Valuation and Holding Costs When Rents are Rising
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Valuation and Holding Costs When Rents are Rising

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INTRODUCTION AND DEFINITIONS

Eqn. 1, below, is the basic capitalization formula used to value permanent assets, meaning mainly the land element in real estate, of course. Eqn. 1 looks simple. Once you work with it, though, there is more in it than one can tell a class in the available time.

There is nothing published that begins to cover it adequately, in spite of its central importance in real estate and public finance. So I wrote this for my students. I haven't captured all the nuances yet, there is so much to milk from this one simple equation. I have indicated in the text where more work is needed.

These notes deal with a perpetual stream of net rent or other pure net income that is expected to rise indefinitely into the future, beginning from "a" dollars per year. Think of it as the annual rent of land, a kind of pure net income. A usefully expressive and analogous concept from property law is "usufruct," meaning "the enjoyment of the income of an estate without impairment of its substance."

"Without impairment of its substance" - that's the key idea. It's the idea most economists blind themselves to by fusing or lumping land and capital as though they were alike in all ways. Land endures, while capital rusts, molds, rots, obsolesces, cracks, and in a hundred other ways suffers the outrages of senescence and entropy. In a word, capital **depreciates**, while land endures and often **appreciates.**

To finesse many complications, think of this land as yielding cash flow without any buildings, and with minimal expenses: it could be a parking lot, space used for open storage, grazing, annual cropping, or other such use. The next reading, "Land Prices with a Series of Discrete, Progressively Higher Future Uses," addresses those complications (and, I believe, makes them fairly simple to understand and deal with). See also Appendix 1 to the present reading

To keep the model simple, we also assume a constant yearly fractional growth rate, g. The cash is measured in current dollars (not constant dollars), so the rise may be due both to

real causes and to inflation. The nominal interest rate is "i." The income begins with "a", received at the end of the first year, and then rises at a compound rate of g per year.

The lump-sum up-front present Site Value is "S." S is often called the "capitalized" value -- not that it is capital, for it is not stored up by saving, nor can it be drawn down by dis-saving. But it is expressed in the same present-value terms that are customary with capital. "Capital value" is a common contraction of "capitalized value."

The Site Value, S, is the sum of an infinite geometrical progression whose first term (f) is a/(1+i) and whose rate of progression (r) is (1+g)/(1+i+t). From your High School algebra, the sum of such a series is known to be: S = f/(1-r). Substituting in the values as defined, and collecting terms (which I leave to you), we get our basic formula:

$$S = \frac{a}{i+t-g} \qquad (1)$$

By rearranging (1) in various ways we can derive a large number of useful insights -- amazingly large, remarkably useful --into valuation, finance and taxation.

1. Valuation of real property.

"Real" property means an asset that includes land, and therefore has a perpetual life expectancy. (1) derives capital value, S, from the current year's cash stream, a, and the factors i, t, and g. The process of converting a stream or flow of cash into a corresponding up-front value is called "capitalizing." When dealing with common stock, S/a is called the Price/earnings ratio, or P/e.[1] You can see that this important number is equal to the reciprocal of (i+t-g).

The market process by which i and t and g determine S is called "arbitrage." It is based on constant buying and selling, some of it by shrewd and savvy investors. It is a fairly well-

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[1]Common stock is not subject to the property tax, but the same term may be used in real estate. In England it is called "years' purchase," meaning the number of years of cash flow required to purchase title to the property.

tuned market process, at least in regard to i and t. As for g it is a future expectation and therefore not subject to precise measurement or automatic correction of errors.[2] To keep the present demonstration brief and mathematical, we will treat g as an objective fact.

2. Tax capitalization.

The process of adding "t" to the denominator of (1) is called "tax capitalization." (This is based on assuming the tax is not shifted, but is entirely borne by the owner of the subject land -- an assumption supported by both theory and observation.) Adding "t" as shown has the same effect as subtracting tS from the numerator, instead. In fact, you can rearrange the terms of (1) to do exactly that. Then we have:

$$S = \frac{a-tS}{i-g} \qquad (2)$$

3. Capitalization of growth expectations.

The process of subtracting "g" from the denominator capitalizes the expected growth. Subtracting "g" as shown has the same effect as adding gS to the numerator, instead. You can rearrange (2) to do so. Then we have:

$$S = \frac{a-tS+gS}{i} \qquad (3,a)$$

Alternatively you can leave the "t" downstairs:

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[2]There is an irrational side to human nature which is repressed by objective reality when dealing with the present, and which therefore finds a natural outlet in anticipating the future, with results often bizarre. We cannot say, therefore, that the response to g is finely tuned because there is no way of knowing what g is: it lurks in the dark corners of fevered minds. We do know from history, much of it recent, that loan officers, supposedly trained and savvy, still often behave like sheep and idiots on a rising market.

$$S = \frac{a+gS}{i+t} \qquad (3,b)$$

You can pick any of the alternative forms, depending on what you want to emphasize.

gS is the annual growth in S. We defined it as the annual growth of "a", to be sure. But with each passing year that means that every term in the infinite geometric progression is g times higher than before, so you just multiply through by g and get S higher by that same factor. This exercise is left to doubters.

If you are a stock broker you want to focus the buyer's attention on gS. The P/e becomes S/[a+gS]. ("t" is zero in this case.) Of course the official P/e listed is just S/a, but the job of the broker is to justify the high price by highlighting gS.[3]

Stockholders' political champions do their best to persuade voters that gS is not income, and therefore should not be taxed as income. At the same time, the stockholders and their broker-salespersons are telling buyers to treat gS as current income. This is either amusing, irritating, or disillusioning, depending on your temperament, but it can be confusing until you recognize it as hypocrisy. Then it all falls into place.

4. Carrying costs > cash flow.

"Carrying costs" (cc) of the subject property are interest and taxes, both based on its own value. (Consult the INTRODUCTION, and Appendix 1, if you are concerned with definitions). cc = S(i+t). From Eqn. (3,b),

$$S(i+t) = a + gS \qquad (4)$$

Here, we are not distinguishing between interest on debt and imputed interest on equity capital, but lumping them together

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[3]Oriental rug merchants do the same thing ("It's an investment, my friend, it will appreciate for your old age.") And of course, above all, land boomers do it. As the saying goes, lawyers do it with license, but Realtors do it with appreciation.

in Si. Later we will show how to separate them. As to St, that is always an explicit cash drain, for private landholders.[4]

(4) brings out the central point that "a" alone is too small to cover carrying costs. The holder has to treat gS, the annual appreciation of S, as a current receipt, just like cash, in order to cover the carrying costs. This is consistent with Haig-Simons' position, standard among tax economists, that unrealized capital gains are current income. Indeed, it is the very sort of thing that led them to that finding.

If the land investment be financed 100% (either because of recent purchase, or later pledging as collateral) the cc are all cash outflows, and the outflow exceeds the inflow (a) by gS. This is the source of the term "Negative Cash Flow," discussed later. The holder has to come up with cash of gS every year, over and above the $a that the land yields, to pay interest and taxes. He has to raise the cash from some other source. He is thus buying the augmented land value each year, strange as that seems. Thus works the peculiar backwards economics of land in a rising market.

It is tempting to blame everything on taxes, and landholders faced with cash flow problems routinely do so. But you cannot blame the cash bind shown in (4) on taxes. Set t=0 and the problem is as bad as ever: worse, in fact. The problem is caused by gS, which doesn't go away when you eliminate taxes. Rather than go away, gS gets larger.

(If that seems to be done with mirrors, remember that lowering t has the effect of raising S, which accounts for the result. Remember, too, that we are lumping the opportunity cost of equity capital in with cash interest payments as part of cc. We refine that later. §8, "Negative cash flows," distinguishes cash drains from imputed interest on equity.)

What is a problem for some is a benefit for others, namely those who have surplus cash to keep on sinking into real estate or common shares while they rise. It is a benefit because it gives them a leg up on rival bidders who are cash-poor. An added benefit is that the rise of S is not recognized as taxable income

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[4]An interesting point, subsidiary here, is that public landholders, who are exempt from their own property taxes, should treat tS as an imputed cost.

(i.e. for personal and corporate income taxes, Federal and state) until and unless it is sold, and sometimes not even then.

5. Dependence of tax on the interest rate.

The property tax levy on land, T, is the rate, t, times the base, S. But the base varies inversely with the interest rate, i. Thus the tax bounces up and down as i bounces down and up. In the extreme i falls to zero, in which case the tax takes the entire rent, for any t>0. In fact it is only necessary for (i-g) to fall to zero to get that result. In this §5, however, we simplify by setting g=0. Bear with me: in §6 it returns with a roar.

$$T = tS = a\frac{t}{i+t} \qquad (g=0) \qquad (5)$$

(5) shows that rent (a) is shared between the fisc and the landholder according to the ratio of t to i. The absolute value of t means nothing by itself; its ratio to i is what determines the effective tax rate. The fisc gets St; the landholder gets Si; and the sum equals "a."

It's not the simple ratio of t/i, either, but t/(i+t), as shown in (5). (5) shows, among other things, that t does not rise in proportion to t. Doubling t does not double T -- try it if you doubt it, with a numerical example of your own. This is not due to any "wedge effect" or reduction of incentives or tax shifting: remember, land supply is inelastic, so there is no shifting of the tax. It is due rather to "tax capitalization."

"Tax capitalization," in turn, is an indirect way of viewing the fact that the property tax is based on the after-tax rent of land. This weakens the effect of raising the tax rate, because it eliminates part of its own base. To see this effect without the interposition of capital value, S, imagine that the income tax were based on after-tax, disposable income: a 100% income tax rate would then take just half of before-tax income. That is the way the property tax actually works, only the view is clouded because the effect goes through the capitalized value, S, which is the tax base. So when you hear "tax capitalization" think of a tax whose real bite rises a lot slower than the apparent rate.

This also has the result that the T/a ratio is affected by a factor, i, other than t (and another factor, g, to be added in §6).

There are two ways to abate or remove these outside influences and control T/a.

One is to set t very high, so that T/a is nearly 100%, regardless of i. If (t+i) consists mostly of t, then changes in i have only minor proportional effects on (t+i). The effect of changes in i is "diluted."[5]

High t-values may seem far-out today, but that is only because we are trapped in our little slot in space and time and don't look around very much. High values of t have been common in parts of California not long ago, and in other places too. Many economists regard a tax on land rents to be the most defensible of all taxes, on grounds of efficiency, equity, and macro-economic benefits. It is the oldest of all taxes, and it keeps getting revived. It may be the only one to survive through your lifetimes.

A second way to control T is to set it independently, year by year, and then adjust t to raise T in the desired amount. This is the current practice in some American tax jurisdictions. This is why Herber (a tax economist) calls the property tax a "residual" tax, one that is used to balance the budget. There is always a taxable surplus there, which the fisc relies on (instead of borrowing) to offset any cash deficit.

California today does neither. Prop. 13 caps t at .01, and even that low rate applies only to lands bought recently - others are tax-assessed at lower, ancient price levels. Theoretically this rate could still tax away all of "a", should i fall to zero, but that is most unlikely. It is possible, however, that (i-g) might approach zero, which would have the same effect. Read on!

6. Tax on current gS.

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[5]Mathematicians might prefer to say that the logarithm of (t+i) grows insensitive to i when t/i is large. Say it any way you like, but do see the point, we will be using it again.

The property tax, being based on S rather than "a" alone, taxes gS as it accrues, something the income tax does not do. Solve (5) for St.

$$St = \frac{t[a+gS]}{i+t} \qquad (6,a)^6$$

(6,a) tells you that gS is part of what is being taxed every year by the property tax. Not only is gS taxed, it is taxed at the same rate as "a", and at the same time. This is a distinctive feature of the property tax which sets it sharply apart from most other taxes. It happens because the property tax base is S, and S is affected by g. "g" is invisible to other kinds of tax base definitions, and either escapes taxation or enjoys deferral. (Taxes are like justice: deferral is denial.)

Another way of viewing this same effect is that the tax rate, t, is a real rate; while the real interest rate is (i-g).[7] Where g is due entirely to expected inflation, this effect is entirely as described here. "a" is divided up accordingly. The fisc gets tS each year; the landholder gets (i-g)S. That is:

$$tS - a = (i-g)S \qquad (6,d)$$

Thus in an inflationary period t is mightier than it appears, relative to i. To gauge the strength of t do not compare it to i, but to i-g.

Owners of appreciating land complain they are thus being taxed on phantom income.[8] If one's land is hocked, this is fully offset by the decline in the real value of one's debt. If one's land is fully owned, clear of debt, it is an interesting point. It merits further research - I will not let it divert us here.

7. Carrying costs are independent of tax rates.

A. The case when g=0.

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[6]Alternate forms of Eqn. 6 are in Appendix 2.

[7]See definitions in the Introduction, and Appendix 1.

[8]That is not the way they normally put their case, but it would boil down to that in our analytical framework here.

When g=0, cc are always "a", at any t.

$$cc = S[i+t] = \frac{a[i+t]}{i+t} = a \qquad (7,a)$$

We saw in §6 that as t rises a larger share of "a" goes in taxes. The tax share is t/[i+t]. The other share goes to the landholder. But the sum of the two remains the same, and equals "a".

B. The case when g>0.

Here we get the interesting result that raising t actually lowers cc. Use (3,b) for S, and find cc:

$$cc = S[i+t] = \frac{[a+gS][i+t]}{i+t} = a + gS \qquad (7,b)^{9}$$

(7,b) shows that cc fall when t rises. Can you see how? It is because S is a decreasing function of t, i.e. S falls when t rises. This result may be counterintuitive; it certainly runs counter to conventional belief, but this is based on very short-run perceptions lacking system analysis.

Raising t does not lower T, because t rises by a higher fraction than S falls, so the product of the two, tS, rises.[10] As t --> 100% it soaks up all of "a", which is the upper limit of taxation. You cannot take more than there is.

How do we know that "a" is the upper limit of property taxation? Go back to Eqn. (1) and multiply by t. The ratio t/[i+t-g] rises to a max of one as t rises very high (so long as i>g[11]).

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[9](7,b) is the same as (4). We just came at it by a different route, with a different emphasis.

[10]As to gS, it falls, but t takes a higher share of both gS and a. For very high t, gS approaches zero because S approaches zero, g remaining the same. Thus the influence of g on S is reduced or eliminated, even though g remains the same.

[11]It is a really interesting question what would happen if i<g, or if that is even possible. We leave this now as a loose

T>a still does happen in practice because some landholders are not putting their land to its highest and best use, and some assessors are valuing it at market value based on highest and best use. That issue (which is important) is not treated in these notes. It has causes which are excluded by our simplifying assumptions. Something is left as a challenge for the next writer - maybe you?

The primary effect of raising t (other than to collect more taxes) is to reduce the landholder's need for cash to finance gS every year, as explained in §4. That's assuming the landholding is 100% financed. But what if it isn't? Read on!

8. "Negative cash flow."

It is common for investors to "finance" their holdings, i.e. to buy or hold with borrowed money. "Cash flow" is normally defined, then, as our "a" less the cash outlay on carrying costs. St is almost always a cash outlay.[12] I'll treat it here as a cash outlay.

If the holding is 100% financed then Si is all cash, too. In that case, with g>0, net cash flow (ncf) will always be negative.

$$ncf = a - S(i+t) = -gS \qquad (8,a)$$

The negative value of ncf has to be put in from some other source each year. In effect the investor is buying the annual growth of S each year with outside cash.

Normally the holders of equity positions in assets cannot finance them 100%. Let "s" be the share of S which is self-financed, so there is no cash outlay on it, but only "imputed" or "opportunity" interest.

$$ncf = a - S(1-s)i - St = a - S(i+t) + sSi$$

Substituting from 8,a:

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end.

[12]The exception is when some people let unpaid taxes pile up, in effect borrowing from the county. This is an abuse that has crept into property taxation, and needs to be remedied.

$$ncf = sSi - gS = S[si-g] \qquad (8,b)$$

Cash flow is negative whenever si<g.

During the real estate booms of 1975-81, and 1984-90, it was routine that investors accepted negative cash flows. "Just plan to raise rents 8% a year to keep up with inflation" is what the boomers told the buyers. With equity (s) of 20%, i=15%, and values based on g=8% the new investor began with a large negative cash flow.

9. t as upper limit on S

In some years, when inflation had become a way of life, there was talk that the real interest rate might be negative, meaning that nominal rates are less than inflation rates. In the absence of property taxes that would be logically impossible, because zero real rates mean infinite land values. But with t>0 it is another story. Let i=g (meaning real i.r. of zero) and:

$$S = a/t \qquad (9)$$

There is still a possibility of negative real i.r., with g>i. What is logically impossible is that g>[i+t].

10. Finding the real interest rate.

The foregoing logic gives us a means of finding the real interest rate, i-g.

$$i-g = a/S - t \qquad (10)$$

In California in 1985 or so, a/S was around 4%, and t around 1%, for a real rate of around 3%. That is very crude,[13] but still, (10) takes us a big jump ahead of where most people are on this otherwise elusive question.

The trick that makes this work is that t is a real rate, i.e. it is based on S, and S is reassessed regularly to keep up with inflation. "i," by contrast, is a nominal rate, based on a fixed cash loan whose real value declines as inflation proceeds.

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[13]See Appendix 3.

11. Leverage of i on S: raised by g; lowered by t.

Begin without any g or t, but just simple capitalization, so S=a/i. The elasticity (ϵ) of S w.r.t. "i" is now minus one, meaning that an x% rise of i causes an x% drop in S. (Warning: this value of ϵ applies to small changes only! For large changes, work it out numerically.)

It is convenient to restate that this way: the negative ϵ of S w.r.t. "i" is one. You will soon see why.

Do not be misled by the ambiguity in writing of "an x% change of i," because i is itself a percentage. A rise of i from .04 to .05 is a 25% rise, not a 1% rise.

Ok, now what if S=a/(i-g)? This means leverage where i is the handle, g is the fulcrum, and S gets the action. A rise of i from .04 to .05 now raises (i-g) by more than 25%, and a lot more if g=.04 itself. And the negative effect on S depends on the fractional change in (i-g), not just the change in i alone. (Puzzled? Work out a numerical example, it's quick, easy and persuasive.)

More generally we can put that in terms of the elasticity (negative) of S w.r.t. "i." With some elementary differential calculus (which I leave to you) you can show that:

$$-\epsilon = \frac{i}{i-g} \qquad (11)$$

That means that when g gets up near i, S gets hypersensitive to i. Try, for example, i=.12 and g=.09. Then $-\epsilon=4$, so a 1% drop in i creates a 4% rise of S. We are dealing with dynamite! There are a couple of ways in which this dynamite can blow up in the face of economic efficiency and stability.

One way is through the amplitude of swings in S over the course of a business cycle. The history of boom and bust in land values overmatches any other in terms of amplitude of change. This is unstabilizing for a variety of reasons, not least of which is the heavy dependence of bank credit on land value collateral.

Second is an allocational matter. Access to credit is uneven: a lucky few have no need to borrow, some borrow at the prime, some at higher rates, some from their friendly local Mafia

juice man, and some not at all. Those with the lower "internal" rates can have their pick of the land for sale. Those with poor credit can hardly enter the land market at all, except as renters. What looks like a small difference in the borrowing rate, $\underline{i}$, makes a vast difference in what the individual can bid for land.

12. Dilution of $\underline{i}$ by $\underline{t}$.

Everything said in §11 about the effect of $\underline{g}$ can now be said in reverse about $\underline{t}$. This is because $\underline{g}$ is subtracted from $\underline{i}$, and $\underline{t}$ is added to it. Eqn. (11) may be rounded out by adding $\underline{t}$, for the whole picture.

$$-\epsilon = \frac{i}{i-g+t} \qquad (12)$$

Where $\underline{g}$ magnifies the effect of $\underline{i}$, $\underline{t}$ dwarfs it. Thus $\underline{t}$ reduces the amplitude of cyclical swings in S; and it counteracts the discriminatory effect of differential access to credit.

13. Dilution of $\underline{i}$ by negative $\underline{g}$.

Everything said in §11 about the effect of $\underline{g}$ can be said in reverse about negative $\underline{g}$. What is negative $\underline{g}$? Depreciation. What depreciates? Most true capital, which wears out and obsolesces.

Of course there are many depreciation paths, and the one described by negative $\underline{g}$ is just one of them. Still, for a short way to contrast the effects of $\underline{i}$ and $\underline{t}$ on depreciating capital and appreciating land you could hardly do better than change $\underline{g}$ from positive to negative.

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All those 13 points come from Eqn. 1. That is a lot of milk from one cow, and there is more in her yet. But this is not an encyclopedia, just a solid introduction to the strange, and strangely neglected economics of our most important asset, land.

APPENDIX 1: Definitions

When speaking of land rent we may also call it cash flow (or service flow) because, since the land does not depreciate, the cash flow is also the net income. Expenses like O&M are deducted, to arrive at the net rent of the land. The annualized cost of buildings is deducted. (Annualized cost includes, besides depreciation, an income element on the capital in the buildings. This is income to the owner, but is not imputable to the land.) "Expenses" also include any imputed wages of an owner-operator. These, too, are income to the owner, but are not imputable to the land.

To finesse all such complications, think of this land as yielding cash flow without any buildings, and with minimal expenses: it could be a parking lot, space used for open storage, grazing, or other such use.[14]

"a" is gross cash flow. As used here, gross cash flow means revenues less expenses and less taxes (other than property taxes on the subject land itself). So what is gross about it? It is gross of the costs of carrying title to the subject land itself.[15] These are mainly interest, and land taxes. These are treated separately because they are functions of the subject S itself, the very thing being determined.

"Carrying costs" (cc) refers to the financial costs of carrying the subject land itself, but not to the costs of financing improvements to the land, or working capital used on the land. Thus, in arriving at the amount "a" one deducts interest on production credit used to carry payrolls and raw

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[14]In practice the model as developed is also used loosely for typical "income properties," meaning real estate including durable improvements on land, where real depreciation is very slow and can be overlooked for the first several years while general inflation makes money rents rise. This is however a treacherous practice and is not recommended in general for it may lead to overvaluation. It is only the land portion of real estate that is generally invulnerable to physical depreciation.

[15]"Net cash flow" is used in §8, on "Negative cash flows." Net cash flow means gross cash flow less "carrying costs." "Cash flow" in general, like most terms in economics, is used variously in different contexts by different people, so make an extra effort to remember how I am defining it here and now for this paper.

materials; but does not deduct interest on mortgage debt used to buy the land itself.[16]

All that may sound very fussy and picky, but it is only the basic accounting anyone has to go through to put a value on any asset. It just sounds like a lot when it is thrown at you all at once. It may seem to answer many questions you never asked, but if you want to analyze and understand basic economics you have to answer all those questions. Every one will come up, and trip you if you aren't ready for it.

But the answers won't help unless you yourself get curious enough to ask the questions. You will probably do so as you read on -- when you do, refer back here for the answers. (And if you don't? Well, there's always a demand for good window washers.)

The asset yielding the cash is real property, subject to the property tax. The property tax rate is "t," levied against the base S, which is the capital value. As to income taxes they are not treated here. Think of the cash stream as being disposable income, after income taxes, and including the effective cash value of deductions.

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[16]There is a portion of debt service that goes to amortize the principal. This portion is not even part of carrying costs. It is something else again, an investment in buying title to the land. Carrying costs are pure time costs that hold the land without building up any equity in it. They are the pure costs of enjoying the usufruct without either impairing or augmenting the substance of the estate.

APPENDIX 2: Alternate forms of Eqn. 6

$$St = \frac{ta}{i+t-g} \qquad (6,b)$$

or

$$St = a + gS - Si \qquad (6,c)$$

APPENDIX 3: Finding the real i.r.

Don't engrave the reasoning of (10) on stone just yet. It really is "quick and dirty."

One problem is that future g comes not just from inflation but from real rent increases, i.e. rents that rise faster than the general price level. We have to sort that out, which is not attempted here.

Another problem, especially in modern California, is that the land tax base, S, is no longer reassessed regularly, as (10) presumes. Under Prop. 13, S is only reassessed when land is sold, and not always then.

In most other states, however, the land tax base is reassessed periodically.