



Rent, Interest, Taxes and Land Prices

By Dr. Mason Gaffney

Article citation:

Gaffney, Mason. "Rent, Interest, Taxes and Land Prices." 12 March 1991. Notes.

Fair Use Disclaimer

The Robert Schalkenbach Foundation, a non profit private foundation, is publishing this article, at no cost, pursuant to the Fair Use provisions of Section 107 of the Copyright Act which states that under certain circumstances, the fair use of a copyrighted material for purposes of criticism, comment, teaching, scholarship and research is not an infringement of copyright. If you have any concerns about the publication of this article, please contact us at info@schalkenbach.org.

The Robert Schalkenbach Foundation's Digital Collections and Archives is an extension of the Robert Schalkenbach Foundation's Engel Georgist Library. It collects, organizes, preserves, and provides free online access to researchers and the general public of Georgist literature including books, newspapers, pamphlets, scholarly articles and archival materials.

RSF is particularly proud to offer free online access to the works of the late Georgist scholar Mason Gaffney, made possible through the generosity of the Danica Foundation and with the consent of the Mason and Letitia Gaffney Trust.

Robert Schalkenbach Foundation: <https://schalkenbach.org/>

Engel Georgist Library: <https://www.librarycat.org/lib/EngelGeorgistLibrary>

RSF Digital Collections and Archives: <https://schalkenbach.starter1ua.preservica.com/>

RENT, INTEREST, TAXES AND LAND PRICES

Notes by Mason Gaffney, March 12, 1991

The following tables show how ground rent and land price are affected by the interest rate (i), using simple assumptions. The specific assumptions are realistic for many times and places, but of course not all. The numbers assumed are simply to give the reader a feel for the ballpark. Generic equations and derivations are given in which readers can use other numbers if desired.

We assume a commercial site where there is an initial capital input (K_0), to be replaced after n years. We levelize or "annualize" K_0 by multiplying it times the Installment Plan Factor (IPF), defined below. That is, we convert it into the equivalent level annual payment of n years. "Equivalent" means the present value of the stream of payments is K_0 .

This factor (IPF) is always greater than the interest rate, i . For low values of i and n , $IPF \gg i$, and approaches the value $1/n$, that is, a simple yearly mean. For high values of i and n $IPF \rightarrow i$. We label this annual payment, $K_0 \times IPF$, as "Debt Service" (DS), assuming for simplicity that the K_0 is 100% financed, all interest is explicit, and the debt is fully amortized in level payments over n years.

To find Ground Rent (GR), we simply subtract DS from Cash Flow (CF). Cash Flow here means operating cash flow, i.e. no interest is subtracted to get Cash Flow. Cash Flow means gross current revenues less current expenses (other than interest).¹ For simplicity, we also assume CF is level over n years.

Ground rent is an annual concept. Where there is no fixed capital to install up front, ground rent is simply operating cash flow. Sometimes annual rents are easily identified, as with parking lots, or yearly rents for grazing, or growing field crops. Normally, however, there is a long cycle of investment followed by capital recovery. Our model is designed to convert this into the equivalent annual ground rent, and therefore also to deal with the relationship of interest and taxes to ground rent. *annualize*

Several tables are presented. The independent variable is i ,

¹Much of current expense is labor, and much is materials. The proportions chosen will vary with relative costs. This matter is glossed over here. In a more complete model we should consider the composition of expenses. In addition we should consider the ratio of expenses to gross revenues: the more K_0 is used, the less expenses are needed later to yield a given gross revenue.

which rises from .04 to .12 reading from left to right.

Table 1 shows ground rent, GR. The following parameter values are chosen:

$$K_0 = 100$$

$$CF = 12$$

$$n = 25 \text{ years}$$

$I = 1+i$ (I is an arbitrary expression chosen to simplify writing and reading equations.)

$$IPF = i/[1-I^{-n}]$$

$$GR = CF - K_0 \times IPF$$

E (for Epsilon) = "elasticity," that is the % drop in GR divided by the % rise of i that causes it. This is for finer work than most readers are interested in initially.² Values are given for $-E$. E is negative here because a drop in i causes a rise in the dependent values.

TABLE 1: Ground Rent and the Interest Rate

$i =$	.04	.05	.06	.07	.08	.09	.10	.11	.12
$100 \times IPF$	6.40	7.10	7.82	8.58	9.37	10.18	11.02	11.87	12.75
GR	5.60	4.90	4.18	3.42	2.63	1.82	.98	.13	-.75
% drop	-.	12.5	14.7	18.2	23.1	30.8	46.2	86.7	676.9
$-E$	-.	.500	.735	1.27	1.62	2.46	4.16	8.67	74.5

Note that GR is highly sensitive to i , especially at higher i . This is due to leverage: CF is fixed at 12.00, so as IPF rises and approaches CF, a small % rise of IPF causes a large % drop in GR: so much so, in fact, that GR finally falls below zero.

Table 1 is here to bring out this leverage effect starkly. In doing so, however, it exaggerates the effect of i on GR, by

²Its technical value is to compensate for the fact that the % changes in i are not constant from step to step. Thus, E values are properly comparable from step to step, whereas % drop values are not quite so. The step from .04 to .05 is a 25% jump in i ; from .10 to .11 is a 10% jump.

$$L_0 = GR_1 \frac{1 - I^{-n}}{i} + \frac{GR_2}{i} I^{-n}$$

This is a simpler version, showing double effect of i on B.

? or shortening n

3

holding K_0 constant. Actually, landowners can avoid the worst effects of higher i by lowering K_0 , even at the cost of lowering CF, thus avoiding negative GR. In Tables 4 and ff. we make this adjustment.

First, however, we use the GR of Table 1 to show the further effects of i on Level Land Price (Table 2), and Speculative Land Price (Table 3). These tables show that land prices are even more sensitive to i than GR is.

TABLE 2: Level Land Price (LLP) and the Interest Rate

Level Land Price = GR/i									
i=	.04	.05	.06	.07	.08	.09	.10	.11	.12
LLP=	140.0	98.0	69.7	48.9	32.9	20.2	9.8	1.2	-6.3
% drop	30.0	28.9	29.8	32.7	38.5	51.5	87.8	625.	
-E	1.20	1.45	1.79	2.29	3.08	4.64	8.78	68.75	

Note that the % drop of LLP is nearly 2.5 times higher than the % drop in GR, from $i=.04$ to $.05$. That is because the drop of GR is fortified by the rise of the divisor, i . At higher values of i , however, this effect is minimal, and the % drops move toward each other asymptotically. (This is an artifact, however.)

Table 3, below, shows the effect of i on Speculative Land Price (SLP). Here, land price is derived from two elements, A and B. A is the present value of GR in its current use, Generation #1 (G_1); B is the present value of higher future uses, $G_2, G_3, \dots$ etc. in perpetuity. Each future Generation has a present value, as of its own starting year, higher than its preceding Generation by a factor $(1+g)^n$.

In Table 3:

$$SLP = \text{Speculative Land Price} = G_1 \times LVM$$

$$G_1 = \text{Present Value of Generation \#1, lasting } n \text{ years}$$

$$G_1 = GR \times PVF$$

$$PVF = \text{the Present Value Factor, } [1 - I^{-n}] / i$$

PVF is the reciprocal of the IPF.

g = annual growth factor. This is the annual growth rate corresponding to the step-growth of land price that actually occurs. That is, every n years a new generation of capital is

✓ invested on the site, such that: $G_1 \times (1+g)^n = G_2$,
 $G_2 \times (1+g)^n = G_3$, etc. ad inf.

LVM = the Land Value Multiplier:

$$LVM = \frac{1}{1 - \frac{(1+g)^n}{I^n}}$$

LVM is found by summing the infinite geometric progression whose first term is 1, and whose rate of progression is $[(1+g)/(1+i)]^n$.³

$$g = .03.$$

TABLE 3: Speculative Land Price (SLP) and the Interest Rate

i=	.04	.05	.06	.07	.08	.09	.10	.11	.12
GR=	5.60	4.90	4.18	3.42	2.63	1.82	.98	.13	-.75
PVF=	15.6	14.1	12.8	11.7	10.7	9.8	9.1	8.4	7.8
G ₁ =	87.4	69.1	53.5	40.0	28.1	17.8	8.9	1.1	-5.9
LVM ⁴ =	4.66	2.62	1.95	1.63	1.44	1.32	1.24	1.18	1.14
SLP=	407.3	194.9	104.3	65.2	40.5	23.5	11.1	1.29	-6.67
% drop	-. -	52.1	46.5	37.5	37.9	42.0	52.8	88.4	617.1
-E	-. -	2.08	2.33	2.25	2.65	3.36	4.75	8.84	67.9

✓ Comparing Table 3 with Tables 1 and 2, we see that the element of rising future rents raises the sensitivity of land price to i, and does so by a big factor. When $i \rightarrow g$ (as when $i=.04$), SLP rises to very high values. The corollary is, of course, that a rise of i will deflate land prices extremely. In practise, it also often happens that such deflation dashes cold water on expectations of future rents, by forcing attention to the surplus of land seeking buyers. The double effect is doubly deflationary. g is based entirely on subjective conjectures about the distant future: this helps account for extreme ups and downs

³See handwritten Appendix.

⁴ $g=.03$

(amplitudes) of swings in land prices over cycles.⁵

✓ An adjustment of GR is now badly needed. The figures on the right side of Tables 1-3, at $i > .08$, are dominated by the steep slide of ground rents (GR) toward zero and below. This slide is, as noted earlier, an artifact of an unrealistically rigid assumption that K_0 remains fixed even as i rises to high levels.

✓ In Table 4 we correct for this. With each step of i upwards, we drop K_0 by 12%. Of course, this also lowers cash flow (CF), which we drop by 8%. This tempers the drop in ground rent (GR).⁶

⁵ i is also partly a forecast, because it is future interest rates that it refers to. However, long-term funds may be contracted for in the present at known rates: such long-term financing is the primary influence on i .

⁶The difference in the percentage drops reflects diminishing returns to capital. The question may be raised, if you can cut costs by 12% and cut CF by only 8%, why not have done it anyway? And why not continue doing it back to $K_0=0$? The answer is that K_0 is not the only input; land is also an input. Lowering K_0 means underusing land. The bottom line is the ground rent (GR).

If the numbers were mis-selected, it might be possible, at any fixed i , to gain by using less K_0 . However, I do not believe this is possible at any point in the Table.

Table 4: Repeat of Tables 1-3 with Adjusted Ground Rent

i=	.04	.05	.06	.07	.08	.09	.10	.11	.12
IPF=	.0640	.0710	.0782	.0858	.0937	.102	.110	.119	.127
K ₀ =	100.0	88.0	77.4	68.1	60.0	52.8	46.4	40.9	36.0
Debt Service DS=	6.40	6.25	6.05	5.84	5.62	5.38	5.11	4.85	4.59
CF=	12.0	11.0	10.2	9.34	8.60	7.91	7.28	6.69	6.16
GR=	5.60	4.79	4.11	3.50	2.98	2.53	2.17	1.84	1.57
% drop=	--	14.5	14.2	14.8	14.9	15.1	14.2	15.2	14.7
LLP=	140.0	95.8	68.5	50.0	37.2	28.1	21.7	16.7	13.1
% drop	--	31.6	28.5	27.0	25.6	24.5	22.8	23.0	21.6
PVF=	15.6	14.1	12.8	11.7	10.7	9.8	9.1	8.4	7.8
G ₁ =	87.4	67.5	52.6	40.3	31.9	24.8	19.7	15.5	12.2
LVM ⁷ =	4.66	2.62	1.95	1.63	1.44	1.32	1.24	1.18	1.14
SLP=	407.3	176.9	102.6	65.7	45.9	32.7	24.4	18.3	14.0
% drop=	--	57.6	42.0	36.0	30.1	28.8	25.4	25.0	23.5

✓ In Table 4, GR drops about 14.5% with each step-up of i. LLP is found by simply dividing GR by i. This lets us see the pure effects of capitalizing. LLP drops at more than twice the rate of GR, adding the effect of raising the cap rate to the effect of lowering GR.

✓ SLP drops most of all, especially between $i=.04$ and $i=.05$, where it drops 57.6%. This high sensitivity obtains because more of the present value is derived from distant future rents.

✓ The point is that the present value of speculative land is subject to extreme deflation with a rise of i. One practical consequence of that is that banks should not lend on speculative real estate. Recent history has made the point resoundingly. So has earlier history, for those who read it. Practical regulators have recognized the problem at least since the English Bubble Act of the early 18th Century. 1710

⁷g=.03.

At the same time, less practical regulators have regularly wished the matter away, and circumvented The Bubble Act and its counterparts. This usually has happened after a few years of rising values and buoyant markets. The present theory may have some value in warning persons of an ahistorical mindset of the perils of lending on speculative real estate.

✓ The tables have several other uses. Another point is that the ability to buy and hold land is closed to all but those who have access to funds at low i .

Table 4 may also be used to show the separate effects of ad valorem property taxes on buildings and on land. The tax on buildings has the same effect on GR as raising i , ~~or lowering g~~ . That is, a tax rate (t) of .02 plus i of .05 is the same as i of .07. In Table 4 that lowers GR from 4.79 to 3.50, a drop of 26.9%. Going the other way, removing a building tax of 2% has the same effect as lowering the interest rate on building loans from .07 to .05. That raises GR from 3.50 to 4.79, a rise of 36.9%.

✓ A land tax, on the other hand, affects only the cap rate used to find LLP and SLP. The figures in Table 4 cannot be used directly, because they are based on changes in GR as well as in the cap rate. For LLP, however, the calculation is very simple. A land tax rate of .02 added to i of .05 raises the cap rate by $2/5$, or 40%, and lowers LLP by 40%, GR remaining constant.

✓ For SLP the calculation is a little trickier, and cannot be taken directly from the table. We must find the combined effects of a lower PVF and a lower LVM, holding GR constant. This is done in Table 5. The result gives a notion of how land taxation takes the inflation out of Speculative Land Prices.

✓ It is useful to divide land prices into two elements, A and B. Element A derives from the current use, or "possessory interest." Its value is that shown as G_1 in Table 4. It is much less sensitive to i and to t than are LLP and especially SLP, although it is a part of each of them. It is the other part, Element B, that is highly sensitive to i and t .

✓ Element B derives from future generations of use. Call it the "investment value" of land. Its contribution to SLP is shown by LVM. Subtract 1 from LVM, and multiply times 100 to get the % added to G_1 to get SLP. For $i=.05$, that is 162%; for $i=.07$, that is 63%. Thus, in that example a land tax of .02 deflates Element B by 61%.

Our last table, Table 5, shows the effect of raising the land tax rate, t . The tax rate on buildings is constant at zero⁸. i is also constant, at $i=.04$. This keeps GR constant. g is also constant, at $g=.03$. In Table 5, t is the independent variable, but it applies only to Land Price. GR being constant, raising t has the same effects (on all rows below GR) as raising i - ~~one~~ you simply adds i and t together, and proceed~~s~~ as before.

Element A, i.e. the present value of Generation #1 (G_1), falls moderately when we raise t , even though GR remains constant. That is because future rents are discounted by the sum of i and t . Element B, i.e. the present value of all Generations >1 , falls hugely when we raise t . Land taxes fall only lightly on Element A, the possessory interest in land price; they fall heavily on Element B, the investment value of land, which some call the "speculative" interest, and others call the "store of value" motive for holding land.⁹

Table 5 has the advantage, for some readers, of dispensing with the LVM. Most of us get rusty on our math, and find a coefficient like LVM to be alien, and therefore hard to embrace. Actually it is just a shorthand way of adding Element B to Element A. Table 5, however, explicitly uses addition to perform the same operation. It keeps the two Elements isolated, each with its own row of figures.

Table 5 has the following parameters:

$$i = .04$$

$$GR = 10$$

$$G_1 = A = GR \times PVF$$

$$n = 25$$

$$g = .03$$

B/A = ratio of Element B to Element A. It is found by subtracting 1 from LVM. It may also be calculated separately as

⁸It could also be constant at some rate above zero. Constancy is the point here. We choose zero for simplicity.

⁹The effect of high land taxes is somewhat like having a land system that limits tenures to possessory interests for fixed terms. Such systems have a long history, going back at least to the Mosaic Law of The Jubilee, limiting terms to 49 years. Cf. also George's comments on placer mining tenures in the California gold rush (Progress and Poverty, pp. 386-87). Cf. also the "Land to the Tiller" concept in some 3d World land reform programs.

the reciprocal of $[(1+g)^n/(1+i+t)^n - 1]$. In the last form it is often called "The Faustmann Factor," in honor of Martin Faustmann, a German forest appraiser who discovered it in 1848.

$$B = B/A \times A$$

B is the speculative element in land price, singled out for special attention.

$GR = 10$

Table 5: Possessory Value and Resale Value of Speculative Land

(i+t)=	.04	.05	.06	.07	.08	.09	.10	.11	.12
$G_1=A=$	156.	141.	128.	117.	107.	98.	91.	84.	78.
% drop	.-	9.6	9.2	8.6	8.5	8.4	7.1	7.7	7.1
B/A=	3.66	1.62	.95	.63	.44	.32	.24	.18	.14
B=	571.	228.	122.	73.7	47.1	31.4	21.8	15.1	10.4
% drop	.-	60.0	46.5	39.6	36.1	33.3	30.6	30.7	27.8

✓ The burden of Table 5 may be summarized by contrasting the drops in G_1 (Element A) and Element B, from extreme left to extreme right. Element A drops from 156 to 78, an overall drop of 50%. Element B drops from 571 to 10.4, an overall drop of 98.2%.

✓ What has caused these drops? It is the rise in t , the land tax rate. t has risen from .00 to .08. t is the independent variable, and no other parameter changes. (Remember, i is held constant at $i=.04$, so row #1 is $t+.04$. The building tax is constant, so GR remains unaffected by changes in t . g is constant at $g=.03$.)

✓ From a Georgist view, these data display another reason why banks should not lend on SLP. When SLP is banked it creates a new set of vested interests in supporting SLP. Those who speak for rent-takers seize upon this to demand public support for the land market. Thus Paul Craig Roberts: "Depressed real estate prices are not only an important reason why we are in recession but they are likely to make it all but impossible for us to spend our way out of it." We must lower taxes to "breathe life back into real estate values, save many financial institutions from failure, and save the government - or taxpayers - billions of dollars in bailout costs. ... The downward spiral will have a long way to go if regulators succeed in forcing financial institutions to 'mark-to-market,' or value at current market prices their long-term

investments."¹⁰

These data also indicate why there will always be extreme pressure from landowners to lower land tax rates, once they are installed. Reading the rows from right to left, Element B rises from 10.4 to 571 when t falls from .08 to .00. That is a gain of 5,390%. To overcome such pressure, we need to show that such gains are illusory because lower land taxes necessitate higher taxes of other kinds.

¹⁰Business Week, 18 Feb 91, p.18. This comes from an economist who calls himself a supply-sider and a free-market booster. His inconsistency in those matters results from his consistency in supporting rent-takers at any cost.