



Effect of Land Values on Rates of Return to Investment

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Effect of land values on rates of return to investment
Notes by M. Gaffney, 2-20-85

A. Stable land values: $L_0 = L_n$

1. PIPO case

$$ROR = \left(\frac{F + L}{P + L} \right)^{1/n} - 1 \quad (1)$$

Table 1: ROR on PIPO investment

Let $n=15$; let $P=1$; let $L_n=L_0=L$

F/P	ROR from (1)	L	$\frac{F+L}{P+L}$	ROR from (4)	ROR_1/ROR_4
(1)	(2)	(3)	(4)	(5)	(5)/(2)
1	0	1	1	0	--
2	4.73	1	1.5	2.74	.58
4	9.68	1	2.5	6.3	.65
8	14.87	1	4.5	10.55	.71
"	"	2	3.33	8.36	.56
"	"	4	2.40	6.01	.40
"	"	8	1.78	3.91	.26

Morals:

a. The inclusion of land value in the base lowers the ROR substantially, even though the land is recovered fully at the end of the investment cycle.

b. ROR is ambiguous. You must know how the analyst is treating the land input. He can overstate ROR by omitting land, or by undervaluing it.

2. Combination case: cash flow ended by salvage or redemption at end of investment cycle.

$$\text{ROR} = \frac{a(1-I^{-n})}{P-FI-n} \quad (2)$$

(2) deals explicitly with redeemable bonds. The present value of F is included in P, thus raising it. To adapt (2) to the case of direct investments we break P into two parts, L (land) and B (building).

$$\text{ROR} = \frac{a(1-I^{-n})}{(L_0+B) - L_n I^{-n}} \quad (3)$$

Table 2: ROR on cash flow followed by sale of land

Let $n=10$; $a=.15$; $B=1$; $L_n=L_0$

<u>L</u>	<u>L+B</u>	<u>ROR</u>
		%
0.0	1.0	8.14
.25	1.25	5.90
.5	1.5	4.60
1.0	2.0	3.17
4.0	5.0	1.10

Moral: the need to carry land at a high value over a normal investment cycle lowers the ROR, and not just a little but a lot. It lowers ROR by adding to the base of total assets on which a is the return. This reduction is only partly compensated for by recovering land after n years -- 10 years in Table 2 above.

You might do better by renting the land. In that case annual rent is simply a regular expense, deducted before arriving at a, a simple calculation. But you might do worse, too. It all depends on whether land is overpriced relative to its rent, something that varies with circumstances. Your financial success depends in part on your judgment call, whether to rent or buy. Your judgment call in turn depends in part on your technical ability to reckon ROR correctly.

But wait, there may be another plus for buying. Maybe the land will rise while in your possession. That would improve your ROR. Let's see how much.

B. Changing land values, effect on ROR.

1. PIPO case

You can figure this out now with no further coaching from me. If $L_n/L_0 = F/P$ then the presence of L in the investment base will not change the ROR at all. If the land gains a higher ratio than the PIPO investment, it will actually raise the ROR.

(Reader: before continuing, satisfy yourself that that is true, using either algebra or some numerical examples. A ratio rises when the fractional gain in the top exceeds that in the bottom.)

This gain in land value -- to be denoted here as L' -- is a peculiar animal in economics. It is "gratuitous" in that it is determined by forces almost completely outside the control of the individual landholder, and will occur whether or not he improves the land. He could go to bed for 10 years and the land would rise by virtue of what others do. Some landholders, indeed, do approximately that. But most prefer to combine two kinds of gain.

The question then arises whether L' that occurs during an investment cycle is part of the return on the investment? There is probably a conflict here between what is true for society and what appears true to the individual investor. To society the return on an investment is just that incremental cash flow which is caused by the productive activity of the investor. This is represented by "a" in our equations.

But to the individual investor, life is like a tie-in sale. The individual who intends to build generally has to speculate in the land required, willy-nilly. It is not impossible to lease the land under a building or a tree, but it is clumsy and institutionally difficult and more the exception than the rule. So to the individual, L' becomes part of the return on the investment.

This undoubtedly distorts the pattern of investment from what is socially most efficient and desirable, drawing too much

capital onto lands of rising value and repelling investors from lands of stable or falling values. It also contributes to the instability of business cycles, as land prices move up and down in long, giant swings. But this is another topic for another day (about May 1, actually, in Econ. 100B). Here, our interest is in learning how L' affects the ROR of the individual investor.

Land price gains are routinely expected over the course of many PIP0 investments. Timber is notable, because of the very long investment cycle. The Weyerhaeuser Corporation, for example, a firm whose primary business is holding timber on the stump, has been the main beneficiary of the expansion of Seattle, around which they held and hold much of the land. After the timber is cut, the land is urbanized. U.S. Steel similarly holds timberlands around Birmingham, Alabama, lands originally acquired most likely for the mineral rights in iron ore or coal; Macmillan-Bloedel holds such lands around Vancouver, B.C.; and so on.

Note, it is the ratio of L' to L that affects the ROR, not just the absolute value of L' . Thus, if $F/P = 4$, the ROR will rise if $L_n/L_0 = .5/.1$; but fall if the ratio is $20/10$.

L' can sometimes work against you, too. The gratuity may be negative. Economic history is littered with the bleaching bones of investors who plunged on some investment as an incident to speculating in land, only to see the land value drop like a stone (have you talked to any farmers lately?) The gain is not only gratuitous, it is capricious as well. Luck is a Lady not to take for granted.

2. Combination case

This is where we need some math to overcome the complexities, but let's begin with a simple case that almost explains itself.

a) Simple example: L' offsets depreciation

Here, the appreciation of land value is just enough to offset the depreciation of the building that yields a cash flow for n years. Your salvage value thus equals your initial investment, so your ROR is simply the cash flow divided by the initial cost of $L+B$. Look at (2) and see how much cancels out when you let $F=P$. You are left with:

$$\text{ROR} = a/P$$

(4)

(4) is like the case of a redeemable bond which you can buy for its redemption value of \$1,000. This makes $YTM = \text{current yield} = a/P$. In the bond market such a condition is not unusual, and would in fact seem "normal" and expected. In the case of a direct investment it is a coincidence caused when $L' = B$. To see this, go now to (3) and let $L_n = L_0 + B$. Collect terms and cancel out the terms in the parenthesis, as you just did with (2), and you end up with $ROR = a/(L_0 + B)$

That simple finding is a handy landmark to keep in view as you sail around in these strange new seas. You need a stable point for orientation. It is not in the nature of man to trust mathematical formulae until we have worked with them long enough to develop understanding and confidence. Nor is it easy to keep in mind highly generalized formulae, or to adapt them quickly to changing particulars, even though they are designed for such adaptation. But here is something you can understand and accept readily. Use it as a rule of thumb for situations that approximate it. Use it as a benchmark to check the credibility of your answers for situations that are obviously better or worse.

b) L doubles, from various base values of L_0

(4) makes it clear that you get a higher ROR when L_0 is low -- i.e. you buy in cheap. If you are really lucky you could start from a base with L_0 at zero. Then, $ROR = a/B$. Life is kind to those who get in on the ground floor.

They may do even better when L' is more than B , obviously, and we will be seeing how much better. But the enjoyment of L' by one investor makes it tougher on the next one, and a cumulative rise of L makes it progressively tougher on succeeding generations of investments and investors. Life is less kind to those who get in above the ground floor.

The gratuitous gain enjoyed by Groundfloor O'Grady is to be an added burden to his successor Tardy Tess who had the bad business judgment to be born 30 years later. O'Grady's L_n is Tess's L_0 . Tess gets on where O'Grady got off. Even though the elevator may keep going up, Tess's ROR is to be based on a higher ante -- a number, remember, that you both subtract and divide by in figuring ROR. The higher L_0 will offset much of, all, or more than the gain, (varying with particulars).

So the same L' that stimulated the investments of one

generation may serve to depress those of the next. Here we have the makings of a business cycle, a point not pursued further here, but worth more than a thought to people venturing into the future world of finance.

There are two opposing forces at work here on the ROR. The burden of carrying L lowers the ROR; the promise of L' acts to raise ROR.

Table 3 illustrates the relative weight of forces acting on the ROR. In the Table, L doubles over an investment cycle of 10 years. The higher the base (L_0), the higher is the absolute value of L' . But there is a loss from having a higher base, of the kind shown in (4). In this case the loss offsets the gain, resulting in a (very slight) decline in ROR as L_0 and L' are both higher.

Note: read the "Morals" under the Table carefully in order to interpret the findings correctly.

Table 3: ROR when L doubles in 10 years

$n=10$; $B=1$; $a=.15$; $L_n=2L_0$

	(1)	(2)	(3)	(4)	(5)	(6)
1. L_0	0	.25	.50	1.0	2	5
2. L_0+B	1	1.25	1.5	2.0	3	6
3. L_n	0	.5	1.0	2.0	4.0	10.0
4. $a/(L_0+B)$	.15	.12	.10	.075	.05	.025
5. $L_0/(L_0+B)$	0	.20	.33	.50	.67	.83
6. ROR_1 (%)	8.14	5.90	4.60	3.17	1.95	0.90
7. $L_n/(L_0+B)$	0	.40	.67	1.00	1.33	1.67
8. ROR_2 (%)	8.14	7.82	7.66	7.50	7.37	7.27
9. ROR_2/ROR_1	1.00	1.32	1.67	2.37	3.78	8.08

Morals:

a. Rows 5 and 6 are there to show the effect of L_0 on ROR when $L'=0$. Row 6 is the ROR figured from a constant value of L . Moving from left to right, L rises and depresses ROR down close to zero.

b. Rows 7 and 8 show how a positive L' acts to compensate, and offset the tendency of L to depress ROR. In Row 8, ROR is held nearly steady. If we showed the effect of tripling L , ROR would rise slightly instead of falling slightly as it does in Row 8.

c. Row 9 is the ratio of Row 8 to Row 6. It shows how much the apparent ROR is boosted up over the actual ROR by the factor of L' . The boost is, as you might expect, greater where Row 1 is greater. Row 1 is L_0 , and since $B=1$ it is also the ratio to B . In a rising land market, investors will favor land-using investments, relative to what they should be doing.

d. The effect of L' is to make ROR insensitive to the amount of land being used, as shown in Row 8. This phenomenon reflects the fact that land appreciation offsets the cost of carrying land over time, making land very cheap to hold during the course of the investment cycle.

c) L rises by various multiples from given base

It is useful to round out our understanding of this matter by adding a third dimension to the table, letting L rise by multiples other than 2, which is the fixed multiplier in Table 3. Accordingly, Table 4 shows the effect on ROR of having L rise by multiples from .5 to 12, over 15 years.

Table 4: ROR when L rises by various multiples over 15 years
 $n=15$; $B=2$; $a=.20$; $L_0=1$; $L_0+B=3$

L_n	ROR on pure L'	ROR, com- bined	$\frac{ROR_2}{ROR_3}$
(1)	(2)	(3)	(4)
.5	-4.52	1.77	-2.55
1.0	0.00	3.11	0.00
2.0	4.73	5.14	0.92
2.25	5.56	5.56	1.00
3.0	7.60	6.67	1.14
6.0	12.69	9.85	1.29
12.0	18.02	13.69	1.32

Morals from Table 4:

a. Column (2) shows the ROR on bare land, assuming there is no B at all, and no $\underline{a}$. It is interesting that at the higher values of L_n the investor does better not to use the land at all, even though this entails idling the land and foregoing the positive net cash flow it could yield. This strange effect results because at discount rates higher than 5.56% the present value of the positive cash flow is negative. Putting it another way, the ROR on B alone, at $L=0$, is only 5.56%, so if pure land speculation yields more the individual chooses to buy more land instead of building.

b. The combined ROR in column (3) is much affected by L_n , the resale value of land. With L_0 assumed equal to one, L_n is the multiple of L_n/L_0 . The investor will pay close attention to the likely future of the value of land under the capital he has built.

The condition that bare land speculation yields more than productive building is a disequilibrium condition, i.e. one that tends to work itself out. But life is likely to be a series of journeys between equilibrium conditions which elude us like the rainbow's end, so don't think this never happens: it is all around us all the time, and has been since Columbus landed. Still, let's ask how equilibrium is approached.

Faced with high expected returns from land speculation, the investor seeks to buy more land rather than build on what he has. But this increases the ratio of land to capital in his operation, if the land is capable of integrated use, and this, by the law of variable proportions, raises the marginal return expected from adding capital.

When many people buy more land their bidding raises the price. This reduces L'/L and also reduces a/L . The combination of those two effects with the first one finally may produce a new equilibrium where the positive cash flow from using land is not neglected.

We next see how income taxes affect rates of return. Owing to the preferential tax treatment of land gains, the effect of income taxation is greatly to magnify the relative advantage of adding more land to an investment cycle.

C. The effect of income taxes on rates of return

1. PIPO case

a. When $L=0$

There is a tax benefit enjoyed simply by virtue of tax deferral. This benefit increases with the length of time of deferral, an effect not shown here; and with the rate of gain. Equation (5) and Table 5 show the second effect.

$$RRAT = \left[\frac{F(1-t) + Pt}{P} \right]^{1/n} - 1 \quad (5)$$

where $RRAT$ = rate of return after taxes
and t = tax rate imposed on $(F-P)$ at time n

Table 5: ROR on PIPO investment, before and after tax

Let $n=15$; $P=1$; $t=.5$; $L=0$

F	$RRBT$	$RRAT$	$RRAT/RRBT$
	%	%	(3)/(2)
(1)	(2)	(3)	(4)
0.0	-100.0	-4.52	.045
.5	-4.52	-1.90	.420
1.0	0.00	0.00	.500*
2.0	4.73	2.74	.579
4.0	9.68	6.30	.651
6.0	12.69	8.71	.686
8.0	14.87	10.55	.709

*The seemingly "indeterminate" ratio of $0/0$ may in this case be determined by invoking l'Hopital's Rule. You may see this on your calculator by letting F be 1.001, and .999, and note how your answers approach .500.

The moral of Table 5 is that the income tax, based as it is on realization of gains through sale, contains a built-in bias in favor of PIP0 gains (as opposed to income that flows in annually). The bias is manifest in RRAT's being higher than 50% of RRBT, even though the tax rate is a nominal 50%. This is the background against which we are to measure the further bias that results from adding land to the investment equation.

b. L greater than zero

As we saw before in §A, the effect of adding inert land to the top and bottom of the ratio F/P is to dilute the ratio and lower the ROR. "Inert" here refers to land that remains constant in value over the cycle of investment.

But if L rises in value faster than the capital that is on it, it raises the rate of gain. This advantage is enhanced where land gains are subject to a special low tax rate, "s". Equation (6) and Table 6 put this all together in one package.

$$RRAT = \left[\frac{F(1-t) + Pt + L(1-s) + L_0s}{P + L_0} \right]^{1/n} - 1 \quad (6)$$

Table 6: RRAT on PIP0 investment, with land gain taxed at lower rate

n=15; P=1; L₀=1; t=.5; s=.2

F	L _n	RRBT %	RRAT %	RRAT/RRBT
(1)	(2)	(3)	(4)	(5)
2	1	2.74	1.50	.547
4	1	6.30	3.80	.603
8	1	10.55	6.98	.661
8	2	11.33	7.95	.702
8	4	12.69	9.59	.756
8	6	13.85	10.95	.790
8	8	14.87	12.10	.814
6	8	13.85	11.40	.823
4	8	12.69	10.63	.838
2	8	11.33	9.77	.863
1	8	10.55	9.31	.883

There are two forces at work shown in Table 6. First, the advantage of tax deferral grows as RRBT grows. This effect is manifest in the top 7 rows, with col. (3) rising from 2.74 to 14.87, and col. (5) rising from .547 to .814. A nominal tax rate of 50% leaves the taxpayer with a RRAT equal to .814 of the RRBT, which amounts to an effective tax rate of less than 19%.

Second, there is the advantage of the lower tax rate on land. This is manifest in the bottom 5 rows where col. (5) continues to rise, even though col. (3) is falling. It is also manifest in the row where $F=8$ and $L_n=6$. Here $RRAT = 10.95\%$, which is higher than what we get in Table (5) when $F = 8$ and $RRAT = 10.55$. In this case the diluting effect of the slower-growing land value is more than offset by the effect of the lower tax rate on land gains.

The gain on some PIPO investments in fact now also gets the lower "capital gains" rate. Timber is notable, having been awarded this favorable treatment since 1946. Here, however, our interest is in exploring the effects of the application of different rates, so we do not pursue the timber case, which would obviously be simpler and can be explored now by any reader.

2. Combined case

Here we build from our basic Equation (3), and modify it for taxes, and deductions from taxes. Cash flow is taxed at the "ordinary" rate, t ; and depreciation is deductible at the same rate. "Capital gains", which are really mostly land gains, are taxed at a lower rate, s ; and the "basis" of property, which is the part of the historical purchase price which is not depreciated, is deducted from the capital gain. Equation (7) puts that all together.

$$RRAT = \frac{[a(1-t) + (B/n)t](1-I^{-n})}{(L_0+B) - [L_n(1-s) + L_0s]I^{-n}} \quad (7)$$

a = cash flow

t = tax rate on "ordinary" income

B = Building cost, which is depreciable

L_0 = Land cost, not depreciable

n = economic life, here assumed equal to tax life

B/n = annual depreciation allowed as deduction, assuming simple straight line depreciation with no acceleration. This assumption is made for simplicity: actual treatment is often more complex, with faster write-off followed by some recapture.

$(B/n)t$ = annual reduction of tax liability due to deducting B/n
 s = tax rate on land gains.

L_n = Salvage value of land at time n . If it is resold at that time, there is a tax on the gain.

L_0s = reduction of tax liability due to deducting the "basis", L_0 , from the gain in L

(7) shows the logic of how this equation is constructed. Having this in hand, we now modify it to focus attention on the key ratios that determine the outcome, and which will vary in the tables that follow. Make these changes:

$$P = L_0 + B$$

$$lP = L_0 \quad (l \text{ is the fraction of } P \text{ which is land})$$

$$(1-l)P = B$$

$$F = L_n$$

Finally, divide both numerator and denominator by P , to put the equation in standardized form. We now have the very last equation we will need.

$$RRAT = \frac{[(a/P)(1-t) + t(1-l)/n](1-l-n)}{1 - [F(1-s)/P + ls]I^{-n}} \quad (7a)$$

Table 7 (next page) shows RRBT and RRAT as F/P rises from 0 to 8. Most of its assumptions are realistic. A few are bent a little in the cause of simplicity:

--- When F is less than L_0 Table 7 allows full deduction of the loss, at the gains rate, s . In practise such deductions cannot all be taken for granted. Some capital losses are never usable, and others require quite a struggle.

--- " l " refers to the share of P that is land for tax purposes, hence is not depreciable as an expense against ordinary income. It is here assumed constant at .4. Actually it is subject to the facts of each case, and to judgment and negotiation with IRS personnel. The relationship between the true value of l and the tax value of l may not be very close. It is believed by some experts that the IRS is more lenient in this matter than it is in most others, letting taxpayers depreciate land in effect. Taxpayers usually want to depreciate as much of P as possible so they can take it off against ordinary income, at an early date.

The undepreciated basis is deducted only from a capital gain, and not until the time of sale. There are many reasons (some of them noted under Table 7) why the time of sale may never come.

I have shortened these notes by sparing you a table showing how RRAT varies with the value assigned to l . It does make quite a difference.

--- taking $t=.5$ is a bit high. But when you combine Federal and California taxes it is closer. As in all these calculations it refers to the marginal rate, not the average.

--- taking $s=.2$ is shorthand for $t = .5 \times .4(P-L_0)$. Here it doesn't matter. Sometimes it does, and, apart from this example, you should think in terms of excluding 60% of gains from taxable income, rather than applying a tax rate 60% below the ordinary rate.

Table 7: ROR, combined case, as affected by income taxes

$n=15; a=.10; P=1; t=.5; s=.2; l=.4$

F/P	RRBT	RRAT				RRAT/RRBT
		$s=0$	$s=.2$	$s=.5$	$s=1.0$	$s=.2$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1) 0.0	5.56	.61	1.47	2.56	4.00	.264
2) .5	8.18	4.62	4.50	4.33	4.00	.550
3) 1.0	10.00	7.00	6.50	5.68	4.00	.650
4) 2.0	12.56	10.12	9.27	7.76	4.00	.738
5) 4.0	15.87	13.90	12.76	10.60	4.00	.804
6) 8.0	19.84	18.25	16.87	14.19	4.00	.850
Row 6/1	3.57	29.92	11.48	5.54	1.00	3.22

Table 7 shows the combined effect of land value gains and their preferential tax treatment. The combined effect is at its strongest in Col. (3) where there is no tax at all on the land gain. The RRAT in row 6 is 29.92 times that in row 1, even though the ordinary income remains unchanged at $.1P$.

Morals:

a) RRAT/RRBT is highly variable: low where there are losses on the speculative land element, and high where there are gains.

b) This variation is a maximum when L' is untaxed, as in Col. (3) where $s=0$.

For most of us a tax rate of zero is a pipe dream. But landholders achieve it routinely, simply by not selling. The best

way in the world to avoid income tax is to buy land in advance of anticipated future needs -- your own needs, that is. This option is of dubious value to most firms and individuals because they lack the deep pockets of "patient money" that are required. It is of no value to those who buy the wrong land at the wrong time and see its value drop. It can be useful to ordinary people who can squeeze some cash flow from land while waiting for it to make them rich in later life.

c) The preferred treatment of land gains is only partly due to the use of a lower tax rate. It is also due to deferral of the tax until the end of the cycle, in year n . This is shown in Col. (5) where $s=t$. Even with a common tax rate there remains a large rise in RRAT as F/P rises.

d) A tax of 100% on gains (Col. (6)) eliminates their effect on RRAT, as you would expect. If there were such a tax it would be avoidable, however, by not selling, resulting in a tax rate of zero.

Do not conclude from Table 7 that the secret of financial success is to seek out those investments showing the highest RRAT in the table. The problem is that others have figured this out before, and gotten there first. That in turn has caused land prices to rise, and anticipated gains to fall, with a tendency to equalize after-tax rates of return. There is reason to believe, in fact, that many people have overemphasized tax matters in their financial strategies, such that "tax shelters" are oversubscribed. One cause of the current distress in agriculture, for example, is certainly excess supply resulting from all the urban capital poured into farm tax shelters in recent decades.

The secret of financial success is harder, with calculations like those in Table 7 being merely a tool to help you judge whether others have overreacted to tax bias before you came along. If it seems tough, cheer up, it is even tougher for others who have not been through this mental discipline, and who will leave loose opportunities lying around from which you may gain.