ripening deadlocks.

Bldr. may not see ahead so clearly? Maybe
not. But climate of opinion created, derived from
experience, that molds behavior.

This shows itself in practice in bldrs. ignoring
salvage of site. If they considered it, they wd.
bld. & plan for shorter terms



Leverance tax

$$\frac{g - C(1-t)^m}{}$$

$$\frac{g(1-t) - C(1-t)^m}{}$$

$$g(1-t)^{-m} - C$$

$$g(1-t)^{-m}(1-t) - C$$

Avoid bldg. plants in ray-time.

Prop. Tax

ii. The other side: forces pressing for earlier start ~~are~~ need to begin sooner.

Minerals analogy n.a. Must consider later generation. (over, top)
~~forward effect of considering later generation is to shorten cycles~~ (over)

Timber analogy - modified Faustmann for higher future uses. (If I've worked this out.)

Value of ~~Need to~~ advancing future starts. ~~at~~ T_0

Lutz case. Simple rise to a plateau (over)

Rationale for saying S-i is o.c. of time.

Impl. conditions implicit in max. solutions.

Models to fit various cond circumstances.

$$a. S = V \left[1 + \frac{(1+g)}{(1+i)^2} + \frac{(1+g)^2}{(1+i)^4} \dots \right]$$

$$b. S = V \left[1 + \left[\frac{(1+g)}{(1+i)} \right]^2 + \dots \right] \text{ This is more favorable to deferral argument, but faith.}$$

c. Squeezed interim use (Like Lutz case?)

Higher future rents come anyway, indep. of when start.

Impl. o.c. of time > Ave.

Value of avoiding squeezing interim use.

d. Mnp. vs. competition

iii. Opt. start time, on balance. Mass systems seldom (over, middle)

4 (cont.) iv. Situations where city ripening argument may apply: present crop of CIA dependents. (over)

5 3. ~~Implications for Tax policy~~ [Uncertainty. Adapt by sacrificing some scale. But sometimes may adapt by advancing (over)]

Effect of prop. tax.} sometimes may adapt by advancing (over)
 Synch. w. p.w. extensions. Pretty obvious.

Banker asks, if build ahead of demand, how long ahead?

Deferral of start-date compensated by rapid recovery once start. But one horiz.
approach to develop urban land has no cut-off, CN. lasts forever, fail to max. rent.

note effect of dividing by $[1 - (1+i)^{-t}]$. Defender is 1st cycle, gets shortened, too.

(Might cite Jorgensen et al. here, on ^{how} such cycles begin anywhere.)

(Show or cite how unq. condition is implicit in max. cond.)

Later generations deflate argument, 2 ways: a. Raise $\delta \cdot i$ which is o.c.

b. Lower ΔS from waiting, less defers
later gens.

This approximates transition between two limits.

(seldom) rep. a lower use. Ripening argument suggests we shd. advance
them if that is the effective way to prevent entrenchment of C (a lower
use, ^{stamping} ~~imprinting~~ low use on land for long time.

Also, mass system/lead demand, can't be as passive as Ely's spec.

~~origin time, so 1st gen. is dispensable earlier.~~

Some of them seriously interfere w. later higher use. Such as subdiv. e.g.
Homer & neighborhoods aggressively, ^{rigidly} designed for permanent low density.

Solution lies in bldg. more flexible design. The low density house, side
lots shd. be resellable. Such as interior shd. be subdivisible.

If a low use today binds future generations, then Ely is right.

Land tax, doesn't matter, he gets money anyway. But, as result, also get use of facility. At least, a large element (over) Uncertainty. Ecst. often ask, how adapt to it. Here is a policy to reduce it.

Less obvious, outside p.w., ripening land.
Burning issue, area of great uncertainty. Current reforms, catching up.
Ad val. basis, distributionally desirable, tax Δ s, Haig-Simons basis.
Incentive effect desirable, no penalty on fldr. or subdividers if assmt. was already up.

But does it encourage premature urbanization? Show it is neutral.

F. Concln.

1. Need mass systems to save on capl.
Easy to misunderstand. They might seem capl. using.
But they lower ac. Obviate capl. elsewhere. Share common costs. Spread overhead.

2. Remove obstacles to higher density
Tax C/A; "subsidize" mass system

3. Need mass systems to enable compen.
Many regard them as another threat of the big to the small.

of delay is removed. It's still possible to err, and there are
examples, e.g. Manned I.D. But things are improved.

In fact, just the reverse. They make niches for the small.

While our eyes have been focused on govt. as the threat, it is mergers, giant firms, that have been gobbling up small, pose the real threat.

Mass systems are best weapon vs. this.

Propty. tax implications

The banker will ask "How long"?

Answer is, accelerate land change w. land tax.

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• DEPARTMENT OF ECONOMICS

Attached seems to show land tax is neutral re timing of bldg.

Use in article: re tax policy outside serviced area.

Note: mere proximity to serviced city area does not automatically create expectation of imminent higher use. If a city is not expanding in space (even tho perhaps Δ pop. etc. by Δ density), & has known policies to prevent needless extensions, outer land need have no high value.

Conceivably, static boundary can prevail for years, & values just outside line be sharply lower.

Ripening



- 1 -

7: Timing renewal

$$1 = \frac{(1+i)^L}{(1+r)^L} - \frac{t}{1+r} - \frac{t(1+i)}{(1+r)^2} - \dots - \frac{t(1+i)^{L-1}}{(1+r)^L}$$

$$1 - \frac{(1+i)^L}{(1+r)^L} = \frac{-t}{1+r} \frac{1 - \frac{(1+i)^L}{(1+r)^L}}{1 - \frac{1+i}{1+r}} = \frac{-t}{r-i} \left[1 - \left(\frac{1+i}{1+r} \right)^L \right]$$

$$1 = \frac{-t}{r-i}$$

$$r = i - t \quad (\text{Assuming no tax capn.})$$

If tax capn., land grows at $1+i+t$

~~$$1 = \frac{(1+i+t)^L}{(1+r)^L} - \frac{t}{1+r+t} - \frac{t(1+i+t)}{(1+r+t)^2} - \dots - \frac{t(1+i+t)^{L-1}}{(1+r+t)^L}$$~~

~~$$1 - \frac{(1+i+t)^L}{(1+r)^L} = \frac{-t}{1+r} \frac{1 - \left(\frac{1+i+t}{1+r} \right)^L}{1 - \frac{1+i+t}{1+r}}$$~~

~~$$1 = \frac{-t}{r-i-t}$$~~

~~$$r-i = t-t = 0$$~~

~~$$r = i$$~~

?

If there is tax cap., land grows at $1+i+t$;
and is discounted at $1+r+t$

Then

$$1 = \frac{(1+i+t)^L}{(1+r+t)^L} - t \left[\frac{1}{1+r+t} + \frac{1+i+t}{(1+r+t)^2} + \dots + \frac{(1+i+t)^{L-1}}{(1+r+t)^L} \right]$$

$$1 - \left(\frac{1+i+t}{1+r+t} \right)^L = \frac{-t}{1+r+t} \frac{1 - \left(\frac{1+i+t}{1+r+t} \right)^L}{1 - \frac{1+i+t}{1+r+t}}$$

$$1 = \frac{-t}{r-i}$$

$$r = i - t$$

E. Some dynamic problems

1. Uneven agedness of CIA

View CIA as ^{whole} going concern. Perfectly staggered, ^{must (own)} show how treating cap. costs as current is ^{similar to} ~~same as~~ if ~~even-aged~~ & include capl. costs & crf. -- thus, staggering is ^{similar} ~~same as~~ the no capl. is sunk. (The cap. cost is a little lower than if were about to sink a new system, but not much: $\frac{c}{L}$ vs $c \frac{i}{1-(1+i)^{-L}}$) As the system never wears out, there is never a good time to replace, w/o waste. To avoid the trap. Analogy: old car w. miss. new parts.

2. Drifting demand & progressive obsolescence.

(Fixed demand has some realism: i.e., ftr, status does, bes. is shift from one density to another.)

But even if demand fixed, plant depreciates (unless staggered, & FC added to VC). But even if staggered, MC of CIA will rise of neg. externs. are ^{cumulative, as poltn. of lake or feed's w. table.} ~~Begin w. simpler case, no defender.~~ Or if public becomes more sensitive, e.g. to noise.

3. Proper tax policy outside users' costs.

Resolve conflict. On Haig-Simons equity grounds, tax Δs . But does this avoid motivating premature use?

4. Implications for land reassessment reforms.

Begin in center?

5. Implications for saving on capital. How save most?

~~Don't~~ allocate cap. costs to yr. incurred -- treat as current expense. (This is esp. clear in regul. year.)

1/ stagger, $c = \frac{C}{L}$

1/ even-age, $c = C \frac{i}{1 - (1+i)^{-L}} > \frac{C}{L}$

The staggered C/A has lower capl. charges, bec. ave. inv. made later.

In return, however, has greater costs of stopping. Continuing capl. costs ~~are~~ must be viewed as current expense, thus accelerating replacement. And ~~later~~ none of parts get fully amortized. save the earliest.

Ripening - Sequence of Expo.

1, 14

2, 9

3, 8, 13, 11

5

6, 12

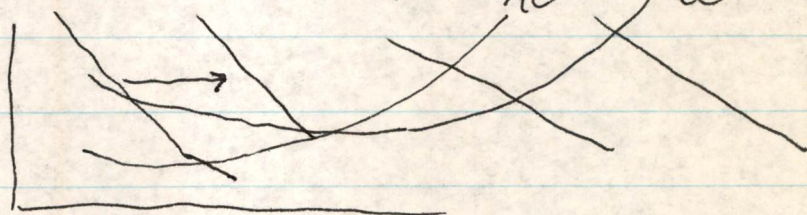
Typis Approach to ripening -

a. Figure $\frac{PVAT}{PVBT}$

b. See if ratio is same for different intensities, ripenings, etc

WTBW approach:

W. rising demand, opt. bldg. is first too large, then too small.



Ripening

Summary of points, — not in order of expo.

1. ~~1/2~~ waiting pays interest, it pays. ~~That is if:~~
 $\frac{\Delta S + \alpha_0}{s} > i$. (See #6.)
2. ~~Takes on bldg~~
~~— ^{increase} return, ^{and defer ripeness} if waiting for lower i.g.~~
~~— reduce " ^{and accelerate ripeness?} " higher — But you~~
(Show algebra, ~~app #~~) could go ahead with a smaller bldg — I don't think it would advance the ^{heavier} ~~heavy~~ ^{big} ~~itself~~ ^{itself} bldg.
So they advance lighter bldgs. and defer or retard ^{heavy ones?}
3. More commonly, one is waiting for lower i.g. (See #8)
So bldg. taxes ~~at~~ the ρ rate of return, & defer ripeness.
4. Waiting must pay interest not only on G_1 , but $S_2 e^{-im}$
This adds to base of growth rate. (or you could subtract drop of $S_2 e^{-im}$ from (a))
It may also add to numerator, if $S_2 e^{-im}$ grows with time.
 - a. Bldg. taxes lower S_2 , tending to defer ripeness.
 - b. " " lengthen m_1 , " " " "
 - c. " " add to growth rate of S_2 , just as they do to G_1 .So their overall effect is generally not much changed by adding S_2 ~~to~~ to the base and ΔS_2 to the numerator.
~~But~~ (c) offsets (a). and (b) reduces PVS_2 and ~~the~~ $PV \Delta S_2$ equally. So this is not a general factor of high importance.

In some cases, it would be important, —

when m is short, and $\Delta S/s \gg \frac{\Delta G}{G}$

5. Taxpayer ~~avoidance~~ ^{waive action} modifies ~~the~~ $C, R,$ & $\frac{C}{R}$ at each year, hence their path of change.

Posit a base path, w/o taxes, with C/R falling. Taxpayer will lower C/R when it is higher.

Net effect is then a combo of 2 waive responses. He builds, less, later. Maybe build nearly as soon, and much smaller; or much later, and nearly as large.

Rationale for ripening is to ~~build~~ save for later to build more. on Bldg. taxes cause saving for later and building less.

6. Bldg. taxes reduce new income relative to old, from G_0 or extant use.

Renewal is timely when income from $G_1 >$ inc. from G_0 plus ΔS from waiting.

Translating to the % terms I have been using, defer renewal as long as:

$$\frac{a_0}{s} + \frac{\Delta S}{s} > i, \text{ or } \frac{\Delta S + a_0}{s} > i$$

$$a_0 + \Delta S > si \approx a_1$$

1. Bldg. taxes, in aggregate, also lower i , further deferring renewal or ripeness.

8. Why ripening generally entails lower i .g.

~~See Sheaf Z, p. 3-4.)~~

✓ a. Quantum jump between discrete land uses. Demand rising. The G_1 moves from its outer ~~margin~~ has outer margin and inner. First appears on outer margin where is the more intensive use, demand is just barely strong enough to justify it. As demand rises, $\frac{c}{R}$ falls.

✓ Dubious This R_1 . b. By waiting for G_1 , one brings G_2 closer. This compresses or squeezes G_1 , reducing opt. C_1 , but also in retail areas, where bldg. obsolescence fast, this wd. be a large factor. Taxes on G_2 reduce C_2 ; but, by pushing it into the future, increases likelihood that it will grow; and also a growth rate, by tax effect.

c. If i .g. doesn't fall, ~~it's~~ it's harder for $(R-C)$ to rise very much. Not impossible, but less likely.

✓ d. Lower C can raise $(R-C)$ all by itself - due to new bldg. techniques, obsolescence; or due to ripening, to a discrete other use of lower C .

9. To show ~~how~~ ^{why} effect of taxes on growth rate of site value is determined by drift of c/R

Without taxes, and regarding only G_1 ,

$$\frac{\Delta S}{S} = \frac{\Delta R - \Delta c}{R - c} \quad (1)$$

After taxes, (and evasive reductions of c & R),
taxes raise the growth rate if

$$(2) \quad \frac{\Delta S - T \cdot \Delta c}{S - T \cdot c} = \frac{\Delta R - \Delta c(1+T)}{R - c(1+T)} > \frac{\Delta R - \Delta c}{R - c} \quad (2)$$

By inspection, ^{or solution,} (2) holds if

$$\frac{\Delta c}{c} < \frac{\Delta R}{R} \quad (3)$$

Which is true if c/R is ~~growing~~ falling.

10. Takes raise ρ growth rate if one shifting to lower c/R , thus encouraging waiting for that, but discourage waiting for higher c/R

11. If $\frac{c}{R} = 1$, then $R - C = 0$. So for land to have any use, $\Delta R > \Delta C$, and l.g. falls, c/R falls.

This is the extreme expropriating case of how l.g. is likely to fall as land ripens.

If $\frac{c(1+\tau)}{R} = 1$, then for land to ripen,

$$\Delta R > \Delta C(1+\tau)$$

$$\frac{\Delta R}{\Delta C} > 1 + \tau = \frac{R}{C}$$

$$\frac{\Delta R}{\Delta C} > \frac{R}{C}, \text{ and } \frac{c}{R} \text{ must fall.}$$

12. Bldg. taxes defer repaving 3 ways.

a. Lower G_1/G_0 .

b. Defer G_1 by repaving effort

c. Lower value of G_2/G_1 , at end of life.

✓ 13. Another gain from waiting, leading to lower C/R .

Possible ~~to~~ scale eqs., - esply. for p.w.

✓ Improved credit rating --- lower i for borrowing.

This can be all-important! It depends on a low C/R , if C is to be debt financed.

✓ Others may help pay. Public sewer & water instead of pvt.

✓ Added certainty, reduced need for versatility.

14. Describe successive hypothetical optimal ~~steps~~ bldg. plants as $P_1, P_2, \dots, P_n$.

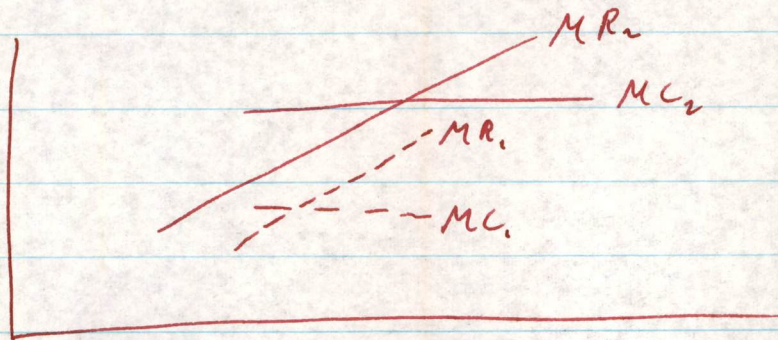
Waiting means you sacrifice PVP_1 now to get PVP_2 later. ~~Low~~ is good if yields i .

Sheaf Z

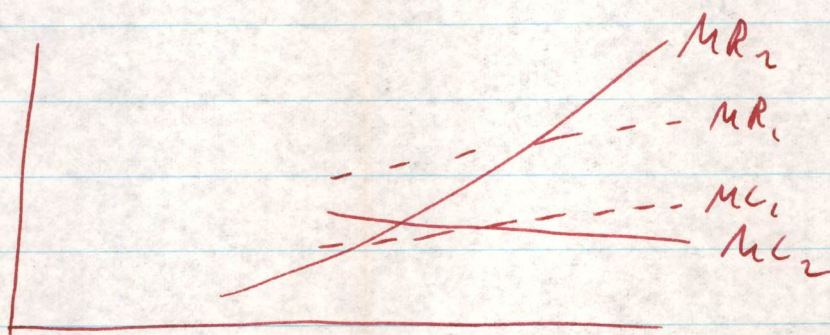
- (-

If MS rises bcs. of rising demand for same bldg.,
that is no reason for deferring bldg.? Yes, it is.

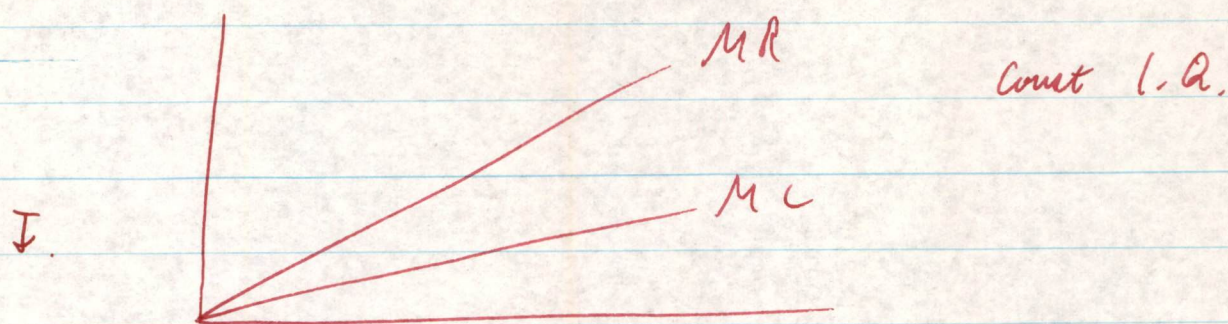
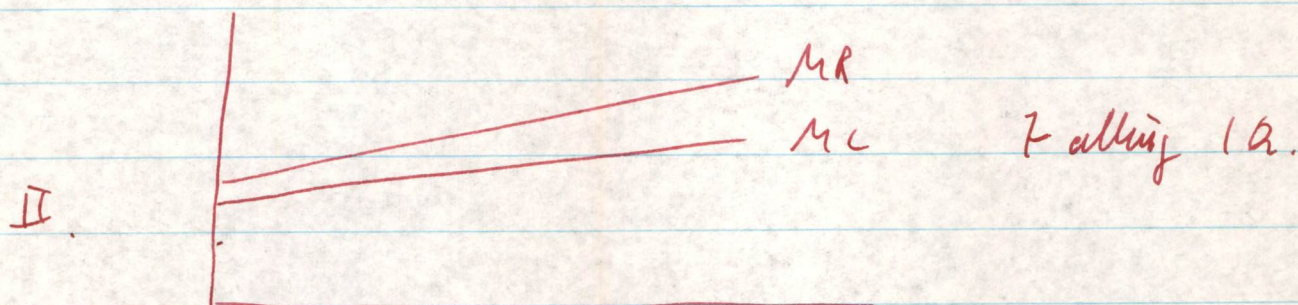
Only when MC rises is there a ripening rationale?



If the₁ interferes with, precludes the₂, then holding
may be economical. the₂ might ^{even} entail less capt., but
different capt. — like saving Hell's Canyon for recreation.
Interference and preclusion are the essential points.



One might be waiting for lower bldg. costs, too.



II seems more likely.

All told, falling l.Q. seems probable in general.

The other case is exemplified by going from pasture to citrus. l.q. is higher for citrus.

Generally, a land use is high l.q. at its ~~lower~~ outer margin, where it is the new or higher use, and low l.q. at its ~~upper~~ inner margin, where it is the old or lower use.

✓ Then, by waiting, one lowers l.q.

Also, S_2 will be higher l.Q. at the time land is ripe for G_2 , and hit harder by taxes, and devalued and defensed. This lowers S_1 and defers G_1 .

Summary, why ripening generally entails lower l.a.

1. ^{Discrete} Land uses have ^{an} inner margin, where they compete with higher uses, and ^{an} outer margin where they compete with lower uses.

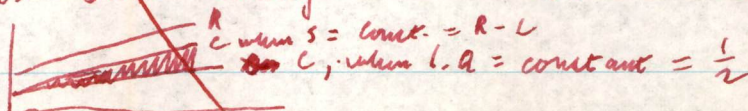
At the outer margin they are the more intensive use, and risk being premature. Demand is rising, beginning to justify the higher intensity, but just barely, so cost is hi rel. to revenue.

By waiting for demand to rise more, one increases R more than C. Thus lowers l.g.

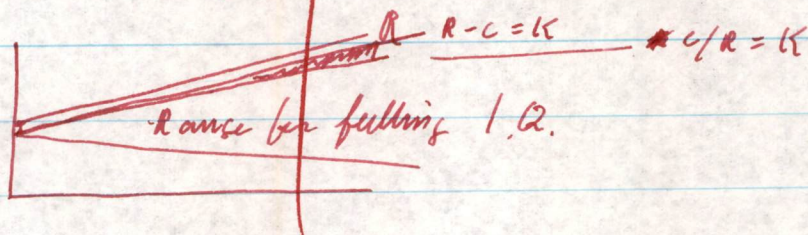
2. By waiting, one brings G_2 closer, thus lowering value of opt. bldg. ~~at present~~ One builds to recover cap faster, and due to limited limited flow - capacity of site this is unlikely.

Expand

3. As a matter of probability, the range of possible values of MC is small satisfying the condition of rising l.a. and rising $R-C$ (shaded area.)



This argument looks shaky when begin w. $l.Q = \frac{1}{2}$.
But when a use first becomes supranormal, $l.Q \cong 1$.



4. Ripening may result from lower C , not just higher R .

G_2 might be e.g. recreation, vs. a G_1 with heavy capt. input.

The condition is that G_1 would preclude G_2 — not that G_2 need be higher cost.

One might be waiting for lower C due to new inventions, techniques. i.e., obsolescence.

5. Ripening might involve ~~going~~ waiting for use of higher $l.Q$. E.g., don't ~~last~~ improve land for farming, we are going to urbanize.

Bldg. taxes would hit the urban burden. Thus deferring ripening. So do bldg. taxes defer ripening either way?

T. 1, p. 19

Discussion Draft

Comments Welcome

**PROPERTY TAX TREATMENT OF FARMLAND:
DOES TAX RELIEF DELAY LAND DEVELOPMENT?**

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1. Introduction

For a variety of reasons, social planners and environmentalists have observed with concern the loss of productive farmland to urban development. As land values rose along urban fringes, the returns to developing land for housing or commercial enterprise exceeded the returns to farming, and even some of the most productive agricultural areas became attractive sites for suburban settlement. Property taxes based on the fair market value of land were accused of exacerbating incentives to convert land to urban purposes by increasing the cost of farming as land values rose. A landowner's property tax liability is determined by the sum of the jurisdictional rates (library tax, school district tax, etc.) that apply to the land and by the basis upon which the rates are applied, i.e. the assessment. Without special property tax treatment, a higher market value eventually means a larger tax basis. Simultaneously, as encroaching development absorbs fringe farmland into more taxing jurisdictions, higher nominal rates may apply to the land.

Since 1957, in response to the economic pressures to develop farmland, every state has passed a statute allowing or requiring preferential property tax treatment of farmland. In almost every case this includes a use-value assessment provision, under which qualified farmland is assessed according to its value when restricted to farming rather than its full market value. Thus, while the land is kept in agricultural use, the farmland owner need not pay property tax on the speculative component of the land's market value. A common companion policy, rollback taxation, allows localities to recapture several years of previous tax abatements, sometimes with interest, when land becomes ineligible for the special assessment. Although these policies are widespread and may represent substantial tax expenditures in some areas, little empirical work exists to test how well use-value assessment laws work to preserve agricultural land. Even if planners and economists agreed (and they do not) that farmland preservation at taxpayer expense is a worthy goal, it remains to be shown whether property tax relief has had the desired result. Clearly, if the disparity between farming return and post-development return is high enough, even zero taxation cannot preserve farmland indefinitely. The goal for tax relief can then only be to delay conversion of lands for which the disparity in returns is comparable to the tax reduction. This paper outlines current literature in the area, models the landowner's optimization problem, and uses county-level data to evaluate the impact of use-value legislation on the proportion of land in farming.

There has recently been increased attention given to use-value assessment policies for several reasons. Fiscal crises in local governments have spotlighted the tax base and spurred scrutiny of all policies resembling a tax expenditure. Notorious cases of wealthy landowners “farming” on their estates have made the policy look like a tax dodge for the rich. Mostly, however, it is concern about continued loss of open space that has ignited debate over the realm of policy options, use-value assessment included. Analysts sharply disagree about the extent of farmland loss and whether it should concern policy makers.¹ Nonetheless, many states and localities are developing programs to purchase conservation easements on farms to preserve open space land, and some are imposing rigid zoning ordinances to control land use. Better analysis of current programs could inform the debate over the need for these new efforts. In addition, despite the lack of rigorous empirical analysis of use-value assessment, the policy has been promoted as a way to preserve other kinds of undeveloped land, especially forest land.²

Section 2 of this paper provides background for the policies discussed in this paper. It reviews the debate over preservation and preferential tax treatment of farmland, and describes several differential taxation schemes, explaining implementations of use-value assessment in more detail. Section 2 of this paper also surveys the limited empirical work investigating the impacts of use-value assessment. Since this paper is largely an empirical study of preferential property taxation of farmland, a discussion of relevant economic theory is outside our scope here. Morris[1995] provides a more complete discussion of the theory of the property tax treatment of undeveloped land and pays special attention to the optimal timing problem involved in a landowner’s decision to develop. Section 3 of this paper describes the county-level data from various census sources that this study uses. In Section 4, I discuss the empirical models and the estimation results. Estimations show that use-value assessment has a positive and significant effect on the proportion of land in farming in a county. When looking at differences across the sample as a whole, counties with use-value assessment have about .5 to 1.6 percentage points more land in farming. However, when we look at the effects on a year to year basis, the policy retained almost five more percentage points of farmland per county. Section 5 contains concluding remarks.

¹ Heimlich, et. al. [1992]

² Cushman, J.H. [1994]

2. Farmland Preservation and Preferential Taxation

2.1 Why Preserve Farmland?

In this section, I briefly review the usual arguments for public policy efforts to preserve farmland and preferentially tax it, and I describe how states have implemented their policies to this effect. Reasons for preferential property tax treatment of farmland fall into two main categories: to preserve the economic viability of farming, and to adjust the tax burden to reflect the relatively low use of city services of farmland owners. By far the most attention goes to the former category, and numerous authors have discussed this controversial issue. Gloudemans[1974] provides a comprehensive discussion of farmland preservation issues. An interesting critique of legislation designed to promote agricultural land retention appears in Gardner[1977]. Dunford[1980] and Barlowe et. al.[1973] survey the different kinds of property tax relief programs for farmland. Nickell[1994] discusses the extent of tax shifting caused by use-value assessment. The statutes themselves are compiled in Aiken[1989].

The most commonly cited objective of preferential taxation of farmland is to preserve the economic viability of farming, either for the farmer's sake or for a larger social value placed on that land use. Some view government attempts to preserve farmland as a straightforward welfare transfer to the agricultural sector, arising either from political pressure from the farm lobby or in reaction to a lamentable decline in the heritage of family farming. However, there are also many economic arguments put forth for farmland preservation. Some argue that farm and open space lands create positive environmental externalities, such as providing visually pleasing landscape and increased wildlife habitat, and therefore a Pigouvian subsidy is appropriate. One argument for preferentially taxing farmland that is increasingly put forth is that there is a need to counteract implicit subsidies to development, such as construction of highways and airports in urban outskirts, and the deductibility of mortgage interest, which subsidizes large homes on big suburban plots.

Another argument points to the irreversible nature of land development. Since developing a parcel of land is effectively an irreversible investment under uncertainty, undeveloped land has an option value associated with it. Thus there exists some hurdle price that must be reached before development will be undertaken. If this option value is higher for society than it is for the landowner, it may be socially efficient to try to delay development until the social hurdle price is achieved. Farmland preservation may also supply the

social good of food security for future generations, though changes in technology have lowered the expected need for land.

Aside from motivations to preserve farmland for improved social efficiency, the user fee concept of property taxation indicates that lower effective tax rates on farms are appropriate if farmland owners are relatively low users of services that property taxes fund. Because property taxes generally go to schools, city government, fire and police protection, local roads, sanitation, and libraries, farmland owners may consume fewer services per dollar value of land owned than residential or commercial landowners. Rural residents frequently pay privately for road construction and maintenance, sewage treatment, fire protection, and other services. Of course, truly rural areas lie in fewer taxing jurisdictions, so effective property tax rates in rural areas tend to be lower even without special tax treatment of farmland. Nonetheless, farms on the urban fringes may lie within highly-taxed jurisdictions, and a user fee approach may warrant a lower tax burden on this land.

2.2 Preferential Tax Policies

Whether for political, social efficiency, or equity reasons, state and local governments have decided to provide special tax treatment for farmland. **Table 1** shows the year in which use-value assessment was adopted by each state, and whether the policy is combined with deferred taxation and/or restrictive agreements, which will be discussed below. While some states have modified the policy slightly from time to time, in general the policies have remained fairly constant since they were adopted. Many states adopted their preferential tax policy in the mid-seventies. The frequency chart in **Appendix A** of **Table 1** shows the number of states that adopted the policy in each four-year time period. The increased incidence of adoption of use-value assessment in the seventies coincided with sharply increasing land prices and a general movement to reform assessment practices to conform with the law. Because in some areas farmland tended to be systematically underassessed, the new policy could have been adopted to maintain current tax burdens. From **Table 1**, one can see that use-value assessment exists in some form in all states -- except Wisconsin, which has an income tax credit system for property tax relief and will be excluded from the empirical analysis in this paper. While use-value assessment is the most common preferential tax policy for farmland and will be discussed in detail later, some other schemes are worthy of mention.

First let us consider the components of a landowner's tax liability. As mentioned before, the tax rate that applies to a given parcel of land is the sum of the tax rates for the jurisdictions in which it lies, such as the school district, city borders, library district, etc. These rates are determined locally, and are generally not set explicitly by state statute, though some states do put upper limits on local rates. The assessment ratio is the proportion of actual market value that a state uses as the basis for property tax purposes. Assessment ratios vary widely across states, but most states have a uniform assessment ratio that applies within that state.³ Almost all property tax relief programs for farmland work through the assessment of the land and real property. Differential property tax treatment could be implemented by varying nominal tax rates, but states usually only address the assessment because the overlapping mosaic of jurisdictions makes legislating rates too complicated.

One way to distribute the tax burden across land uses is to abandon a uniform assessment ratio. Some states officially categorize land according to its use (residential, agricultural, industrial, etc.) and compute assessed values with different percentages of market value (assessment ratios) applied to different categories of land. Called classified property taxation, the same nominal tax rate applies to all land within a jurisdiction, but the tax basis of the land depends on its market value and the percentage applied to its use category. Land classified as agricultural generally receives the lowest assessment ratios in states with this system. States with classified property tax have also adopted use-value assessment, so that the final assessment of farmland in those states is the use-value assessment times the percentage that applies to farmland. In that case, landowners who develop face higher tax burdens from two sources. When the land is developed, the land comes under a different classification that may have a higher assessment ratio, and the basis to which that ratio is applied is now the full market value rather than the farming-only value.

Another preferential tax system designates agricultural preserves and requires fairly long term contracts between farmers and the taxing authority about how the land will be used in return for special tax treatment. New York and California both have large-scale programs. Conklin and Leshner [1977] discuss the New York policy of agricultural districts and contracts in two important agricultural counties. They

³ Note that because assessment ratios differ, it is impossible to compare tax burdens in different states by looking only at nominal rates.

point out that without preferential tax agreements that are longer-term, farmers may not make the large farm-specific investments (e.g. drainage, leveling, fencing, etc.) that are necessary for continued efficient farming. California was one of the first states to preferentially tax farmland with the passage in 1965 of the California Land Conservation Act. Schwartz et. al.[1975] describe the program and model the incentives to participate in the contract agreements. They estimate the tax benefits to the farmers under several price pattern scenarios, but they lack the data to evaluate the program's actual impact on farmland preservation.

Finally, some states limit property tax burdens using a circuit breaker mechanism, whereby total property tax liabilities are bounded by a certain percentage of the property owners' incomes. This policy is almost exclusively for residential property rather than agricultural land. In 1979, only Michigan and Wisconsin had circuit breaker programs specifically for farmland.⁴ Other government interventions may serve to reduce property taxes indirectly. Zoning land for open space uses or purchasing conservation easements makes market values lose their speculative component and fall to levels reflecting only the returns from open space use, at least to the extent that the zoning is considered permanent. Thus assessments and property taxes fall *for the targeted land*. However, nearby land without development restrictions may become more attractive to speculators, and taxes and pressures to develop that land may be exacerbated. In such a scheme there is no reason to believe that protected parcels are chosen efficiently. Hence, there may be scope for market mechanisms in this allocation, such as tradable development rights or bidding for easement purchases, as New York has tried.

Why do states choose a given policy? Chicoine and Scott[1983, p. 2] cite evidence that states with lower income or a larger agricultural sector choose pure preferential assessment policies, and higher income, less property-tax dependent urban states combine preferential assessment with agricultural districts and restrictive agreements. Note that use-value assessment and classified property taxes can be quite different, even when agricultural land has a preferential assessment ratio in the classified system. In the use-value system, a landowner is not taxed on any part of the speculative value of the land, whereas in a classified system, tax burdens definitely increase with the higher market values that development pressures bring.

⁴ Gold [1979], p. 103.

As land prices along the urban fringes rise, use-value assessment may represent a substantially greater tax expenditure than a classified property tax system. If market values for farmland are close to the use-values, then a classified property tax system carries a larger tax expenditure than use-value assessment.

2.4 Use-Value Assessment

Now let us consider the most common preferential taxation policy, use-value assessment, and its frequent companion policy, deferred taxation, which is also called rollback taxation or a recapture provision. While the principle of use-value assessment is quite simple, there are several practical considerations to its adoption, and state implementations of use-value assessment differ in several respects. One main variation is in their eligibility requirements. Some states have a minimum acreage requirement, usually about five to ten acres. Many have a minimum gross revenue requirement from the land, usually over \$100 and in some cases over \$2500 for the entire plot of land. New York requires revenue of \$10,000 to qualify for agricultural districting. Another difference is how the use-value is computed. It is difficult to capitalize the owner's future income when operating costs, prices and yields are uncertain. The majority of states employ a standard formula that the assessors use to compute a reasonable farm value. A productivity rating is determined, based on the soil quality, drainage, location, stoniness, etc. Expected income is capitalized using expected yields and prices with a capitalization rate derived from, for instance, a five year average of the farmland mortgage rate on new loans from the Federal Land Bank. Actual income figures from the farm being assessed may not be used, since some states prefer to use state averages for a given soil type and crop mix. For a specific example of this computation, see Chicoine and Scott[1983], who outline the formula used in Illinois.

In some states, participation is automatic and in others the landowners must file periodic paperwork to maintain eligibility. States with deferred taxation tend to require more paperwork because they must keep records of both the farm value and full market value; in the event that land is developed, they need to compute the back taxes owed. States differ both in the number of years for which the deferred tax is levied and in the number of years the land must be farmed before it is eligible for use-value assessment, generally about two or three years in each case. There are slight variations in what kind of land use qualifies, but almost every ordinary agricultural activity qualifies, e.g., growing crops, raising livestock and poultry, pasture, and dairy land. Ranch, horticultural, and floricultural land qualifies as well, and idle land that is part of crop rotation is generally included. States vary somewhat in their treatment of forest land and open

space land that is not agricultural. Many include land used for timber production in the same statute as other agricultural land, some have a separate use-value statute for that land, and some states do not tax forest land preferentially. Privately-owned wilderness or idle land is not included in use-value assessment statutes for most states. This could be seen as being in conflict with the ostensible goal of preserving open space land.

Ferguson[1988] is the only empirical study in the economics literature of the impact of use-value assessment on farmland retention. He tests for a change in the trend of the proportion of land in a county devoted to farming with data from four Virginia counties near the Washington, D.C. area over the time period between 1920 and 1980. He finds no significant effect of use-value assessment on development trends in three of the four counties, but in the fourth county the policy seems to have helped preserve farmland.

3. Data

In contrast to Ferguson's study, this study uses county-level data from almost 3000 counties in 47 states from the years of the Census of Agriculture 1959 to 1987 (1959, 1964, 1969, 1974, 1978, 1982, 1987). Alaska and Hawaii have been excluded because early data were poor, and Wisconsin is excluded because instead of use-value assessment it adopted a very different tax credit system. The data come from the Bureau of the Census, in particular the Census of Agriculture, the Census of Governments, and the Census of Population and Housing. County level data on land area, population, income, etc. were obtained from computer tapes of USA Counties and the County City Data Book. All counties that were included in each of the census data sources are included in this study. Some counties were excluded because their identifying numbers were not consistent over time, possibly because they were created or eliminated in the time period covered by this study. Independent cities were excluded because some Census of Agriculture data for them were unavailable. This represents significant loss of data only for the state of Virginia, which has several dozen independent cities, whereas only a handful of independent cities exist in the rest of the country. Some counties are excluded from the regression because of missing data, but these represent less than two percent of the observations. **Table 2** shows the number of counties from each state that were included in this study.

Table 3 defines the variables used in this study, most of which are on a per-acre basis. **Table 4** shows descriptive statistics for each variable in each year included in the panel. When years for data from other censuses did not match up with the years of the Census of Agriculture, I interpolated between the available years.⁵ All dollar values are converted to 1982 dollars using the Consumer Price Index. The market value of farm land and buildings was determined by asking the operators their estimates of those values. There could certainly be a lot of measurement error in that variable.

Land defined as farming for census purposes may or may not qualify for a state's use-value program, and vice versa. On one hand, the census classification is more strict because of the \$1000 revenue requirement, somewhat higher than many states' eligibility requirements for use-value assessment. On the other hand, some states require land to have been engaged in farming for several years before it qualifies for use-value assessment, though the land would appear in the census figures. Figures for the value of farm products sold may include wood products not covered by use-value programs. Data to untangle these problems are unavailable, so we use the term "farmland" loosely to include both census and state statute definitions. For the census survey, the land in each farm was designated as being in the operator's principal county, the one where the largest value of agricultural products was produced. In a few mostly agricultural counties, this convention resulted in a figure for farmland acreage that was higher than the total acreage in the county. I dealt with this problem three ways, and found that it did not make much difference in the estimation results. First I dropped all counties with farm proportion figures above one, then I truncated all figures above one to exactly one, and finally I dropped figures above 1.2 (163 out of about 21000 observations) and truncated the rest to 1 (635 out of about 21000 observations). The estimation results that appear in the following sections are from the third truncation technique.

4. Empirical Specification

This section considers several reduced form estimation strategies. First I discuss the simplest specification that can estimate the effect of use-value assessment on the preservation of farmland, with two approaches to modeling the policy's effect over time. Then I add other explanatory variables, and consider the potential problem of endogenous policy.

⁵ For population I used logarithmic interpolation.

4.1 The Simplest Model

First let us consider the simplest empirical specification that can test the impact of the policy on the preservation of farmland, which we shall write as in **Equation 1** below. Let c = county, s = the state in which county c lies, and t = year. Then

$$\text{proportion farmland}_{ct} = \alpha_0 + \alpha_1 \text{use-value}_{st} + \beta_c + \gamma_t + \varepsilon_{ct} \quad [1]$$

As in every regression model in this paper, the dependent variable is the proportion of land in a county that is farmland.⁶ We want to test whether, all else equal, counties with the policy have more farmland than those without it. A variable called use-value equals one if the policy is in effect during that year in the state in which the county lies and equals zero otherwise, and we test our hypothesis by looking for a positive coefficient on this policy dummy variable ($\alpha_1 > 0$).⁷ Year fixed effects, given by the γ_t , are important in this analysis to control for year-specific unobservables. For instance, the U.S. Bureau of the Census changed the definition of a farm with the 1974 Census of Agriculture, requiring at least \$1000 in sales to qualify. This shrank estimates of farmland acreage by an unknown amount, and the effect of this redefinition has declined in real terms since 1974. Location (state or county) fixed effects, given by the β_c in **Equation 1**, control for time-invariant unobservables for each location. These unobservables include all sorts of economic, demographic, policy, geographic and other characteristics associated with a given county or state that do not change significantly over time. Because counties within a state can be consistently quite different from one another, the model with county-level fixed effects is probably preferable to the model with state-level fixed effects. This simple model essentially breaks down the panel data set into subsets and computes the averages of each.

⁶ This variable is the net proportion of farmland remaining after some farmland is converted to other uses and new farmland is created.

⁷ Not all states adopted identical policies, particularly those like California and New York which had programs involving agricultural districts and contracts. The regressions that follow were repeated without the four states with such programs and the results were very similar, especially estimations that included location fixed effects.

Table 5 shows the ordinary least squares regression results for **Equation 1**, with Huber standard errors. The first column of that table leaves off the location fixed effects for comparison to the models in the other two columns, which have state- and county-level fixed effects, respectively. County-level fixed effects explain much of the variation in the dependent variable, bringing the R^2 up to 0.975. The coefficient on the use-value policy is about the same size for both models with location fixed effects, and the regression coefficients on the policy dummy variables appear statistically significant at a 5 percent significance level. Thus, from the estimations in **Table 5**, the policy appears to have a positive effect, in that counties with the policy have on average a little over one percentage point more farmland than counties without the policy.

By introducing the policy variable the way we did in **Equation 1**, we assumed the group of counties with a use-value assessment policy had a consistently different average proportion of land in farming than the group of counties without the policy. That model, however, restricts the difference between these two groups to being the same in all years in the sample. A different approach allows a more flexible interpretation of the impact of the policy. By interacting the use-value dummy variable with each of the year-specific fixed effects, we assume that the policy may have different impacts in different years. This is intuitively more appealing, the interpretation of the regression coefficients requires more care. **Table 6** reports the regression statistics from a model that replaces the policy dummy with a set of variables, each of which interacts the policy dummy with a year fixed effect dummy. The regressors in the first column of **Table 6** consist of six year dummies, five variables that interact the year dummies with the policy dummy, and a constant. The year dummies represent 1964, 1969, 1974, 1978, 1982, and 1987, the last six of the seven years in the panel data.⁸ The interaction terms represent how counties with the policy differed from counties that did not have the policy, after we control for county-level fixed effects. The variables of interest are the interaction terms, which report the “bonus effect” of the policy on farmland.

To visualize the results in **Table 6** (column one) more easily, see **Figure 1** following **Table 6**. I have graphed the intercepts of the two groups of counties over the time period of the sample. The vertical distance between the two graphs is the “bonus effect” I just referred to. This picture, with the

⁸ The intercept will represent 1959, the first year of data in the sample.

accompanying regression results, gives us a somewhat different interpretation of the impact of use-value assessment policy on the retention of farmland. In this model we find that the policy has a statistically insignificant impact for the first years in the sample, 1959 through 1974, but afterward there is a significant difference between the two groups of counties -- almost 5 percentage points difference in the amount of land in farming. The graph for the group without the use-value policy cuts off at 1982 because by then all counties in the sample had some form of the policy.

4.2 Including Other Explanatory Variables in the Basic Model

Now let us consider introducing other explanatory variables into the empirical model. For one thing, we may think other variables belong in the model because they impact the dependent variable in a systematic way, and for another, we may be interested in how some of those variables influence the ability of a use-value assessment policy to accomplish its purpose. In this section we introduce two variables that may interact with the policy to influence its effect. First, use-value assessment only provides a tax break when there is a real difference between the farming value and the development value. In purely farming or purely urban counties, this assessment policy may not matter much. Second, we might wonder how the effect of this preferential tax policy depends on the overall property tax burden; we may see different results in highly versus lightly taxed counties.

Ideally we would like a measure of development pressure to add to our regression to see how well the policy does where it may be needed most. The best we can do with available data is to interact the use-value dummy with the market value of the farmland and buildings. On one hand, high market values mean that use-value assessment could be a substantial tax break for farmland owners. On the other hand, high market values suggest strong incentives to develop the land, so that even the most generous tax relief cannot compensate for these pressures.⁹

We include a measure of the tax rate in our model, so that we can interact the tax burden with the policy variable to find out how its effectiveness varies with property tax levels in the county. While the coefficient on our tax variable cannot be interpreted simply, its interaction term with the policy variable can suggest

⁹ However, if high market value is a result of extra-profitable farming, this won't work very well.

how policy effects differ under different tax burdens. There are several problems with determining an appropriate tax rate variable. Nominal tax rates are set very locally, so it is not clear what rate to use for a given county, and statutory rates may bear little resemblance to effective rates because of widely varying assessment ratios and classification systems. In any case, county-level tax rate data are simply unavailable for the period in question. As a proxy for the overall tax burden in a county, I use total property taxes per capita in the county.

Along with the market value of farms and property tax burdens, we introduce other explanatory variables that could affect the proportion of land in farming. For instance, we might expect the most profitable farming areas to be less susceptible to development. Net returns data for farms are unavailable for the time period of the sample, so to try to capture this I use instead the county's average value of farm products sold per acre of farmland. In all, county-level explanatory variables I include are population density, average market value of farm property per acre, total property taxes paid per capita, and average value of farm products sold per acre. I assume a specification that is linear in the logs of each of the explanatory variables except population density, because there are two kinds of counties with very little farmland: mostly wilderness and mostly urban. This specification for population density allows a convex downward relationship. With the added variables (but no interaction terms), the empirical specification becomes:

$$\begin{aligned} \text{proportion farmland}_{c,t} = & a_0 + a_1 \ln(\text{pop. density}_{c,t}) + a_2 [\ln(\text{pop. density}_{c,t})]^2 \\ & + a_3 \ln(\text{mkt. val. land}_{c,t}) + a_4 \ln(\text{prop tax per capita}_{c,t}) + a_5 \ln(\text{farm revenue}_{c,t}) \\ & + a_5 \text{use-value}_{st} + \beta_s + \gamma_t + \varepsilon_{c,t} \end{aligned} \quad [2]$$

Tables 7 and 8 show the results from the estimations of the enhanced model, both with and without interaction terms. When we add the other explanatory variables to the model, the policy coefficient is still positive and significant, but its value depends on whether state- or county-level fixed effects are used, either .014 or .007, respectively. As expected, there is a strong convex downward relationship between the proportion of farmland and population density, as both wilderness and highly urban counties both have little farmland. There is a negative relationship between market values of farmland and proportion of land in farming, even when controlling for population density.

Two variables, property tax per capita and value of farm products sold per acre, have positive regression coefficients when state fixed effects are used, but negative coefficients when county fixed effects are used.

Large within-state variation in these variables could account for the sign changes. One might not expect the negative relationship between value of farm products sold per acre and the proportion of land in farming that appears in the county-level fixed effect models in **Table 7**. In counties with little farmland, perhaps it is the highest-valued product that is the first to be produced or the last to be eliminated. It may also be that in areas with little farmland, fresh local produce receives a higher price.

The results of the last two columns in **Table 7** demonstrate the interactions between the impact of the policy and the market value of farm property. The negative coefficients on the interaction term suggest that use-value assessment policy is less effective in preserving farmland when market values are high. In those cases, to the extent that higher market values represent pressures to develop, use-value assessment (or perhaps even zero taxation) will have limited effect on farmland preservation.

The models with interaction between the policy and property tax levels appear in **Table 8**. The interaction term has a positive significant coefficient, suggesting that use-value assessment is more effective when tax rates are higher. In the footnotes to **Table 7 and 8**, the weighted totals of the policy and interaction term coefficients are computed; the interaction term is multiplied by the mean of the log of explanatory variable. These sums are consistent with the regression coefficients for the policy in the other models. Again, the coefficient with state fixed effects is about double the coefficient with county fixed effects. As I mentioned before, there may be quite a lot of time-invariant differences within a state, so the county-level fixed effects model is probably more convincing.

These additional explanatory variables may be endogenous. For instance, the scale of agriculture in a county may affect farm returns, so the value of farm products sold (or any other similar measure) may be endogenous. Any measure of tax rates may be endogenous, because effective tax rates tend to be lower in rural areas, mostly because there are fewer city services provided. Comparing the results from **Table 5**, which did not include these variables, with those in **Tables 7 and 8**, we find consistent results for the coefficient on the policy variable. In every case, use-value assessment comes out positive, significant, and between .0048 and .016. From these results we can expect about .5 to 1.6 more percentage points of county land in farming with the policy. Since the county-level fixed effects control for more unobserved time-invariant heterogeneity among counties, the amount of preserved farmland will most likely be at the lower end of those bounds.

Again we might believe that the policy had different effects in different years, so we can repeat the estimations in column one of **Table 6** with the added variables, producing the results in column 2 of that table. **Figure 2**, which follows **Figure 1**, shows the graph of the intercepts from that regression. We see a pattern, similar to **Figure 1**, where I graph the year effects as the other variables are held constant at their means. In this figure, however, the initial negative relationship between the policy is significant and there is a more pronounced uptick in 1978. When controlling for the other variables, the greatest difference between the averages of counties with and without the policy is about four percentage points, in 1982.

4.3 Endogenous Policy

Let us consider what effects endogenous policy would have on the coefficient policy variable. If the motivating force for adopting this policy was loss of farmland, then that would bias the policy coefficient negatively. If the policy really just reconciled the statutes with the actual practice of underassessing farmland, then we would expect the policy variable to come out statistically insignificant. If, however, the strength of the farm lobby was instrumental in getting the state to adopt the policy, then the coefficient would be biased upward. No convincing data that would serve as an instrument for this effect were available that went back to the time during which this policy was adopted. One strategy may be to use data that characterize state budget constraints, such as deficit/surplus figures or percentage of population that is school age, to get at the fiscal burden financed by property taxes. If states are less likely to adopt the policy if they have a deficit or large school age population, and that is uncorrelated with the error term in the second stage, then we have an effective instrument.

5. Conclusion

This paper surveys preferential tax policies for farmland and uses county-level data from 1959 to 1987 to examine the effect of the most common policy on farmland preservation. Estimations indicate a positive and significant effect of use-value assessment on the proportion of land in farming in a county. They particularly suggest that use-value assessment can help preserve farmland over time. Counties with the policy have about .6 to 1.4 percentage points more of their land in farming on average over the sample, but when we look at the effect in different years, we find a difference of up to five percentage points. The policy appears less successful when market values are high, but tends to be more effective when tax rates are higher.

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Table 1
State Property Tax Policy for Farmland

State	Tax Assessment Law			
	Preferential Assessment Only	Preferential Assessment with Deferred Tax	Preferential Assessment with Restrictive Agreements and Deferred Tax	Effective Date for Use-Value Assessment and/or Contract Program
Alabama		x		1981
Alaska		x		1966
Arizona	x			1981
Arkansas	x			1969
California			x	1967
Colorado	x			1967
Connecticut		x		1963
Delaware		x		1969
Florida	x			1959
Georgia		x		1983
Hawaii			x	1963
Idaho	x			1970
Illinois	x			1972
Indiana	x			1963
Iowa	x			1969
Kansas	x			1977
Kentucky		x		1971
Louisiana	x			1978
Maine		x		1971
Maryland		x		1957
Massachusetts		x		1974
Michigan			x	1976
Minnesota		x		1967
Mississippi	x			1975
Missouri	x			1983
Montana	x			1973
Nebraska		x		1976
Nevada		x		1975
New Hampshire		x	x	1973
New Jersey		x		1965
New Mexico	x			1967
New York			x	1973

cont. next page

Table 1, cont.

State	Tax Assessment Law			
	Preferential Assessment Only	Preferential Assessment with Deferred Tax	Preferential Assessment with Restrictive Agreements and Deferred Tax	Effective Date for Use-Value Assessment and/or Contract Program
North Carolina		x		1974
North Dakota	x			1973
Ohio		x		1974
Oklahoma	x			1976
Oregon		x		1963
Pennsylvania		x		1966
Rhode Island		x		1968
South Carolina		x		1976
South Dakota	x			1970
Tennessee		x		1977
Texas		x		1966
Utah		x		1972
Vermont		x		1978
Virginia		x		1973
Washington		x		1970
West Virginia	x			1985
Wyoming	x			1974

Sources: Aiken [1989]
 Gloudemans[1975, p. 16]
 Census of Agriculture 1987, Appendix C
 Census of Agriculture 1982, Appendix C
 Census of Agriculture 1978, Appendix A, Table 3

Table 1 - Appendix A
Frequency Graph for Dates of Preferential Tax Policy Adoption

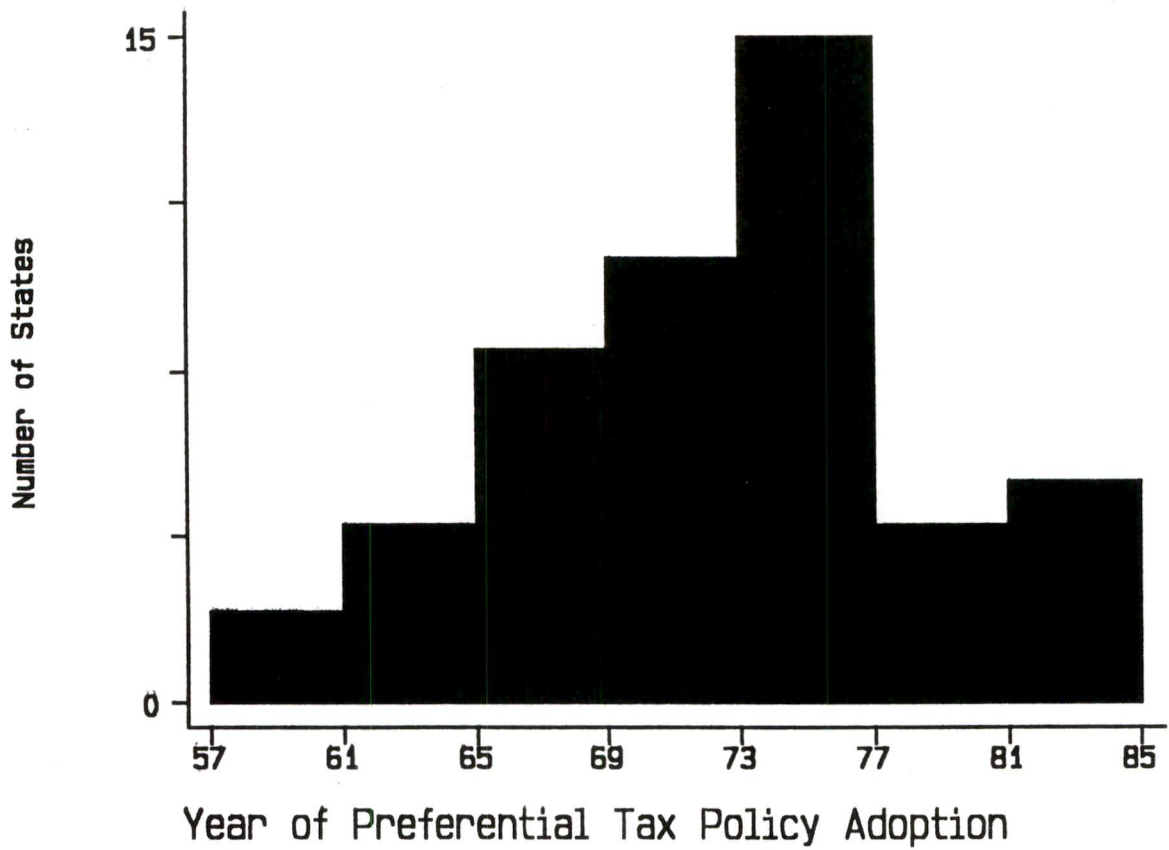


Table 2
States and Counties in the Data Set

State	No. of Counties (Total = 2963)	Percent of Sample
Alabama	66	2.23%
Alaska	0	0.
Arizona	14	.47
Arkansas	75	2.53
California	57	1.92
Colorado	61	2.06
Connecticut	8	.27
Delaware	3	.1
Florida	67	2.26
Georgia	159	5.37
Hawaii	0	0.
Idaho	44	1.48
Illinois	102	3.44
Indiana	92	3.1
Iowa	99	3.34
Kansas	104	3.51
Kentucky	120	4.05
Louisiana	64	2.16
Maine	16	.54
Maryland	23	.78
Massachusetts	14	.47
Michigan	83	2.8
Minnesota	87	2.94
Mississippi	82	2.77
Missouri	113	3.81
Montana	56	1.89
Nebraska	92	3.1
Nevada	16	.54
New Hampshire	10	.34
New Jersey	21	.71
New Mexico	31	1.05
New York	61	2.06
North Carolina	100	3.37
North Dakota	53	1.79
Ohio	88	2.97
Oklahoma	77	2.6
Oregon	36	1.21
Pennsylvania	67	2.26
Rhode Island	5	.17
South Carolina	46	1.55
South Dakota	66	2.23
Tennessee	95	3.21
Texas	239	8.07
Utah	27	.91
Vermont	14	.47
Virginia	94	3.17
Washington	39	1.32
West Virginia	55	1.86
Wisconsin	0	0.
Wyoming	22	.74

Table 3
Definitions and Units of County-level Variables in Estimations

Proportion of land in farming	Proportion of county land area that qualified as farmland for census purposes
Population Density	Population per acre of land area. Data for Census of Agriculture years were logarithmically interpolated from Census of Population years.
Market value of farm products sold	Average value per acre of all farm products sold, includes livestock, produce, etc.
Total property tax per capita	Total property tax revenues in the county divided by the interpolated population
Value of land and buildings	Market value of farmland and farm-related buildings per acre of farmland
Use-value assessment dummy	Dummy variable = 1 if use-value assessment was in place in that county's state in that year (policies remain after adoption). Looks like, e.g. {0, 0, 0, 1, 1, 1, 1} for a county across the seven census years
State dummy	Dummy variable = 1 if the county is in that state = 0 otherwise
Year dummy	Dummy variable = 1 if observation is for the given year = 0 otherwise

Sources: Census of Agriculture: 1959, 1964, 1969, 1974, 1978, 1978, 1982, 1987
 Census of Population and Housing:
 Census of Governments
 1993 County City Extra Data Book

Electronic Data Sources:
 County and City Data Book Consolidated File, County Data 1947-1977
 COSTAT 4
 Census of Agriculture 1982, CD-ROM

Table 4
Summary Statistics: County-level Means and Standard Deviations

County-level Variable	Years of Census of Agriculture						
	1959	1964	1969	1974	1978	1982	1987
Proportion of county land in farming	.639 (.276)	.621 (.285)	.598 (.300)	.562 (.300)	.559 (.303)	.543 (.297)	.525 (.303)
Population density (population per acre)	146 (1176)	152 (1184)	128 (661)	127 (589)	149 (855)	160 (997)	173 (1055)
Mkt. value of farm land and buildings (\$ per farmland acre)	844 (6723)	1034 (8316)	942 (6271)	1163 (5158)	1479 (3362)	1288 (3560)	935 (2752)
Total property tax per capita (\$ per person)	230 (158)	289 (193)	352 (231)	371 (257)	351 (264)	310 (252)	366 (300)
Value of farm sales (\$ per farmland acre)	191 (1782)	183 (1167)	217 (1623)	314 (3214)	276 (1491)	244 (1615)	226 (1323)
Use-value dummy (no. of counties with policy adopted)	90	225	972	1883	2581	2665	2939
No. of observations	2963	2969	2957	2960	2957	2961	2939

Notes:

1. Standard deviations are in parentheses below the means.
2. All dollar values are in 1982 dollars.
3. See Table 3 for descriptions of the variables.

Table 5
OLS Estimation Results
Simplest Models

Dependent Variable: Proportion of County Land in Farming¹

	Model without location fixed effects	Model with state fixed effects	Model with county fixed effects
Use-value dummy	.0755 (12.12)	.0136 (2.55)	.0129 (9.47)
Intercept	.4494 (54.55)	.0706 (2.04)	.5130 (311.2)
State fixed effects?	no	yes	no
County fixed effects?	no	no	yes
Year dummy variables?	yes	yes	yes
R-squared	.0241	.547	.975
No. of observations	20770	20770	20770

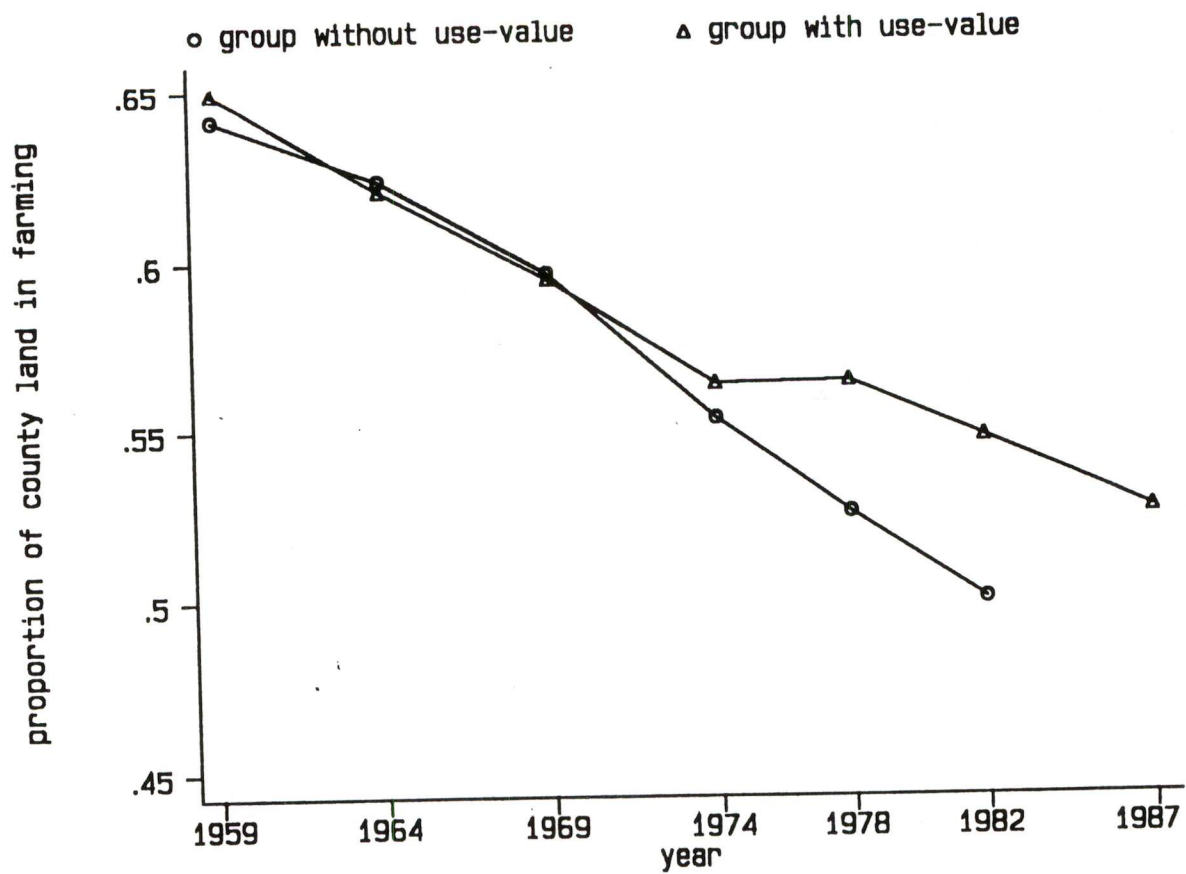
¹ Note: t-statistics appear in parenthesis below the regression coefficients.

Table 6
OLS Estimation Results of Model with Policy and Year Effect Interaction
Dependent Variable: Proportion of County Land in Farming¹

	Simple Model	Enhanced Model
ln(population density)		.067 (10.0)
[ln(population density)] ²		-.016 (-17.59)
ln(mkt. value of farm property per farmland acre)		-.027 (13.79)
ln(total property tax paid per capita)		-.022 (-11.67)
ln(value of farm products sold per farmland acre)		-.020 (-10.33)
Intercept (year 1959)	.641 (515.0)	.991 (53.48)
year 1964 (relative to year 1959)	-.018 (-11.4)	-.0036 (-2.39)
year 1969 (relative to year 1959)	-.045 (-29.8)	-.0141 (-8.04)
year 1974 (relative to year 1959)	-.088 (-51.3)	-.0375 (-15.93)
year 1978 (relative to year 1959)	-.116 (-43.8)	-.0532 (-16.05)
year 1982 (relative to year 1959)	-.141 (-49.13)	-.0861 (-26.27)
year 1987 (relative to year 1959)	-.115 (-72.47)	-.0715 (-37.5)
use-value in year 1959	.007 (.66)	-.0299 (-2.61)
use-value in year 1964	-.003 (-.67)	-.0128 (-2.97)
use-value in year 1969	-.002 (-.96)	-.0045 (-2.52)
use-value in year 1974	.010 (6.46)	.0071 (4.61)
use-value in year 1978	.039 (15.626)	.0331 (13.56)
use-value in year 1982	.048 (17.34)	.0402 (14.83)
R-squared	.9710	.9732
No. of observations	20770	20770

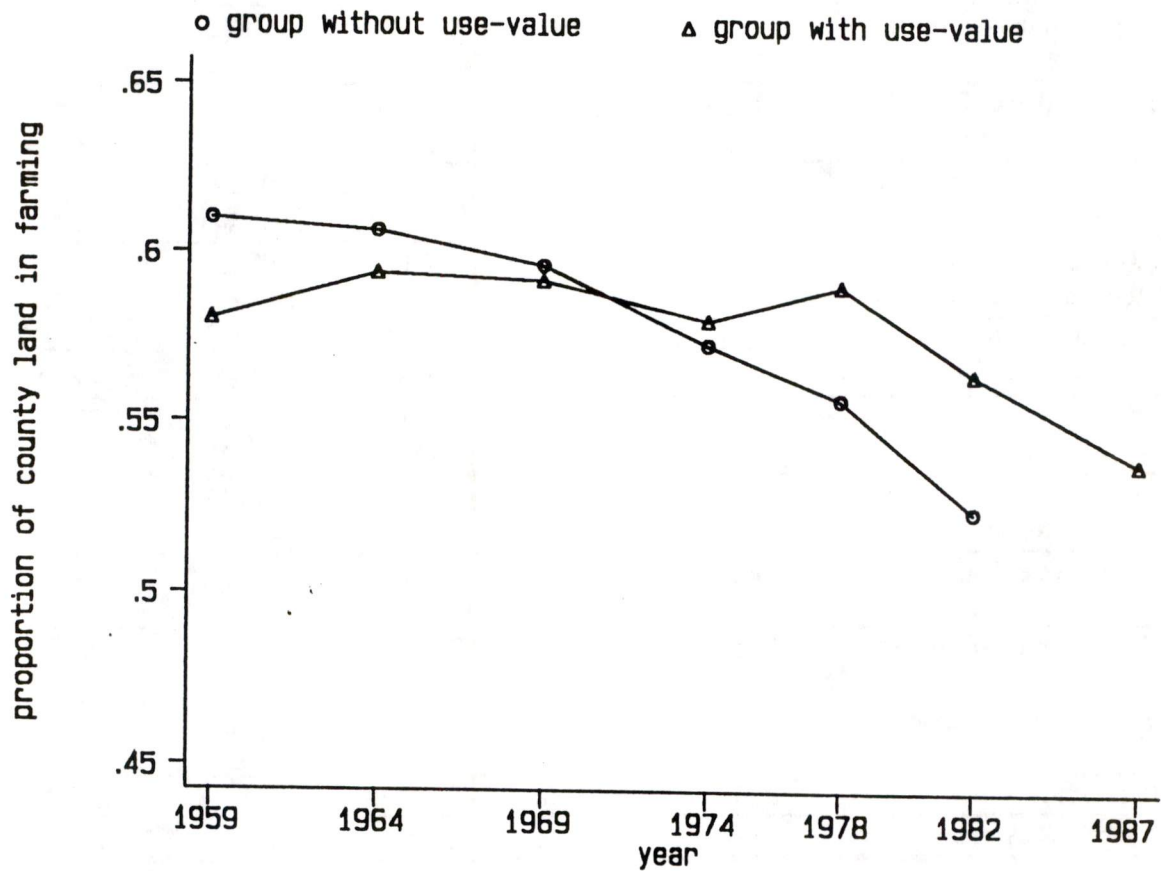
¹ Note: t-statistics appear in parenthesis below the regression coefficients. County-level fixed effects included are included in the estimations on this table.

Figure 1
Graph of Policy Effects Across Time¹
From Table 6, Column One



¹ Other variables controlled for: County-level fixed effects

Figure 2
Graph of Policy Effects Across Time¹
From Table 6, Column Two



¹ Other variables controlled for: county-level fixed effects, population density, market value of farm property, property tax per capita, value of farm products sold. The data graphed above are the estimated dependent variables calculated by adding year effects in the regression to the other variables, evaluated at their means. This means I added .61 to the intercept and year effects.

Table 7
OLS Estimation Results
Enhanced Model and Market Value Interaction Term

Dependent Variable: Proportion of County Land in Farming¹

	Model without location fixed effects	Model with state fixed effects	Model with county fixed effects	Market value & policy interaction (state fixed effects)	Market value & policy interaction (County fixed effects)
ln(population density)	.1148 (25.00)	.0721 (19.22)	.0694 (12.57)	.0727 (19.42)	.0675 (12.17)
[ln(population density)] ²	-.0206 (-37.40)	-.0111 (-24.86)	-.0152 (-21.90)	-.0111 (-24.78)	-.0146 (-20.44)
ln(mkt. value of farm property per acre)	-.0686 (-13.13)	-.0881 (-20.87)	-.0276 (-15.04)	-.0720 (-15.84)	-.0267 (-14.41)
ln(total property tax paid per capita)	.1305 (44.70)	.0683 (19.21)	-.0246 (-14.08)	.0669 (18.84)	-.0248 (-14.20)
ln(value of farm products sold per farmland acre)	.0429 (13.00)	.0858 (32.16)	-.0192 (-12.31)	.0862 (32.35)	-.0192 (-12.28)
Use-value dummy	.0515 (9.00)	.0145 (2.85)	.007 (5.67)	.2330* (9.731)	.03222** (4.69)
Intercept	-.1074 (-3.88)	.1845 (3.70)	.914 (52.43)	.0851 (1.67)	.9066 (51.61)
Use-value * ln(Mkt. val. of farm property / acre)				-.0333 (-9.34)	-.00377 (-3.68)
State fixed effects?	no	yes	no	yes	no
County fixed effects?	no	no	yes	no	yes
Year dummy variables?	yes	yes	yes	yes	yes
R-squared	.201	.588	.977	.590	.977
No. of observations	20641	20641	20641	20641	20635

¹ Note: t-statistics appear in parenthesis below the regression coefficients.

* The sum of the coefficient on the use-value dummy and the interaction term, evaluated at the mean of ln(market value per acre) = .2330 + (-.0333 * 6.5025) = .01647

** The sum of the coefficient on the use-value dummy and the interaction term, evaluated at the mean of ln(market value per acre) = .03222 + (-.00377 * 6.5025) = .007706

Table 8
OLS Estimation Results
Model with Property Tax Interaction Term

Dependent Variable: Proportion of County Land in Farming¹

	Model with policy & property tax interaction term (state fixed effects)	Model with policy & property tax interaction term (county fixed effects)
ln(population density)	.0720 (19.23)	.0729 (13.49)
[ln(population density)] ²	-.0112 (-24.97)	-.0150 (-22.22)
ln(mkt. value of farm property per farmland acre)	-.0855 (-20.23)	-.0200 (-11.01)
ln(total property tax paid per capita)	.0503 (11.85)	-.0424 (-23.14)
ln(value of farm products sold per farmland acre)	.0852 (31.96)	-.0183 (-11.96)
Use-value dummy	-.1545* (-6.87)	-.1510** (-25.63)
Intercept	.274 (5.36)	.945 (55.23)
Use-value * ln(property tax per capita)	.0300 (7.71)	.0282 (27.55)
State fixed effects?	yes	no
County fixed effects?	no	yes
Year dummy variables?	yes	yes
R-squared	.589	.978
No. of observations	20641	20641

¹ Note: t-statistics appear in parenthesis below the regression coefficients.

* The sum of the coefficients on the use-value dummy and the interaction term, where log of the property tax variable is evaluated at its mean (5.525) = $-.1545 + (.0300 * 5.525) = .01125$

** The sum of the coefficients on the use-value dummy and the interaction term, where log of the property tax variable is evaluated at its mean (5.525) = $-.1510 + (.0282 * 5.525) = .00481$