

Payback Times

"Payback Times" at 8%
% of capt. recovered, for level annuity

[illegible]

Payback Times.

If you have staggered 50 level annuities, then each year you recover the value of one. Your total cap. sunk is:

$$\sum_{n=1}^{50} \left[\frac{1 - e^{-in}}{i} \right]$$

(There is also 50 u. of land)

Payback Time is then:

$$\frac{1}{P} = \frac{\frac{1 - e^{-50i}}{i}}{\sum_{n=1}^{50} \left[\frac{1 - e^{-ni}}{i} \right]} ; \quad P = \frac{\text{Fund}}{\text{Flow}}$$

See TM faw App. for resolution. Then

tabulate some

$$\sum_{n=0}^{50} \left(\frac{1 - e^{-\cancel{ni}}}{i} \right) = \frac{1}{i} \left(50 - \frac{1 - e^{-50i}}{i} \right)$$

$$P = \frac{\text{Fund}}{\text{Flow}} = \frac{\frac{1}{i} \left(50 - \frac{1 - e^{-50i}}{i} \right)}{\frac{1 - e^{-50i}}{i}}$$

Payback Time.

1 down from + for Table.

1. At lives below 10 yrs, @ 8%, payback % $\rightarrow$ S.L.

Have a column showing $\frac{\text{actual payback}}{\text{S.L. payback}}$

Show sensitivity to i + Δ l , where l = ec. life,
 n = current year.

E.g.

$l \rightarrow$	10			20			50		
n $\downarrow$	<u>S.L.</u>	<u>P</u>	<u>P/S.L.</u>	<u>S.L.</u>	<u>P</u>	<u>P/S.L.</u>	<u>S.L.</u>	<u>P</u>	<u>P/S.L.</u>
1	.1	.0690	.690	.05	.0219	.438	.02	.00174	.087
5	.5	.4050	.81	.25	.1282	.5128	.10	.0102	.102
10	1.0	1.0	1.0	.50	.3166	.6332	.20	.0252	.126

2. At lower i , $P/S.L.$ rises, $\rightarrow$ 1 as $i \rightarrow 0$.

3. K not attached to land, or on poor land, may have less sustained income than K on good land.
 Land may land its durability to K . E.g.:

— Old bldgs. are subdivided, used intensely. They get grandfather clauses. They take income from shanty sites where l.v. for renewal has declined.

— Old plants fix in w. xptn, labor pool, etc. -- locational factors have adjusted.

- Stationary things get less wear than mobile things. (Even the ships, rail cars, planes do last surprisingly long.)
- Int-ente Cap. pays off by Δ l.v.

On other hand, the robbing & running of l.v. creates much locational obsolescence, which mobile cap. escapes.

Mgmt. land often uses more durable cap. Etc.

4. The indiv. payback time is slower than the social bcs. indiv. must also carry land.

- a. Land is a higher % for the shorter lives
 - bcs. they cost less to begin
 - " " ~~run~~ payback faster
 - " " go on better land, more than not,

probably ~~less~~

b.

5. The indiv. used to carrying land will affect him.

- a. If by rent, adds to cost of time. But may also reflect added productivity of time.

- b. If carrying land is a burden, shortens l
- " " " " desired for its own sake,

will lengthen l.

6. Show the 50% year, when half payback is achieved.

$l \rightarrow$ 10 20 50

n
↓

6 c. .50

14

c. .50

42

c. .50

7. Show gross invt. error w. a \$ of K , recycled at given l .

It ~~must~~ understate the diff. to say the $l=1$ capl. cycles 50 times in 50 yrs, while the $l=50$ cycles once. Bes. the $l=1$ capl. has a mean life of $\frac{1}{2}$ yr.; & the $l=50$ capl. has a mean life well over 25 yrs. Work this out, using Payback Times

8. Show math. & Table for decaying incomes. Short & long.

Payback Time (P) -- think of "Period"

You have staggered ^{level} annuities of n years' whole life.

$$(1) \quad \text{Inflow of } K = \frac{1 - e^{-in}}{i}$$

Flow of cash = n (b/c, ea. ann. yields 1 per yr.)

$$(2) \quad \text{Outflow of } K, \text{ or Payback, is } n - Ki.$$

$$(3) \quad n - Ki = \frac{1 - e^{-in}}{i} \quad (\text{App. 1, TM 9a})$$

(So outflow of cap. = inflow)

$$(4) \quad P = \frac{\text{Fund}}{\text{Flow}} = \frac{K}{\frac{1 - e^{-in}}{i}} = \frac{Ki}{1 - e^{-in}}$$

$$(5) \quad \text{Subst. } Ki = n - \frac{1 - e^{-in}}{i} \quad (\text{from (3)})$$

$$(6) \quad P = \frac{n}{1 - e^{-in}} - \frac{1}{i}$$

Tabulate P , next page

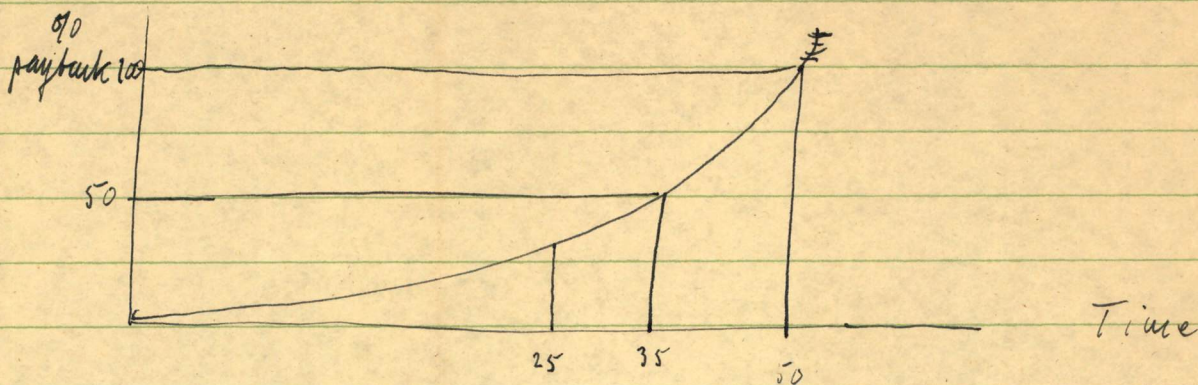
$$\text{If } n=1, \quad P = \frac{1}{\frac{1 - e^{-i}}{i}} - \frac{1}{i} = 1$$

$$\text{If } i=0, \quad P = \frac{n}{1-1} - \frac{1}{0} = \text{undefined } \infty - \infty, \text{ use l'Hopital}$$

Payback Time, $P = \frac{n}{1 - e^{-in}} - \frac{1}{i}$

$n \backslash i$	.005	.01	.02	.05	.07	.10	.15	.20
1		.5008	.5017	.504	.5058	.508		.517
2			1.01	1.02	1.023			
3			1.51	1.54	1.55			
4			2.03	2.07	2.09			
5		2.52	2.54	2.60	2.65			2.91
6			3.06	3.15	3.21			
7			3.58	3.70	3.78			
8			4.11	4.27	4.37			
9			4.63	4.83	4.97			
10			5.17	5.41	5.58	5.82		6.57
15			7.87	8.43	8.79			
20			10.67	11.64	12.26	13.13		15.37
25			13.54	15.04	15.97			
30			16.49	18.62	19.90	21.57		25.07
40			22.64	26.26	28.30			35.01
50			29.10	34.5	37.27	40.34		45.00
75			46.54	56.8	61.11	65.0		70.00
100	54.1	58.2	65.7	80.7	85.8	90.0		95.00

Payback Time



Say you reach 50% payback in 35 years. What do we know about mean payback time (P)?

The units of Cap. recovered after 35 ~~are~~ have P closer to 35 than the units recovered before 35. Therefore, the ave. payback is less than 35 yrs.

to the second; let us treat it now. What is the labor-content of capital?

Let us say farm machines displace farm labor. Looking upstream, we see labor helping produce the machines. Is capital displacing labor, or is it merely labor stored in machines displacing onsite labor? We know the machine needs fuel, and fuel is capital-intensive to produce, but that doesn't tell us much until we know what "capital-intensive" means, for refineries too are produced by labor. So let us just focus on the farm machine. Keeping it simple, we ignore marketing costs between factory and farm.

To answer, let us follow one machine through its life. It lasts n years and yields a service flow worth \$1/year. I is the warranted investment to produce the machine, and equals the present value of the future service flow:

$$I = \frac{1 - e^{-ni}}{i} \quad (1)$$

In equilibrium, as a result of competition, machine costs settle into this relationship to service flows. The cumulated value of the service flow over n years is $\$n$. The share of investment cost (I) in the total flow is:

$$\frac{I}{n} = \frac{1 - e^{-ni}}{ni} \quad (2)$$

(2) is a decreasing function of n . (Table 4 and Figure 1)

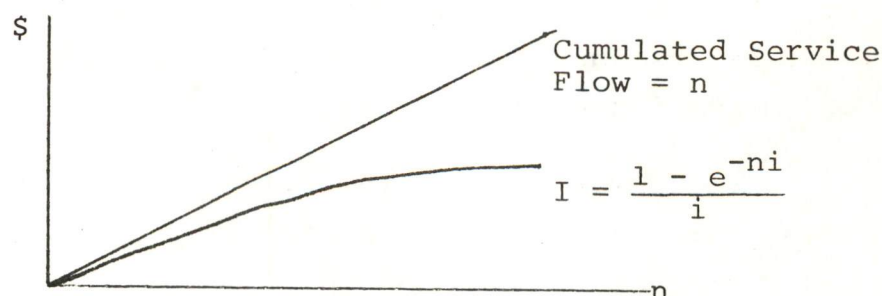
Table 4. Investment Cost (I) as a share of cumulative service flow (n) when $i = 8\%$

n	I	I/n
5	3.99	.80
10	6.71	.67
20	9.82	.49
40	11.92	.30
80	12.47	.16

Figure 1 shows the same information graphically. If the buyer pays on the instalment plan at 8% interest over $\underline{n}$ years, he pays the full $\underline{n}$, the entire service flow, because

$$\underline{n} \times \frac{i}{1 - e^{-ni}} \cdot \frac{1 - e^{-ni}}{i} = \underline{n}.$$

Figure 1:



Now what is labor's share in the service flow? It is no more than $I/\underline{n}$ -- the rest is interest. $I/\underline{n}$ is the share when $\underline{I}$ is 100% payroll. More generally, labor's share is $wI/\underline{n}$, ($w \leq 1$), where w is the share of $\underline{I}$ that is payroll, plus the share of other costs that trace back to labor in the same manner.

Such historical research could get complex, and it may be that the Austrian economists with their concept of a "period of production" were diverted and neutralized by critics dwelling on the difficulties. Fortunately there is an easier way out. That is to note that if machines are produced at a constant rate, say one a year, there must be $\underline{n}$ machines out bearing interest for every work crew making them, so again the share of labor in the income is a decreasing function of $\underline{n}$. It is not only a decreasing function, it is exactly the same function. This is shown in Appendix I.

This simple relation lets us detour all those involved Clark-Böhm-Bawerk and Knight-Hayek debates and generalize that in a going concern, with replacements balancing retirements, the share of labor in the flow of service from capital decreases as the life of capital lengthens. A total economy is a going concern of this kind, better balanced than individual concerns, and there is negligible

error in saying that labor's share is a decreasing function of the average life of capital.

Appendix I also shows that the share of land rises with life of capital¹ for the simple reason that labor is applied less frequently to land where labor is embodied in capital of long life.

There are two kinds of capital: that which is storing up value, and that which is releasing it in the form of service. The one is appreciating, the other depreciating, and for short I refer to the one as "growing" and the other as "flowing" capital.

The above all refers to flowing capital. The same relationship between long life and labor's share also obtains with growing capital, only more so, as shown now. We follow \$1 through the life of a tree it is invested to plant. The tree is cut after n years and sold for $\$e^{ni}$. $\underline{1}$ is \$1. So labor's share is $w \frac{1}{e^{ni}}$ or $w e^{-ni}$, another decreasing function of n . I omit any table or graph because growth at compound interest is so familiar. I merely underscore that for any given life the share of labor in growing capital is less than for flowing capital of the same life. The labor in flowing capital starts to leak out early on, but that in growing capital is locked in until the product is ripe, and joined by yet more capital which is not produced by labor at all, but by land and other capital.

With growing as with flowing capital, the basic principle is unaffected by having a going concern. If we have a normalized forest of n cells or patches, and cut and regenerate one patch each year, then we must keep n patches in inventory drawing interest for every one that we put workers on. As before, the function relating labor's share to life is the same whether we look at one patch of trees over life, or one normalized forest over one year of its life -- which is not surprising considering that the normalized forest is a cross section of the whole life of one patch of trees, there being one patch of every age. Knut Wicksell demonstrated this long ago in

¹ For long cycles of timber it falls again after 15 or 20 years, because so much capital builds up on the land. But land's share continues to rise relative to labor's.

his Lectures. The mathematics is in Appendix I, and again there I introduce a land input. As before, there is less labor per acre when labor is used less frequently.

Here are some familiar, recognizable traits of capital-using objects and enterprises, a sort of Field Guide to Capital Intensity.

(1) The payout is deferred, the benefits are strung out, so the object has to yield a large surplus over investment to cover interest. This surplus is the value-added by capital, the Austrian "agio".

(2) The cash flow when it comes is largely income. Recovery and depreciation are a minor share of cash flow. By the same token, if the object is financed, most of the periodic payments are interest for several years. The instalment needed to retire the debt with interest is not much higher than simple interest on the original principal.

(3) Demand is very sensitive to changes in interest rates, as with housing and all durable capital. Demand is also sensitive to property taxes.

(4) Only a small share of the objects are normally replaced each year.

(5) A large share of the objects suffer obsolescence at any given time.

(6) If the objects are attached to a site, as the most durable ones are, labor is applied onsite in a bulge, a one-shot payroll. There is no fund quickly recovered to reinvest to sustain the payroll.

(7) The services stored up do not flow through to consumers for a long time, so production creates incomes without yielding up the goods to match them.

(8) Finally, it is fair to say the owners and other beneficiaries of these objects are often found lobbying demanding special relief from the test of competitive interest rates, a test they cannot pass, and doing their best to make it seem impolite, vulgar, and downright non compos mentis to suggest they should have to. They also demand special relief from property taxes.

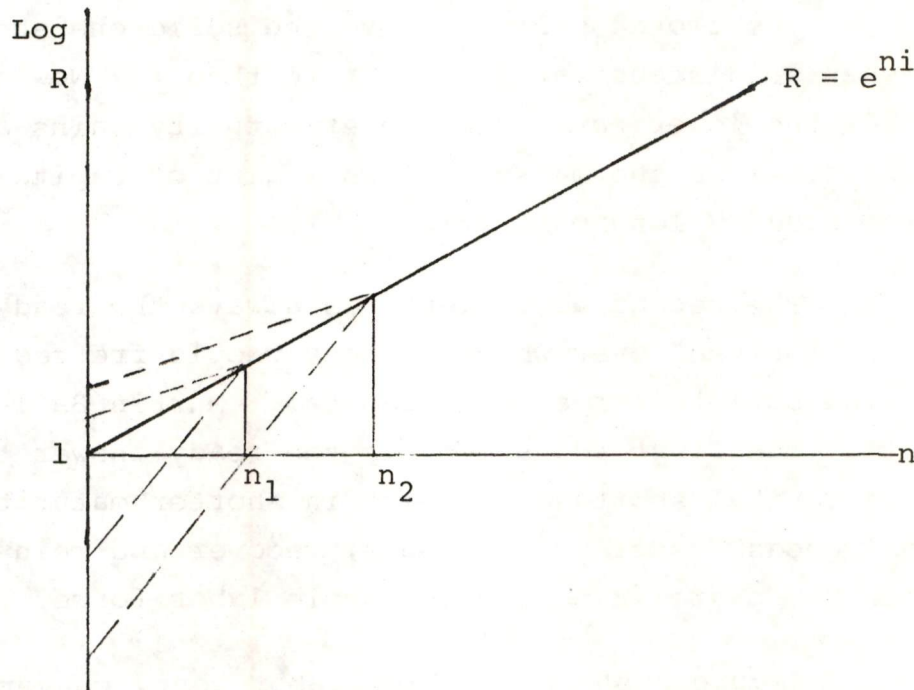
It would be interesting but not really necessary to display examples of the wide range of lives of familiar assets and goods, from a few minutes for a restaurant meal to hundreds of years for road cuts and fills. There is a full range of technical options in

every field. The choice depends on relative input costs, that is the cost of labor vs. the rate of interest.

Just as with the labor/land mix, there is a great leverage effect that makes demand for labor elastic. Where labor is 90% of costs, a drop in unit labor cost to employers raises property income with a nine to one multiplier on the percentage change: 1% off labor cost adds 9% to property income, drawing new investment into labor-using enterprise in the most compelling way. Symmetrically, dear labor screens out labor-using investments and high interest rates screen out capital using investments. This means that dear labor screens out shorter ones, and high interest longer ones.

Figure 2 shows the screening effect of interest rates on growing capital of different lives.

Figure 2: Effect of discount rate on present value, different maturities.



In Figure 2 $\underline{R}$ is Ripe Value, the value of an object of growing capital when ripe. The solid curve $R = e^{ni}$ is the locus of all values of R which yield $\underline{i}$ over $\underline{n}$ years, a straight line on the semi-log scale. In equilibrium, the value of all growing capital will rise to touch this locus, at which time it is ripe. If we

discount any value on the curve at $\underline{i}$, its present value is unity.

The two dash lines below the solid one show the effect of discounting at a higher rate than $\underline{i}$. The present value of shorter maturities like $\underline{n}_1$ falls less than that of longer ones like $\underline{n}_2$. At the higher rate the shorter maturity gains a premium over the longer. Thus the market responds to scarcity of capital by raising discount rates which screen out long maturities in favour of shorter ones.

This makes sense in the simplest terms when we observe that the cost of producing the long maturities is mostly interest, i.e. value added by capital. They are prodigal of capital, so naturally a high price of capital screens them out.

Leverage may be observed on the graph. The decline in wages needed to absorb the higher interest rate is slight for short maturities and great for long ones.

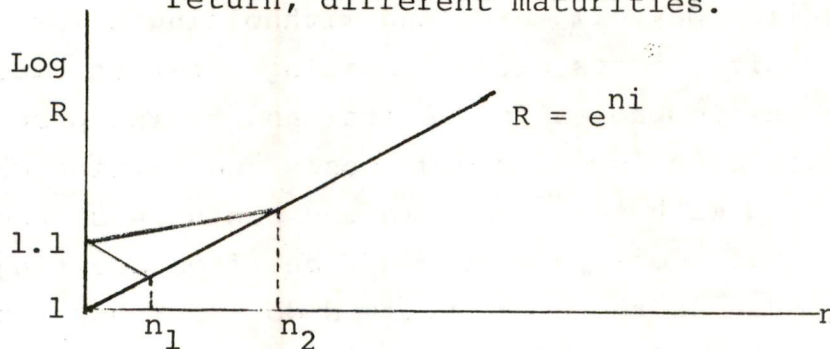
The two dash lines above the solid one show the reverse effect when we discount at a lower rate than $\underline{i}$. Now $\underline{n}_2$ is preferred to $\underline{n}_1$. At the lower rate, the longer maturity gains a premium over the shorter. Thus the market solves a glut of capital by letting it be sequestered in long maturities.

The second adjustment was always the ready answer to the Keynesian "impasse" over which so many people fretted not long ago, how to find outlets for surplus capital. Martin Bailey has pointed this out¹. The first adjustment is the ready answer to our current crisis of capital shortage. Invest in shorter maturities, deliver the final goods faster to consumers, recover and reinvest the capital faster in payrolls to use the whole labor force.

Figure 3 shows how high labor cost, conversely, screens out shorter cycles. In the figure the wage cost of investing in growing capital objects of different maturities is originally one, in equilibrium. Then it rises by 10% to 1.1. On the semi-log scale the investor's rate of return is the slope of the growth curve. At

¹ Martin Bailey, National Income and the Price Level (N.Y.: McGraw-Hill Book Co., 1962, p. 111.)

Figure 3: Effect of higher wage cost on rates of return, different maturities.



the higher wage cost shorter maturities like n_1 are screened out -- the return becomes actually negative. Longer ones like n_2 yield higher returns (although not as high as originally).

Thus high wage costs screen out the short or labor-using investments, and direct capital into the long or capital-using investments. Given shortness of labor, this adjustment would combine capital with less labor and cure the shortage.

The models above refer only to growing capital. I omit analogous models for flowing capital as redundant here. The same principles apply. Mathematically, a unit of growing capital is the building block from which formulae for flowing capital (like those used for Table 4) are derived by summation. So principles that hold for growing capital generally carry over to flowing capital as well, with a few minor mutatis mutandis¹.

The key to full employment then is raising the labor-combining valence of capital by turning it over faster. Active capital moves labor, while torpid capital merely occupies land and often displaces more labor than it employs.

The key to activating capital in this way is to let labor costs fall, and the cost of capital rise. Conservative economists have long advocated something like that, of course. Those of more analytical bent have stressed "Ricardo Effect", the substitution of cheaper labor for capital. Labor of course has resisted that message. They have all however failed to observe that we can lower wage costs

¹ Hans Brems, Output, Employment, Capital, and Growth, (N.Y.: Harper & Bros., 1959) pp. 212-26.

without lowering wage rates, or take-home pay, by abating institutional biases like payroll taxes and withholding taxes. Likewise, we can raise capital costs without raising interest rates, by removing income tax loopholes for capital and taxing property heavier. Thus one can advocate lowering wage costs and raising capital costs without lining up with the demons in the pantheon of the House of Labor. But neither does this preclude one from faulting excessive wage demands, even as the conservatives do. In short, this is not a gut issue pitting "liberals" against "conservatives" in tired routine combat rituals, but a new issue calling for some cerebation -- a cost -- and promising a way out of old dead ends -- a benefit.

The capital stock of an economy is a great revolving fund. Each time a unit of it recycles it combines with workers. To combine the whole great fund with surplus labor we need only turn the whole faster. This will deliver ripe goods to consumers at a faster rate: growing capital will spend less time growing before harvest and flowing capital will spend less time frozen in cold storage before thawing and flowing. Reinvestment of the recovered capital will increase incomes with which to buy the augmented flow of goods and services.

Here we collide with one of the firmest biases in our cultural impedimenta, the bias against rapid replacement. To many people that connotes waste, shoddy, flimsiness, the fast buck, speculation, suede shoes, cultural degradation, demolition of treasured antiquities and cherished memories, tinsel, planned obsolescence, fly-by-night, throwaways, litter, and tacky-tacky. That those are indeed only connotations and perversions of the principle, not the essence, does not placate some people. Long life to them connotes reliability, stability, soundness, trustworthiness, economy, character, respect, and old-fashioned goodness. These values lie deep in the cultural subconscious and will not yield easily. They are indeed part of what sustains the institutional bias that causes unemployment and inflation.

An economist can not plead against them so well as point to the high price of indulging them: inflation and unemployment, as

well as neglecting the positive values of flexibility, adaptability, early embodiment of technological advance, reduced capital requirements and easier entry, replacement of obsolete equipment, stimulus to creativity, mobility, and evolution. To be sure there are those who oppose change and attribute modern malaise to future shock. But 50 years ago we lived with cars, telephones, radios, electric lights, sewers, water works and elevators, even as today, and Al Capone too, and it makes more sense to trace the malaise back to the fear of unemployment and its derivative evils listed earlier.

It may help some to note that the "life" of flowing capital, as the term applies here, is not carcass life but service life. The idea is not to shorten carcass life, but to speed the delivery of value to consumers, and with it the recovery of capital invested. If the carcass survives that, well and good, it is a bonus.

The purpose in demolishing an old carcass of, say, a house, is to recycle the site it preempts. This offends the preservationist in many people, but two observations are in order.

Demolishing old buildings and replacing them with new is a way of preserving more old capital than is demolished, just like replacing a car's dead battery, or pulling a sick tooth. Surgical demolition is preservation, in the larger sense. Replace the sick house and preserve the neighborhood; preserve the neighborhood and preserve the city, with all its capital infrastructure, and all its valuable land.

Second, the best way to renew many sites is not to demolish but to rehabilitate. "Rehab" is labor-using, compared to new construction. So is operating the older buildings: maintenance and operation of buildings eats up an ever larger share of rent as they age. Shelter from old buildings is a product of labor more than of capital. Thus, our present tax biases that favor capital over labor tend towards premature abandonment of old buildings. The policies advanced herein are in tune with Jane Jacobs' image of the good city life. It may seem paradoxical but reducing wage costs, which favors investment in capital of shorter service life, at the

same time and by the same token favors extending the carcass life of old capital. It is quite consistent though, because one recycles the old carcass by patching it up with investments of shorter life than a wholly new structure would have, and by using more labor to operate it.

We have shown now that the value of land to labor depends on how actively the owner combines it with labor. The value of capital to labor again depends on the same thing. Combining capital with labor turns out among other things to mean recycling capital faster. We have shown the elasticity of demand for labor is high for combining with both land and capital owing to the leverage that labor costs exert over returns to land and capital when the factor mixture is rich on labor. We have shown there is a great reserve of land and capital ready to combine with more labor in response to small additional incentives. We have hinted at what such incentives might be. Next we look closer at tax bias against labor.

B. Tax Inducements to Displace Labor by Land and Capital

The tax system affords few shelters for the wage or salary earner as such, directly to him or indirectly to his employer. His income tax is withheld, beginning 15 1/2 months before the tax is otherwise due. All his income is "ordinary" and taxed at the full rate. If one has any question that the income tax is largely a payroll tax he need only try to remember when he last heard of an oil man taking salaried work as a tax shelter. Harry Kahn found that labor income rose from 66% to 81% of the base of the personal income tax, 1939 - 1963.¹

There was a time when income tax enthusiasts argue it did not "disincent"² work because it was a percentage, and your best choice before tax was the same as that after tax. This neglected the considerable undeductible costs of working, including loss of welfare, and the rocketing rise of welfare from 1960 on shows there

¹ C. Harry Kahn, Employee Compensation under the Income Tax (Princeton: Princeton University Press, 1968)

² If this word doesn't exist, it should.

APPENDIX I

Share of Labor in claim on total output as decreasing function of life of capital: identity of single-cycle and going concern models.

A. Flowing (depreciating) capital.

The text shows (Fig.1, Table 4, pp. 29-30) that the share of labor in revenues from the service flow of a building or machine (flowing capital) is a decreasing function of life. Here we show the rule and the mathematics are exactly the same in a "going concern" model where an investment in machines is normalized or staggered.

There is one machine of every age. We build or buy one new machine each year, and scrap another one. The number of extant machines is n , where n is the number of years each machine lasts. As in Eqn. (1), p. 29, each one yields a flow of \$1 per year, so the yearly flow is \$ n .

The yearly labor input is no more than the warranted investment (I) in one machine when new. Dividing this by the yearly service flow (n) we arrive at the same result as when we analyze one machine over life, that is, labor's share, is

$$\frac{I}{n} = \frac{1-e^{-in}}{ni} \quad [\text{same as (2), p. 29}] \quad (2)$$

The share going to capital as interest must be the complement of (2), of course. To check this, let us derive it directly.

The capital value remaining unrecovered in each machine at the start of every year, y , is the present value, (V_y) of future cash flows from that time until scrapping.

$$V_y = \frac{1-e^{-i(n-y)}}{i} \quad (3)$$

Total unrecovered capital (K_y) is:

$$K_y = \sum_{y=0}^n V_y = \frac{1-e^{-in}}{i} + \frac{1-e^{-i(n-1)}}{i} + \dots + \frac{1-e^{-i(n-n)}}{i} =$$

$$\frac{1}{i} \left[n-e^{-in} \sum_{y=0}^n e^{iy} \right] = \frac{1}{i} \left[n- \frac{1-e^{-in}}{i} \right] \quad (4)$$

(I)

Interest on K_y as a share of total output flow is:

$$\frac{i K_y}{n} = 1 - \frac{1-e^{-in}}{in} \quad (5)$$

Q. E. D.

In the going concern, capital recovery is the excess of cash flow (n) above interest cost (Ki). Rearranging (5)

$$n - Ki = \frac{1-e^{-in}}{i} \quad (5A)$$

But the right side of (5A) is I , the warranted investment to build a new machine. So capital recovery from all the machines together is just enough to finance one new machine each year.

Now we add land to the inputs. The capital is a building on a good site. The yearly service flow is now \$1 plus \$ a , where a is the annual value of the site. Fig. 4 shows the share of land:

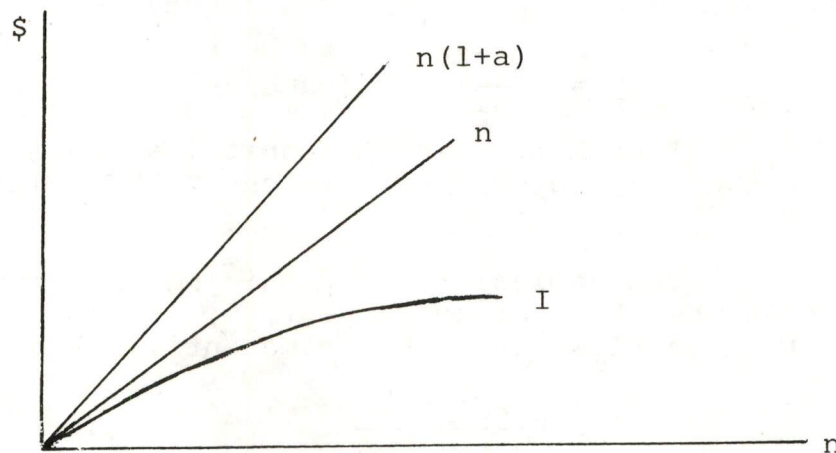


Figure 4: Division of value of service flow of n houses of evenly staggered ages among warranted investment (I), rent (a) and interest.

$\bar{K}$ remains the same as before. So does $\bar{I}$. Only service flow is greater. The shares of labor and capital are accordingly smaller.

The share of land is

$$\frac{na}{n(1+a)} = \frac{a}{1+a} \quad (6)$$

(6) is not a function of n , i.e. is unaffected by life (under the present simplifying assumption of level service flow.) Accordingly, the share of land rises relative to labor, and falls relative to capital, with increasing life of capital.

The last point seems a little surprising because in the last years of an old building the cash flow covers little more than land rent. In part the surprising result comes from my artificial simplifying assumption of level cash flow over "life". In fact, there is a geriatric terminal life of old buildings, after the service life is over, when the carcass survives and yields just enough cash flow to give a return on the site. When we include this terminal period in "life", the share of land rises with life, and moreso when site value rises over time.

But that is not the whole story. In the main the surprising result represents a real phenomenon: to build for long sustained service flow of capital calls for heavy inputs of capital from the beginning of life, inputs which must be paid from the beginning. Note we are not here treating what happens from year to year to the individual building as it ages and the unrecovered capital approaches zero. Of course capital's share then also approaches zero. We are treating of shares over the whole life of buildings, and, what amounts to the same thing, shares generated from a normalized collection of buildings of every age.

The share of labor falls with increasing life. But land tempers this effect by claiming a share of the product even when life is short, like the life of corn plants in rich Champaign County, Illinois; or when there is little capital, as on a parking lot. Appendix III develops this aspect further.

B. Growing (appreciating) capital

Assume we plant a tree on marginal land, at a cost of \$1, and harvest it n years later (when the growth of its stumpage value as a percentage of the base equals the rate of interest.) Stumpage revenue (R) is e^{ni} . Labor's share is no more than e^{-ni} , and less if planting cost is not all wages. e^{-ni} is a decreasing

function of $\underline{n}$. Labor gets a lesser share when life is longer.

This conclusion does not depend on using a single cycle as an example. Let the operation be normalized by staggering the cycles to keep a constant flow of input and output through a going concern. Each year we plant one new tree, and harvest the oldest one. The number of trees in our inventory must equal $\underline{n}$, an increasing function of $\underline{n}$. In addition, the average tree must be older and contain more capital.

The capital stock (K) is the sum of the value of all the trees:

$$K = e^i + e^{2i} + \dots + e^{ni} = \sum_{n=1}^n e^{ni} = \frac{e^{ni} - 1}{i} \quad (7)$$

The share of capital in receipts is:

$$\frac{K_i}{e^{ni}} = 1 - e^{-ni} \quad (8)$$

(8) is an increasing function of $\underline{n}$, and of course the complement of labor's share, e^{-ni} , a decreasing function of $\underline{n}$. This is exactly the same result as for a single cycle.

Now we add land. Let the tree grow on a good site, of value $\underline{S}$. Now growth must cover interest on $\underline{S}$ as well as on capital in the tree, by reaching at maturity a value on the function:

$$R_n = e^{ni} + S[e^{ni} - 1] = (1 + S)e^{ni} - S \quad (9)^1$$

The share of labor is no more than $1/R$, obviously a decreasing function of $\underline{n}$ since R grows with $\underline{n}$.

1. (9) may be derived from $(1 + S)e^{ni} = R + S$, which simply says we put in land at the beginning and get it back at the end, along with the mature tree.

The share of land is Sin/R . We will see ahead that this is an arcade function, an increasing and then decreasing function of $\underline{n}$. The increase comes first because labor's share drops almost inversely with $\underline{n}$ for low values of $\underline{n}$. The decrease comes later because K increases logarithmically with $\underline{n}$ so Ki takes nearly all.

The share of capital is the sum of interest on planting cost plus interest on ground rent, divided by $\underline{R}$.

Interest on planting cost is $e^{in} - 1$.

Interest on ground rent is $S(e^{in} - 1 - in)$.¹

The share of capital is:

$$\frac{e^{in} + S(e^{in} - 1) - 1 - Sin}{e^{in} + S(e^{in} - 1)} = 1 - \frac{1 + Sin}{R} \quad (10)$$

(10) is also the complement of land's and labor's shares, as we would expect.

To normalize the single cycle, assume a fixed piece of land divided into $\underline{n}$ cells or tracts. Each year we plant trees in one cell, and harvest another. Payroll to plant one cell is $1/\underline{n}$. Receipts each year are $R/\underline{n}$. Yearly land cost is S , and for each cell is $S/\underline{n}$.

The capital stock at all times is:

$$K_y = \sum_{y=1}^n \frac{(1+S) e^{yi} - S}{n} = (1+S) \frac{e^{ni} - 1}{ni} - S \quad (11)$$

1. Note in passing that when S is large relative to planting cost (here equal to one), most of the capital is geogenic (land-derived). Some reforestation is entirely voluntary and geogenic, representing no labor at all.

Receipts each year are:

$$\frac{R}{n} = \frac{(1 + S) e^{ni} - S}{n} \quad (12)$$

Labor's share is:

$$\frac{l/n}{R/n} = \frac{1}{R} \quad (13)$$

(13) is the same as the single cycle case.

Land's share is:

$$\frac{Si}{R/n} = \frac{Sin}{R} \quad (14)$$

(14) too is the same as the single cycle case.

Capital's share is:

$$\frac{Ki}{R/n} = \frac{(1 + S) (e^{ni} - 1) - Sin}{R} \quad (15)$$

But (15) is the same as (10), the share of capital in the single cycle case.

So we have normalized tree-growing operations and shown that the shares of land, labor and capital are the same as when we look at one cycle over its life.

Now let us get a better idea of how the shares vary as functions of life (n). Table 5 is an example worked out for assumed values, with $i = .05$, and $S = 800$. Instead of assuming the original investment is \$1, as in the algebra above, it is \$200, assumed to be all payroll (P).

Applying the principle of leverage it is evident from Table 5 that a slight rise of interest rates will screen out or shorten long cycles, as we would expect from the simpler earlier demonstration. A rise of wage rates will screen out or lengthen short cycles -- we economize on labor by using it less often. For very long cycles, interest cost dominates everything. Such long cycles are however unusual outside of forestry, and often pathological there, permitted only by sheltering from real interest

Table 5: Factor shares as functions of life of trees, normalized operation

n	Interest factors		Receipts	Wages		Land Rent		Interest on Cap. Stock		Sum of Shares (check)	Intensiveness
				Am't.	Share	Am't.	Share	Am't.	Share		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	e^{ni}	$\frac{e^{ni}-1}{i}$	$\frac{1000(2)-800}{(1)}$	$\frac{200}{(1)}$	$\frac{(5)}{(4)}$	40	$\frac{40}{(4)}$		$\frac{(9)}{(4)}$	$(6)+(8)+(10)$	$(6)+(10)$
1	1.05	1.00	250	200	.80	40	.16	10	.04	1.00	.84
7	1.41	8.14	87	29	.33		.46	20	.23	1.02	.56
14	1.97	19.6	84	14	.17		.48	30	.36	1.01	.53
21	2.79	35.7	94	9.5	.10		.43	45	.48	1.01	.58
28	3.92	58.4	111	7.1	.06		.36	65	.59	1.01	.65
35	5.52	90.3	135	5.7	.04		.30	90	.67	1.01	.71
42	7.76	135	166	4.8	.03		.24	120	.72	.99	.75
49	10.9	198	206	4.1	.02		.19	160	.78	.99	.80
56	15.4	288	261	3.4	.01		.15	215	.82	.98	.83
63	21.5	410	328	3.2	.01		.12	285	.87	1.00	.88
70	30.4	588	423	2.9	.007		.09	380	.90	1.00	.91
77	42.7	834	544	2.6	.005		.07	500	.92	1.00	.93
84	60.2	1184	707	2.4	.003	40	.06	665	.94	1.00	.94

Notes by Column Numbers

(1) Life

(2) Amount of 1 at compound interest, 5% (9) $Ki = .05 \cdot 1000 \cdot \frac{(3)}{(1)} - .05 \cdot 800 = 50 \frac{(3)}{(1)} - 40$

(3) Amount of annuity at 5%

(11) Discrepancies due to rounding

(4) $\frac{(P + S) e^{ni} - S}{n}$

(12) Intensiveness

P = 200

S = 800

(7) $Si = 800 \times .05 = 40$

costs. For most growing capital, cycles are under 15 years, and land cost is a powerful force. High land rents screen out or shorten medium cycles. An example that the model partly fits is cattle breeding, a very land-using business. High interest rates are not enough to pry land away from cattle and sheep and feed grain, the great historical depopulators of farm land. High holding costs must be brought directly to bear on the tenure of land.¹

Historically, farm labor has had to clear away trees to find jobs working the land, and then to push back sheep and range cattle. These organisms of slow maturity create virtual economic deserts for labor. Even the capital in them is mostly geogenic (land derived). Now for some decades forests and livestock have been repossessing land formerly tilled, while farm labor left for the cities, and food prices rose. Something is scrambling the market signals; we have seen that tax bias is part of that something.

Aside from the intuitive leverage principle, how do higher rents and interest rates shorten life? It is geometrically obvious that any tree is mature financially in equilibrium when its growth curve touches the R function, where it has the same slope. Differentiating (9):

$$\frac{dR}{dn} = ie^{in} (1 + S) = i(R + S) \quad (16)$$

(16) says a tree is mature in the year when its growth just covers interest on its achieved value (iR) plus rent (iS). Raising rent and interest thus results in shorter cycles.

¹ The lives of cattle are foreshortened in the U.S.A. as compared with Argentina, where rangeland and cash grain are cheaper, for example. But in Western Europe and Japan, lives are even shorter, if cattle are grown at all.

APPENDIX II

Investor's rate of return after tax on realization of income from growing capital.¹

The rate of return after tax, ($\underline{r}$), is an increasing function of life, ($\underline{n}$).

$$e^{rn} = e^{in} (1 - t) + t \equiv \theta \quad (17)$$

where $\underline{t}$ is the nominal tax rate.

To prove: $\frac{dr}{dn} > 0$

$$g \equiv \frac{d \ln \theta}{dn} \text{ is } \frac{\theta'}{\theta}, \text{ the growth rate of } \theta(n) \quad (18)$$

$$\ln \theta = \int_0^n \frac{d \ln \theta}{dn} = \int_0^n g \, dn \quad (19)$$

but from (1), $\ln \theta = rn$, so

$$r = \frac{1}{n} \int_0^n g \, dn \quad (20)$$

By inspection of (4) and the Theorem of the Mean, $\underline{r}$ must be rising if $\underline{g}$ is monotonically rising, i.e. if

$$\frac{dg}{dn} > 0.$$

$$\frac{dg}{dn} = \frac{d}{dn} \left[i - \frac{ti}{\theta} \right] = \frac{ti \theta'}{\theta^2} > 0 \quad (21)$$

$$\therefore \frac{dr}{dn} > 0$$

Q. E. D.

¹ Matthew Gaffney, Jr., John Hoven, and Steve Hanke helped refine this proof. Further discussion of this and related points are in the writer's "Tax-induced Slow Turnover of Capital", op. cit.

APPENDIX III

"Intensity" of land use and "labor intensity" of land use are two different things. Capital on land may displace more labor than it requires to produce it. Much capital is partly geogenic (earth-derived), by the operation of compound interest.

We will compare the overall Intensity Quotient (Q) and labor-intensity (Q_w). We begin with a point-input-point-output (PIPO) model, and easily modify it to cover all cases.

We invest $\$I$ at the beginning of year one, on land worth $\$S$, and realize $\$R$ after $\underline{n}$ years.

In equilibrium

$$R = Ie^{\underline{n}} + S(e^{\underline{n}} - 1) \quad (22)$$

$$\text{Labor input} \leq I \quad (23)$$

$$\text{Land input} = S \underline{n} \quad (24)$$

$$\text{Capital input} = I(e^{\underline{n}} - 1) + S(e^{\underline{n}} - 1) - S \underline{n} \quad (25)$$

$$\text{Labor intensity, } Q_w \leq \frac{I}{R} \quad (26)$$

$$\begin{aligned} \text{But total intensity, } Q &= \frac{R - S \underline{n}}{R} \\ &= 1 - \frac{R - I e^{\underline{n}}}{e^{\underline{n}} - 1} \frac{\underline{n}}{R} = 1 - \frac{R - I e^{\underline{n}}}{R} \left[\frac{\underline{n}}{e^{\underline{n}} - 1} \right] \end{aligned} \quad (27)$$

The coefficient on the right [in brackets for easy reference], is the ratio of simple interest to compound interest. Call it θ .

For low values of $\underline{n}$, $\theta \rightarrow 1$, and $\therefore Q \rightarrow \frac{I e^{\underline{n}}}{R}$.

But $e^{\underline{n}} \rightarrow 1$ also, so $Q \rightarrow \frac{I}{R}$. That is, $Q \rightarrow Q_w$ and intensity and labor-intensity are the same, virtually, for short lives.

But for higher values of n , i.e. longer lives, $\theta \rightarrow 0$ and $\therefore Q \rightarrow 1$, even if labor-intensity, I/R , is low. This reflects the buildup of geogenic and autogenetic capital that occurs whenever recovery of principal is deferred.

To adapt this definition of intensity to flowing capital, we need only date all inputs, discount them to year 0, and add these present values to I . Similarly compound all revenues to year n and add them to R . Most investors above the lowest level of sophistication go through some such analysis whatever they may call it. Cash-flow analysis, annualizing, present value analysis, land appraisal, etc., all involve this kind of intertemporal comensuration.

Normally w , the share if I paid out for onsite workers, is much less than one, so true labor-intensity

$$wI/R < \frac{I}{R}. \quad (28)$$

There is on a priori grounds a strong negative relationship between w and n , because building durably calls for heavy materials, of high resource content.

(27) is based on deriving site value, S , from the current use, which is to assume the site is in its highest use. Often it is not, in which case (27) overstates intensity. If we have reason to put an opportunity cost value on S higher than $\frac{R - Ie^{in}}{e^{in}-1}$, then we should not substitute this in (27), but stop at

$$Q = 1 - \frac{Sin}{R} \quad (29)$$

(27A) gives a lower value which can easily even be negative when R fails to cover simple interest on S , or rent.

The only good reason for managing land this way would be to save it for a higher future use. Yet the foregone revenues of these n years must then be regarded as plowed back into the site as "intangible geogenic capital". The present property tax is biased by virtue of failing to tax such capital, thus favoring it over buildings.

Landholders like some government agencies and corporations who are sheltered from social opportunity costs are doubly disinclined to turn over their capital fast enough. The land cost itself is a pressure to shorten cycles; but so is interest on the intangible geogenic capital which they do not feel. The last point has been entirely neglected and is very important.

APPENDIX IV

Inflation, phantom profits, and tax bias against shorter investments.

We compare two PIPO investments, one maturing in one year, the other in ten. $i = .07$, and there is annual inflation at 7%. $t = 50\%$.

	I	R	$R-I$	$\frac{R-Ie^{.07n}}{e^{.07n}-1}$	$(R-I)t$
$n = 1$	100	114	14	7	7
$n = 10$	100	400	300	200	150

When $n = 1$, half the profit of \$14 is phantom, and the 50% tax rate consumes the other half.

When $n = 10$, only one-third of the \$300 profit is phantom, so the tax leaves \$50 of real profit after tax.

More generally,

$$\text{Taxable income} = R(n) - I_0 \quad (30)$$

$$\text{Adjusted basis} = Ie^{jn} \quad (31)$$

where j is the rate of annual inflation.

In equilibrium,

$$R(n) = Ie^{(i+j)n} \quad (32)$$

Income adjusted for inflation is:

$$R(n) - Ie^{jn} = Ie^{(i+j)n} - Ie^{jn} = Ie^{jn}(e^{in} - 1) \quad (33)$$

Taxable income as a multiple of adjusted income is:

$$\beta = \frac{I[e^{(i+j)n} - 1]}{Ie^{jn}(e^{in} - 1)} = \frac{e^{(i+j)n} - 1}{e^{(i+j)n} - e^{jn}} \quad (34)$$

β is a decreasing function of n , ranging from a high of $\beta = \frac{i+j}{i}$ when $n = 1$, to a low of one when $n = \infty$.

The case is often made that it is the opposite, that inflation hits the longer investments harder. The argument is that the short investment lets principal be recovered at a lower price level, while it is worth more. It is an unbalanced argument, overlooking the larger fact that the long investment lets revenue be taxed later, in softer dollars. That is when $n = 1$ the \$7 phantom profit is taxed in year one, and paid in dollars worth twice as

much as those of year ten. When the phantom profit merely accrues in year one it is not taxed until year ten, when the dollar is worth half as much.

As we have seen, most long investments are written off faster than they actually depreciate. The intertemporal bias here is magnified because costs are deducted from hard dollars and taxes are later levied on soft ones.

drop, retire, decommission, demolish,
slaughter, harvest,

As a rough rule, the flow (F) you can handle equals your capital (K) times turnover (T). The average payout period (P) is the reciprocal of turnover:

$$\frac{K}{F} = P \quad (3)$$

You must hold down that payout period by scheduling your sales so your cash flow balances your outgo before you run out of capital. If $K = 6F$ (still assuming daily payments) you must sell the first cohort of goods out in six days, or fail to meet payroll #7.

As you get into financing slower inventories, compound interest adds to your capital required and $K > FP$. If your period is seven years,¹ then compound interest at 10% doubles the value of each item by the time it is sold. At this time your capital will be ten times your flow, rather than seven times, because the cumulative value of an annuity of one ^{for 7 years, at 10%} equals 10. 10% interest on ten equals one. The memorable thing about this period is that your annual interest bill now equals all your other costs, and takes half your cash flow.²

*This is hard to read - needs more explanation.
Need to explain staffing here.*

Meantime, your capital has virtually stopped sustaining any payroll. Instead of cycling daily it cycles once every seven years.

The demand for labor does not depend primarily on the amount of capital, then, but how fast it turns over -- how active it is. Each time capital cycles it combines with and activates labor. Every investment in payroll creates labor income equal to capital on the first round. But for sustained impact it must keep recycling. Paybacks deferred are payrolls denied.

If you recover capital slowly, you constantly need more money, until you reach an equilibrium with cash flow balancing outflow -- which by this time includes very large interest payments on all the unrecovered capital.

¹ 7.273 years to be more exact.

² Instead of $K = FP$, the proper formula is now:

$$K = F \frac{e^{Pi} - 1}{i} > FP$$

... more labor is available than can be employed ... a shorter period of production ... is adopted, and the capital which was before insufficient is now able to give employment to all workers ..."¹ He saw social capital as a wage-fund, but a fund which can sustain any rate of flow because it revolves. This Great Revolving Fund does not limit wages. By recycling faster it employs more workers up to any needed number, and it speeds up when stimulated by lower wage rates and higher interest. In the idiom of modern macroeconomics, this increases replacement demand. Aggregate demand can fall short of full employment if capital turns slowly, but quicker replacement corrects things and fills the gap. Thus, "...the existing capital must just suffice to employ the existing number of workers ..."² The greater replacement demand is financed by greater capital recovery, and matched by a greater flow of finished goods, so it is not diluted by inflation.

Let us look at Wicksell's device³ as a way of meeting the national payroll with a small capital. He was telling us in effect the economy can do what the small businessman has to do all the time. He has to recover his capital quickly each time he sinks it, if he is to meet the next payroll without dropping workers.

Consider a baker on a busy corner open 365 days a year, with working capital of \$200. To keep it simple, assume payments are made daily, and they spend the first day setting up, making no sales, but sinking the \$200. Half goes for payroll, half for feed-stock, and we'll ignore overhead for simplicity. Thereafter they sell out each night. The \$100 turning daily finances annual payroll of \$36,500, and an equal flow of net production above cost. To this he need add only \$10 for 10% interest on \$100 of his working capital.

If it took two days instead of one to sell out, he would have to find another \$200 of working capital, or drop half his bakers.

¹ K. Wicksell, Value, Capital and Rent, S. H. Frowein transl. (London: G. Allen & Irwin Ltd., 1954) p. 127

² Ibid. p. 160

³ He credited it to Böhm-Bawerk, who however expounded it very roundaboutly, if not obscurely.

twelve years (and probably ranges much higher), making the job valence of capital here very low. As a corollary, most of the cash flow is property income, not capital recovery.

✓ As another example, we could lower the capital cost of buildings a good deal by shortening their service lives. This might seem like a bad trade since to reduce the cost by $1/3$ we would reduce the life about $2/3$. But we could then build 50% more houses each year with the same capital, increasing the annual service flow by 50%. We would increase jobs three times, since each building would be replaced in $1/3$ of the time. This example is highly oversimplified, ignoring maintenance and rehabilitation as alternatives, but gives an idea of how many jobs we destroy by sequestering a nation's capital in forms that pay out slowly.

Long advance inventories and durable flowing capital are not bad in themselves. Deferral of recovery is the bad, and durability is the good that usually accompanies it. The point here is that this good is forced on us beyond our voluntary willingness to pay for it, and part of the cost is involuntary unemployment.

The life span of particular capital items is not to be judged in isolation. Durable capital like that in a barn, a sewing machine, or restaurant furnishings may complement and have a high valence for labor "in parallel", that is labor applied in using and operating the equipment and short term investments in maintaining it. And the aggregate capital needs of the overall operation, in a consolidated accounting, may be a modest share, if the material moving through the process is finished and sold quickly.

The point about capital turnover is not that all durability is bad for labor, but that capital which appears to drive labor off the land really does so, even though labor helps produce the capital. And opening new lands, seemingly so favorable to labor, may actually damage labor by pulling capital into forms where it turns slower than before and so has a low valence for labor.

Or it may be that an operation uses little labor in

parallel with capital but a great deal downstream. Thus pulpmills use more capital per man than sawmills, yet paper requires little downstream capital per man, while lumber needs a lot. Newsprint turns over daily, while lumber in buildings ties up capital for decades. Looking upstream, too, pulpmills use smaller logs, and chips, and so require much less capital in timber than sawmills do. It is the price system that weighs these compensating factors in the same balance and lets us achieve an optimal total deployment and mixture of labor, capital and resources.

Again, some durable capital may help labor by obviating even more durable capital. Thus utility cores and elevators in high-rise buildings may yield back capital slowly, but they use much less (for the functions performed) than one alternative, that is expanding the city laterally by extending streets and utility lines; (they return it faster, too, and with taxes to boot). Also, high-rise helps labor by substituting for land, releasing a good deal for other uses. Of course there may be still better alternatives in rehabilitating older houses, and low-rise garden apartments, and so on, depending on particulars. The price system is what supplies us with these particulars.

The point is not to regard capital as a threat. Labor needs capital, and labor suffers now from the shortage of capital available to invest where its job-creating efficiency is high. The point is rather to mobilize capital and redeploy it so its valence for labor is higher. This means making it available to small businesses, especially, and others which combine a little capital with a lot of labor. And this means keeping capital out of sinks and traps. Of these, the worst are monuments, frontiers, and wars. Let us survey these three sinks of capital.

By "monuments" I mean things built with one eye on eternity, like the pyramids, and things that resemble them, like many works of governments and of other large organizations, the family seats of the very wealthy, and overmature timber.

Many monuments are built to make jobs. The intent is

WICKSELL AND THE AUSTRIANS

Carl G. Uhr

I. INTRODUCTION

Although Wicksell obtained much of his inspiration from the founders of the Austrian School, the "older Austrians,"¹ he differed from them on important points both in economic theory and economic policy. He adopted his value theory principally from Carl Menger and the basis of his capital theory (but not its specific formulation and extension into dynamic analysis) from Eugen von Böhm-Bawerk. At the same time, his methodology was distinctly Walrasian. His socioeconomic outlook and policy orientation was derived from several sources, principally and in general from J. S. Mill, but in monetary theory from the Bullionists and later from the Currency School versus Banking School controversies about monetary reform in nineteenth century Britain. Finally, his work on public finance and income distribution owes much to the writings of Emil Sax, Adolph Wagner, Maffeo Pantaleoni, and Ugo Mazzola.

Though the "older Austrians" were essentially united in matters of value

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theory, Menger, Friedrich Wieser, and Böhm-Bawerk did not see eye to eye in questions of economic policy. There was quite a gulf in outlook between Wieser and Menger. In his *Social Economics* (1914) Wieser urged a broad social reform program inclusive of income redistribution via progressive taxation and provision of a panoply of social services by government for people in low income strata. On these matters, Menger was a noninterventionist whose primary interest was in economic theory, the subjective or marginal utility theory of value and its extension toward a capital theory in his analysis of the time-structure of production—his goods of “lower” and “higher” orders and their relations in coordinated stages of production. In his later years, Menger’s interest shifted to problems of economic methodology due to his protracted controversy with the leaders of the German Historical School. As for Böhm-Bawerk, his position was essentially noninterventionist, but, as a practical matter, he could not help being involved with economic policy. During his long years of service in the Austrian government, 1889–1904, he was appointed finance minister on no less than three occasions. However, Böhm-Bawerk’s contributions to economics are almost entirely in the area of capital theory.

While he discussed Böhm-Bawerk’s work at length, Wicksell made very few comments about Menger and Wieser. His longest treatment of Menger is in the obituary article in *Ekonomisk Tidskrift*, 1921.² There he did not discuss Menger’s *Principles* (1871) as such but praised that work, saying: “No book since Ricardo’s *Principles* has had such a great influence as Menger’s *Grundsätze*, not even the work of Jevons, nor that of Walras.” The main propositions of Menger’s *Principles*, he went on to say, had long ago become common property in economics. To this he added an expression of regret that Menger had not written, as he had promised, a sequel to his *Principles*, but had rather wasted his energy on bootless debates on methodology with Gustav Schmoller.

Wicksell’s own social perspective was close to that of Wieser. But, as we shall see, his only comment on Wieser had to do with Wieser’s incomplete imputation theory. It is surprising that Wicksell never mentioned Wieser’s *Social Economics*. This can only be because he had not read it, probably because it may not have been available to him after the outbreak of World War I.

It is a historical coincidence that Wicksell was a contemporary, his years, 1851–1926, coinciding with those of Wieser. It is also true that he had little direct contact with the “older Austrians.” He had none with Wieser. He corresponded a few times with Böhm-Bawerk and eventually had a meeting with him in Vienna in 1911. As for Menger, it is very likely (though direct evidence on this is lacking) that Wicksell attended some of Menger’s lectures during his years of study of economics abroad, 1880–1885, in England,

Austria, Germany, and France, supported by grants from a Swedish foundation.

As for the “younger Austrians,” Ludwig von Mises and Friedrich von Hayek, Wicksell had only indirect contact with Mises, by way of a review he wrote of Mises’s *Theory of Money and Credit* (1912) in the *Zeitschrift für Volkswirtschaft, Sozialpolitik und Verwaltung* in 1914 (henceforth cited as ZVSV).

As Wicksell’s writings—on monetary policy, business cycles and stabilization proposals, tax reform and income distribution—reveal, he would have taken issue vigorously with the “do nothing to disturb the action of the free market” and the “let nature take its course” policies urged by Mises and Hayek for the several periods of severe economic instability the western world has experienced in the twentieth century, especially subsequent to World War I.

However, Wicksell did not take issue with the “older Austrians” on problems of economic policy, only on matters of economic theory. As for the “younger Austrians,” he would surely have criticized their position directly if he had lived longer, say through the Great Depression. But he died in 1926. At the same time, nearly all the writings of Mises and Hayek date from the late 1920s through the 1970s. So we are forced to infer from his earlier works, written between 1896 and 1925, what Wicksell’s reaction would have been to certain economic policy issues raised by Mises and Hayek in the decades subsequent to his death.

II. A CERTAIN DEVELOPMENT OF CAPITAL THEORY: WICKSELL’S THEORY RELATED TO THOSE OF BÖHM-BAWERK, Menger, AND WIESER

If we assume, as Wicksell himself often did, an economy with a money of constant purchasing power, then most of his work in economic theory can be viewed as providing a synthesis of the Walrasian and the Austrian approaches. It eventuated in a concise and lucid articulation of the marginal utility and marginal productivity theories of value, capital, production, and distribution. His exposition supplemented by mathematical formulations was an adaptation of the presentation used by Walras in the *Elements of Pure Economics* (1874).

In his first brief treatise, *Value, Capital and Rent* (1893) (hereafter cited as *VCR*) Wicksell compressed (pp. 47–96) the substance of Menger’s value theory and of what Wieser in *Natural Value* (1888) had expressed on the same subject with a distinctive emphasis on opportunity cost.³

Menger’s complementary “goods of higher order,”⁴ the values of which

were derived from those of "lower" and ultimately of "first order" (i.e., of consumer goods in the production of which the higher order goods participate) implied a theory of capital and a distribution or imputation theory. Both were elaborated by Wieser, but in his treatment of imputation Wieser proceeded implicitly on the assumption of fixed factor proportions. Wicksell found this to be awkward, and when he then introduced variable factor proportions in his treatment, he not only greatly improved this analysis, but he also arrived at a determinate marginal productivity theory of distribution. Thus, Wicksell originated and provided the first proof of the "product exhaustion theorem" a year ahead of Wicksteed.⁵

Menger's goods of higher order, inclusive of the time needed for their construction and of that for their utilization (until they are used up in continuous production and are to be replaced) were incorporated in Böhm-Bawerk's concept of "the production period." That notion was to serve as a quantification of the economy's real capital, an index of its capital intensity. The production period, in turn, was supported by an extensive treatment concerning the advantages of "roundabout methods of production" over "direct methods" (i.e., those using no real capital). These ideas led to the inference expressed by the conception of the "technical superiority of present over future goods of the same kind and quantity." This last was the major one of the "three grounds" on which Böhm-Bawerk built his explanation of interest, as a return to owners of capital goods for the services their capital goods render in production of final goods. These building blocks toward a theory of capital were coordinated in an extensive analysis illustrated by a series of tabular, arithmetic displays in Böhm-Bawerk's *magnum opus*, his *Positive Theory of Capital* (1889).

Wicksell was greatly impressed by the *Positive Theory*. He accepted and adopted much, but by no means all, of Böhm-Bawerk's theory of capital. Some of the revisions he introduced are indicated in his "Note on Böhm-Bawerk's Theory of Interest" in his *Lectures on Political Economy*, vol. I (hereafter *Lectures-I*, 1901) pp. 167-172. He took Böhm-Bawerk to task for being excessively critical (in Böhm's earlier work, *Capital and Interest*, 1880) of Thünen, Senior, and Ricardo. Both Thünen and Senior had stressed the role of time in explaining interest on capital. They had brought into clearer light the influence that interest has on the relative values of commodities produced in lengthy (i.e., capital intensive), processes compared with goods produced in short, chiefly labor intensive processes. And Ricardo had noted that employment of labor-saving machinery is always more profitable with high than with low wages. All this seemed to fit with and support, not contradict, Böhm-Bawerk's conclusion that, *cet. par.*, a rise in wages conduces to net investment (i.e., to a "lengthening" of the period of production).

In this context, Wicksell affirmed his agreement with what Böhm-Bawerk

had emphasized, that in capital analysis "the capitalistic (roundabout) process of production" should be "the primary concept, and capital itself (as the complex of intermediate products emerging in various stages of the roundabout process) should be the secondary concept." To liberate capital theory from its association with the classical wages fund doctrine, Wicksell then went on to say, it was inconsistent of Böhm-Bawerk in explaining the level of interest to represent capital as a subsistence fund. For then, "capital again becomes the primary, and the capitalistic process of production the secondary concept" (*Lectures-I*, p. 168).

Böhm-Bawerk's "three grounds" for interest may be paraphrased as follows: (1) Circumstances of wants and provision for them differ with respect to the present and the future. The future is probably viewed by most persons as being more abundantly supplied. (2) People generally underestimate their future wants and overestimate the resources that will be available to satisfy them. (3) Present goods possess a technical superiority over future goods of the same kind and quantity.

Reasons (1) and (2) were seen as mutually reinforcing. They accounted for the *agio* or premium, which is expressed by interest, of present over future goods. Reason (3) explained why interest could and would be paid. That was because present goods could be invested in roundabout production processes, which, when "wisely chosen," are more productive than short production processes.

As for (1) and (2), Wicksell said they are affected by two difficulties: both the supply of future goods and their period of consumption are indeterminate. He also found Böhm-Bawerk to be inconsistent, in arguing in defense of a positive *agio*, by saying that the aged (who have little or no reason to overestimate provision for future wants as compared with the young) can hoard present goods to provide for future needs. This, said Wicksell, could hardly explain a positive *agio*. Instead, it might explain why a negative *agio* could not for long exceed the cost of storage of present goods (*Lectures-I*, p. 109).

As for ground (3), Wicksell found it so poorly formulated that it might "lead to the absurd argument that . . . all production periods . . . might be prolonged indefinitely." Beyond a certain point the greater productivity of roundabout methods are subject to diminishing returns. But "what really limits the length of productivity processes . . . is simply the circumstance that a longer period of production, even if technically more productive, would yield entrepreneurs with (given) available supplies of labor and capital a smaller profit than the production processes already begun." So, as Bortkiewicz put it, "Böhm-Bawerk's cardinal error is that . . . he seeks to solve the problem of the existence of interest—as distinct from its actual rate—without referring to the market for capital and labor" (*Lectures-I*, pp. 170–171).

After this critique there was not much left of the "three grounds" interest explanation. Despite Böhm-Bawerk's aversion to all productivity doctrines of interest, what was left was an explanation of interest as the marginal productivity of capital goods, sometimes also expressed as the marginal productivity of waiting. It was that marginal productivity which accounted for entrepreneurial demand for capital. Then there was also a consumer demand exerted mainly by the young who tend to underestimate future wants and overestimate provision for them. In the market these two demands are added through the market mechanism that composite demand is equated to the supply of gross saving by business firms and households at an interest rate which is determined in this manner.

As for Böhm-Bawerk's "period of production" concept, it was the first among several attempts to quantify an economy's real capital as a time-structure of production, illustrated in sundry models. Structures of that kind have both enriched and befogged the literature of capital theory for more than a half century, beginning with the *Positive Theory* in 1889 and extending at least to the arrival of Hayek's *Pure Theory of Capital*, 1941.

Society's production from inputs of services of capital goods, labor, and land (in combination) can be viewed in a longitudinal perspective as a "lengthwise section" through the time dimension of the production process. Or one can also view it as a "cross section" (i.e., a crosscut through the production process at a point in time rather than over some duration). Both Böhm-Bawerk and Wicksell applied the longitudinal perspective, according to which "capital is saved up labor and saved up land. Interest is the difference between the marginal productivity of saved up labor and land and of current labor and land" (*Lectures-I*, p. 154).

By taking this approach they did *not* intend to deny that current production of capital goods requires, besides inputs or services of "uninvested" labor and land, also inputs of services of preexisting capital goods. From a "cross section" view, preexisting capital goods are another factor of production coordinate with labor and land. But from a "lengthwise perspective," such preexisting capital goods can also be regarded as consisting of labor and land services "saved up" from earlier periods.

Conceived of in this manner, capital goods made up the content respectively of the "period of production" quantification of capital which Wicksell used in *VCR* (pp. 120–130) and the related quantification, "the weighted average investment period," which he applied in his *Finanz-theoretische Untersuchungen* (1896, hereafter *F.U.*, pp. 29 ff). However, he became aware that the latter average was not independent of the interest it was designed to explain. As he put it, "where one or more factors are invested in a single capital good . . . the average period of investment will be dependent on the interest rate . . . waiting is not a simple quantity but

is . . . complex" (*Lectures-I*, p. 184). Consequently, he abandoned both the period of production and the average investment period in favor of a quantification he called "the stratification of capital through time." I refer to it more briefly as the "time structure of production" or "the time structure of capital." This structure is illustrated by a model which Wicksell developed with great care in *Lectures-I*, pages 147–66, and 172–84. It takes too much space for even a summary statement of it here, however, a few of its features must be sketched as follows.

A capital time-structure may be expressed as (1) the quantity or number of invested input units that are contained in its stock of capital goods, when these goods are arrayed in order of duration of their service lives or maturity terms, times (2) the periods (years) such inputs must remain invested. They remain invested until the goods begin to yield or "mature out" their services period by period in production (where their services are combined with services of "uninvested" or current labor-land inputs) of output of consumer goods and of new capital goods alike. By multiplying invested inputs by given wage, rent, and interest rates (the latter properly compounded, for opportunity cost reasons, for the maturation terms for which the inputs must remain invested) the value \$K, of the time-structure of capital may, in principle, be ascertained. In stationary conditions, this structure is maintained by annual replacement investment for those invested inputs which are used up in production. Replacement requires that a portion of society's total available productive resources be "saved up" in producing the replacement goods, while the remaining "uninvested" resources are engaged in production of consumer goods.

As Wicksell set it up, the capital structure was capable of expansion, as we shall indicate, in two dimensions, in "width" (capital widening) and "height" (capital deepening) by net investment, particularly by net investment at a rate greater than that of the growth of the population or the labor force. Thus, his structure was also adaptable for extension of capital theory to dynamic analysis. It readily incorporated Menger's "staggered" production stages, denoted by consumption goods as goods of "first" or "lowest" order, with the backup of raw materials, tools, machinery, industrial plants, transportation networks, etc., as goods of "second," "third," and "higher" orders.

If real capital used in production has a marginal productivity such that the net returns on capital or the interest rate is 5 percent, then factor inputs invested or "saved up" in capital goods on one-year terms must, for opportunity cost reasons, have a marginal productivity that stands in the ratio 1.05/1.00 to that of "uninvested" factor inputs. Similarly, inputs "saved up" in goods of two- and three-year terms, must have marginal productivities in the ratios of 1.1025/1.00 and 1.1576/1.00 relative to those of

"uninvested" factor inputs, and so on. Thus, in equilibrium net current yields of capital goods of longer than one-year maturation terms must stand *in a compound rate relationship to one another*.

There are three features of Wicksell's capital theory as expressed by his time-structure model of production, which lead to an insight that has lately been challenged by several Cambridge-U.K. economists. That is the insight or prediction that when, in given technological conditions, net investment increases faster than the population or the labor force, capital accumulation tends progressively to expand the capital structure in the height dimension (capital deepening), with the result that the interest rate declines much more slowly than it would otherwise do while real wages and rents rise rather moderately.

These features or propositions are: (1) as mentioned before, that the marginal productivities of capital goods with long maturation terms (with inputs invested for many unit periods) must, for opportunity cost reasons and in equilibrium, stand in a proper compound rate relationship to the productivity of goods of short maturity terms.

(2) For the period-by-period maintenance of a given capital structure, the replacement requirement per unit period of production, or annually for invested inputs used up, *is a progressively smaller fraction of the goods in the structure, the longer their maturation terms and the greater the proportion of long-maturity goods to total goods in the structure*. Let a given quantity and combination of factor inputs be invested for one-unit terms and give rise to one-term goods. Let five times that quantity and combination of factor inputs result in a five-term capital good (i.e., one which gives its services and is used up over a succession of five unit-periods in production). then let a given structure of production contain 100 one-term and ten five-term capital goods. At the close of each unit-period of production, 110 units of the foregoing factor combination must be withdrawn from total factor resources available, to be used for replacement investment. But if it becomes profitable to convert any five of the one-term goods into a five-term one and still maintain at least the same production as before, the the per period replacement requirement goes down from 110 to $(95 + 11) = 106$ units of that factor combination. Then four units previously scheduled for replacement investment production will be released to join the "pool" of uninvested factor resources, at either some retardation in the rise, or possibly at some decline, in their marginal productivity and their wage and rent rates.

(3) Usually net investment tends at first to increase the capital goods of different terms in the structure *proportionately* (capital widening). With more short-term goods than long-term ones in the structure, this reduces the productivity of short-term goods more than that of long-term ones. This *disrupts the proper compound rate relations* between the productivity

of the “various capital goods *in favor of the long-term goods*. This relative advantage that then obtains for long-term goods *induces more and more of net investment to be placed in goods of long terms*. Meanwhile the *interest rate falls to the lowered productivity rate of the short-term goods*. When that happens, *this also induces a shift of investment from goods of short term previously in the structure into goods of longer term*. This shift is accomplished by *undermaintaining some of the short-term goods for a few periods and using what would otherwise have been their replacements for producing new goods of longer terms*.”

Say that in an initial equilibrium capital goods of one-, two-, and three-year terms have net yields of 5.0 percent, 10.25 percent, and 15.76 percent respectively. Now net investment occurs over a sequence of period and at first this takes the form of “widening.” As a result of this the marginal productivity of the various goods is reduced by an absolute amount of one percent, to net yields of 4 percent for one-year, 9.25 percent for two-year, and 14.76 percent for three-year capital goods. These yields are now no longer in proper compound rate relations to one another (which would mean yields of 4 percent for one-year, 8.16 percent instead of 9.25 percent for two-year, and 12.5 percent instead of 14.76 percent for three-year goods). Here it is clear that the advantage is with investment in long-term goods. Accordingly, net investment is progressively placed in such goods. At the same time some preexisting investments in short-term goods are shifted to goods of longer term by undermaintenance and by using their erstwhile replacements for producing more new goods of longer terms. It is in this manner that height expansion or deepening of the capital structure occurs. Then interest rates rise from the lower levels to which they had fallen during width expansion. In the new equilibrium they may rise to proper compound yields of 4.5 percent, 9.2 percent, and 14.1 percent respectively for goods of one-, two-, and three-year terms, while rates of real wages and rents recede somewhat.

The foregoing indicates some of the insights which Wicksell's capital theory provided as he extended it from comparative static to dynamic analysis, first of net capital accumulation in width and height, and then of such accumulation combined with labor-saving technological change. In fact he labored on capital theory off and on over a thirty-year period, from 1893 when *VCR* was first issued until 1923, when he wrote a remarkable article, “Real Capital and Interest,” now appended to *Lectures-I*, pages 258–99. There he tried to extend his analysis to a determination of the optimal durability of capital goods. But he ran into difficulties which he did not resolve. These had to do with the circumstance that in the process of analysis an unforeseen **revaluation of capital occurs**, a phenomenon which is nowadays referred to as the “Wicksell Effect.” This is a topic on which we cannot enter here because of its complexity. However, this matter

has been analyzed at length, most recently by Mark Blaug, and earlier by Trevor Swan and also by myself.⁶

The intent of capital-structure analyses was to express the very heterogeneous factor of real capital as homogeneous in terms of time. Thus, capital was to be placed alongside labor, which, though heterogeneous in quality, can be viewed as homogeneous in time-units such as man-hours of service. This laudable attempt did not succeed except peripherally. It was feasible only for fairly simple point-input, point-output investment sequences. For instance, it was used first by Wicksell and later by others for determining the optimal time for letting freshly pressed grape juice mature over a more or less long period into quality wine, and for letting tree seedlings grow into timber. But for looped investment sequences, such as steel mills using scrap iron along with currently produced iron to make steel, or for waste paper being recycled into fresh paper, the tracing of the maturity terms of saved up inputs becomes intractable.

It is because capital time-structure models failed in their aim of reducing real capital to homogeneity in terms of time for use in analyses of production and investment sequences, that these elaborate and cumbersome models have practically disappeared from the literature of capital theory in the last two or three decades. They have been replaced by other less ambitious modes of quantification.

III. MONETARY AND TRADE CYCLE THEORY: ECONOMIC POLICIES AND REFORM—WICKSELL IN RELATION TO VON MISES AND VON HAYEK.

The “younger Austrians” are staunch and uncritical defenders of “free markets”⁷ and of the results that actions in such markets (where, for the most part, imperfect competition of various degrees of severity dominates the exchanges) bring about with respect to the distribution of income and wealth. Wicksell also supported free markets because of their efficiency in allocating resources to production of goods and services dictated by effective demand, as expressed by consumers’ choices. At the same time, he was also a social reformer, ready to modify the results of market distribution toward greater equality in ways which would not diminish private economic initiative and incentive. We shall return to this theme later, but first there are some issues in monetary and business cycle theory between Mises and Wicksell, and then implicitly between Wicksell and Hayek, that require attention.

Mises’s treatise, *The Theory of Money and Credit* (1912), was reviewed, as mentioned earlier, by Wicksell in ZVSW in 1914. Mises never replied to Wicksell’s review. In 1924 Mises revised his treatise (from which the

English translation was made, 1935). In both editions of this work (pp. 18–21, 306, 355–ff.) he acknowledged his intellectual indebtedness, as well as his disagreement on some points, to Wicksell's monetary volume, *Interest and Prices* (1898). It is regrettable that he repeated in 1924 what he had said about Wicksell's monetary theory in 1912, for in the meantime (1922) a German edition of Wicksell's *Lectures on Political Economy*, vol. II, *Money* (1935, hereafter *Lectures-II*) had appeared. That volume represents a revision of some of the treatment in *Interest and Prices*. But Mises never mentioned *Lectures-II*, which, if he had studied them, might have changed his argument.

Mises's treatise was an elaborate analysis of monetary history and theory. Beginning with "the determination of the objective exchange value of money in terms of commodities," it proceeded to problems of monetary standards, the development of paper money and deposit credit by banks (both of which to a large degree involved creation of "fiat money"). It concluded with Mises's monetary overinvestment theory of the trade cycle, which received considerable attention in the 1920s. For avoidance, or at any rate for minimization, of the amplitude and duration of such business cycles, Mises urged a return to the classical gold standard, including circulation of gold coinage, combined with a 100 percent reserve system of bank credit. The purpose of the latter was to obviate inflationary credit expansion based on "fiat money" generated by uncovered bank credit and/or by government deficits.

Mises raised two issues with Wicksell. The first concerns Wicksell's statement that the conditions of the commodity market, in which relative prices are determined, can exert no direct influence over the determination of the "absolute level of prices" (1936, p. 33). This relationship, "the dichotomization of the pricing process" as Don Patinkin called it (*Money, Interest and Prices*, 1956, pp. 110 ff.), requires more analysis than Wicksell gave it. Incidentally, Wicksell's "absolute level of prices" defines and is synonymous with Mises's concept of the "objective exchange of money."

In opposition to Wicksell, Mises tried, unsuccessfully as it turned out, to prove that the marginal utility theory applies equally to the determination of absolute and relative prices. He held that the marginal utility of money was derived from the utility of the goods for which money can be exchanged. *In saying this he forgot entirely about the liquidity advantage of holding money.* Moreover, he ran into a circular argument from which he had to beat a graceless retreat. Money has a subjective value to the individual only because it possesses an objective exchange value in the market relative to commodities, but this exchange value, in turn, is explained by the utility, to the users, of the goods money can purchase. To escape from this *circulus vitiosus* he resorted to an indefinitely long historical regression over past exchange values, back to a time when the value of

the object used as money depended only on its utility *qua* commodity (i.e., on its non-monetary uses, 1980, pp. 118–21).

The other objection which Mises raised questioned the duration and severity of Wicksell's cumulative process on the ground that the loan rate cannot for long remain different from the natural rate, because of changes that arise in production. From an initial equilibrium at full capacity production with the loan rate equal to the natural rate, Mises visualized that the banks, in competition and free from government regulations and other hindrances, issue additional fiat money, which reduces the loan rate. Investment demand rises and expansion begins. Prices and profits on capital goods rise, while workers are transferred at rising wages (and some corresponding reduction in the natural rate) from consumer to capital goods production. Supplies of consumer goods shrink; their prices rise, and when higher wages are spent, the rise in their prices overtakes that of capital goods. But as the augmented quantity of real capital in production begins to throw an increasing volume of consumer goods on the market, demand for and prices of capital goods begin their decline. This adjusts the effective loan rate toward equality with the natural rate. The price level stops rising and a new equilibrium may emerge, without the intervention of a crisis, at a level of prices higher than the initial one. But if the banks resist this adjustment by forcing successive issues of fiat money into the market, they will generate a hyperinflation, which will end in a crisis, with the crisis forcing the needed adjustment of the loan to the natural rate (1980, pp. 362–64).

We paraphrase Wicksell's comments of 1914, which have to serve here as his responses to Mises's criticisms of both 1912 and 1924. Mises claims that the loan rate cannot for long be kept lower than the natural rate, for (1) either the natural rate is lowered to the loan rate by real capital formation resulting from forced saving; or (2) as the price level rises, nonbank creditors will press for higher loan rates and if banks balk at raising them, the system will spiral toward a crisis.

As for (2) Wicksell agreed: he had generally held that the cumulative process would most likely end in a crisis. But as for (1), he insisted this is not how his process works. At the lowered loan rate entrepreneurs invest their gains in capital widening, which draws some labor from consumer goods production at higher wages. With reduced supplies, consumer goods prices rise, and as higher wages are spent, they rise further, making continued gains possible at capital widening. This can go on for several rounds before entrepreneurs find it advantageous to expand the capital structure in the vertical direction. Until they do, the natural rate will not decline toward the lower loan rate, but if it does, the upward draft of price level may come to a stop (ZVSW, 1914, pp. 147–48).

In substance Wicksell conceded the possibility of Mises's second objec-

tion. This would have been clearer to Mises if he had used *Lectures-II* in 1924 rather than *Interest and Prices* to represent Wicksell's position.

Wicksell found the first issue raised by Mises—the attempt to determine the position of the price level “on the basis of subjective use value of money versus commodities”—to be indeterminate. This was all the more so because the development of modern monetary economies makes them approach closer and closer to his concept of a “pure credit system” (1936, pp. 63 ff. and *Lectures-II* pp. 67 ff.). He concluded that, *cet. par.*, the price level will stop drifting and become constant only in monetary equilibrium, when the loan and natural rates are equal. But at what level of prices this will occur is, *a priori*, indeterminate.

It seems strange that Wicksell, with all the building blocks at hand in the dynamic aspects of his capital theory and in his monetary theory with its cumulative processes, did not write a theory of the trade cycle, as did several of his contemporaries, for instance Spiethoff and Aftalion. Instead what he left along that line were only a few fragments collated from some earlier articles of his, which he incorporated in his “Note on Trade Cycles and Crises” in *Lectures-II*, pp. 209–14.

There he maintained that business cycles are rather independent of movements in commodity prices, which latter play a large role in crises. To the contrary, industrial fluctuations depend on *real* causes, principally on the fact that “in its very nature technological or commercial advance cannot maintain the same even progress as . . . does the increase in population, but it is sometimes precipitate and sometimes delayed” (*Lectures-II*, p. 210). As for measures to cope with a cyclical downturn, he urged banks immediately to reduce interest rates considerably at the very start of a recession, to enable manufacturers to produce stock in anticipation of better times. And if the decline is protracted, governments should for a time subsidize or guarantee loans to industry at low rates to keep production going as far as possible.

To ease or limit a downturn, not to speak of staging a recovery, simply by means of a reduction in interest rates, as subsequent experience with interest-in-elastic investment demand has shown, places too great a burden on a weak instrument. But that was hardly known in the 1920s, though it became evident in the 1930s.

If the Wicksell effect, mentioned above, is viewed—as Wicksell himself viewed it—as a partial absorption, during a sequence of net capital formation, into rising real wages of real saving, which saving was fully intended (but is reduced by this partial absorption in wages) for investment in capital goods in order to expand productive capacity, then I believe one can show that the following relationship obtains between Wicksell and Hayek on business cycles.

The Wicksell effect points to problems relating to adjustments between

the capital structure and (1) changes in the distribution of income; (2) changes in the magnitude and composition of total output (relatively more or less capital goods or consumer goods when total output varies); and (3) changes in the disposition of income by households and firms (saving versus consumption when income varies) that are called forth by variations in the capital structure itself.

These are the kinds of adjustments which seem to be required to maintain equilibrium and prevent the "vertical maladjustment" Hayek stresses in his *Prices and Production* (1934, chap. 4) and his *Profits, Interest and Investment* (1939, chaps. 1, 7). As such then, the Wicksell effect at the real level is a force opposed to that of "forced saving" at the monetary level of analysis in Wicksell's cumulative process. If Wicksell had juxtaposed these two forces, he is likely to have arrived at a capital structure maladjustment thesis of industrial fluctuations rather similar to Hayek's. It can be shown that Hayek's "vertical maladjustment" or, in the later version of his thesis, his "Ricardo effect," represents the swamping of the Wicksell effect that must eventually occur by the increasing momentum of "forced saving" in the upward cumulative process.

Consequently, in terms of economic theory Wicksell's position was close to Hayek's in the analysis of business cycles. But in terms of economic policy to forfend against, and when that turns out to be unfeasible, to cope with the effects of economic fluctuations, they were far apart. Wicksell was what the "younger Austrians" refer to pejoratively as an interventionist, whereas they, especially Mises and to a lesser extent Hayek, are strict noninterventionists. They would limit government action essentially to provision for national defense and protection of private property rights, and economic policy to upholding the sanctity and value of contracts particularly between creditors and debtors, and for the rest not to impede the action of the market mechanism, even though most of our markets are oligopolistic.

This brings us to Wicksell's socioeconomic reform program, concerning which the following two statements reveal his perspective:

On the whole it is a mistake to regard as obvious—as is so often done—that all healthy persons capable of work must live by their labor *alone* . . . It is quite conceivable that the output of a society may be large enough for all, but that the marginal productivity of labor is . . . so small that labor has only slight economic value . . . under such conditions the wages paid would only correspond to a part of necessary expenditures, whilst the rest would have to be found from the rent and interest of the society (*Lectures-I*, p. 143, and *F.U.*, p. 146; emphasis in the original).

As soon as we begin seriously to regard economic phenomena *as a whole* and to ask for the conditions of the welfare of the whole, consideration for the interests of the proletariat must emerge, and from there to the proclamation of *equal* rights for all is only a short step. The very concept of political economy, therefore, or the existence

of a science with such a name, implies, strictly speaking, a thoroughly revolutionary programme (*Lectures-I*, p. 4, emphasis in the original).

Wicksell's social reform program, never outlined in any one place, has to be gleaned from several of writings. (It is summarized in Uhr, 1960, pp. 333–37.) Here we can only consider some of its features.

In 1905 Wicksell wrote a tract, *Socialistaten och Nutidssamhället* (The Socialist State and Contemporary Society), for a national student organization in Sweden, in which he set forth several points in his reform program. In reading this essay, one is surprised to find that he did not refer to Böhm-Bawerk's tract, *Karl Marx and the Close of his System* (1896). Neither did he enter on the embattled question, which had bothered the "older Austrians," of the problem of "economic calculation" under socialism, for which Barone had found a general solution in 1907 and on the denial of which Mises in 1920 made his rise to a certain kind of prominence.⁸

In his tract Wicksell thought it not unlikely that Sweden might peacefully be transformed, over a long transition period, into a socialist commonwealth or a socialist and cooperative commonwealth, with its democratic form of government intact and broadened. Once the workers got the franchise (as they did in 1919, when universal suffrage, at age twenty-five, was adopted in Sweden), their Social Democratic Party would become the majority and would begin to dominate the political scene and also to alter the character of industrial relations. But if socialism were imposed suddenly, possibly without bloodshed, the workers could not expect any great immediate gains. Measured on a per capita basis, redistribution to them from the incomes of the small upper and middle classes (perhaps some 20 percent of the households) would only add modest amounts to their wage income. Also, to keep the standard of living from declining, the new regime would sooner or later have to allocate resources to production in much the same manner as under capitalism by applying marginal productivity-marginal utility evaluations in its economic decisions. But income distribution would become more egalitarian.

All this implied "economic calculation," however under different institutional premises than turn-of-the-century capitalism offered. But then, also under 20th century capitalism, economic calculation has had to be modified to allow, among other things, for collective bargaining in the labor market and for the oligopolization of practically all the manufacturing-industry markets.

To Wicksell's mind the alternative of transforming the economy over a decades-long transition period seemed much the better alternative. This would afford time for the population to become better trained and more productive by removing financial obstacles to education and vocational training. What he visualized was essentially a decentralized market so-

cialism of the type sketched by Lange and Taylor in their tract on *Socialism* (1938).

Stationary population, democratic governments, most of the time in the hands of Social Democratic and/or liberal-bourgeois parties, were assumed as prerequisites for Wicksell's program. Basic civil liberties, inclusive of the right to private property in financial and real capital and in land or natural resources, were regarded as guaranteed. But all "natural monopolies" such as public utilities were to be government owned and operated on the marginal-cost-pricing basis by local or national government.

The public sector was to be expanded to provide social services to develop human resources, widen economic opportunities and equalize access to them. First of all provision was to be made for education at all levels, inclusive of support for students at university and professional levels of training. In addition, he visualized a comprehensive social security and health service system. Its functions were to protect the citizen as far as possible against the hazards of illness, accident, involuntary unemployment, and to provide economic security in old age. Where such protection might not be possible the system was to compensate the citizen for the hardships involved.

To finance these services income taxes would have to be raised considerably and also taxes on some types of consumption (liquor, tobacco, etc.). Moreover certain gains regarded as "unjust" or "unearned" such as unearned land value increments, monopoly gains, capital gains and inheritances beyond certain amounts were to be taxed away, (i.e., practically confiscated by taxation (*F.U.*, pp. 145 ff.).

There was also a more restrictive facet to Wicksell's program. In all matters pertaining to government budgets, to public services, and the revenue needed to finance them, he insisted that decisions must be taken by more than simple parliamentary majorities. Ideally, such decisions were to be made on the basis of unanimity, but, failing that, on the basis of "qualified majorities," by which he meant at least two-thirds majorities. He also insisted that all proposals for government expenditures must be considered *simultaneously* with proposals for taxes or other revenues needed to finance them.

His reason for these requirements was his desire to protect the rights of political minorities from being tyrannized by bare political majorities. The existence of political minorities he considered to be creative and critical as well as crucial for the preservation of democratic rule (*F.U.*, pp. 115 ff.).

To be sure, in 1905 much of this program must have seemed quite utopian. Yet, it is surprising to see that now, nearly sixty years after his death, several features of his program have been adopted in Sweden as well as among neighboring Scandinavian countries.

By way of contrast, we shall now sketch the "libertarian" social perspectives urged by the leading spirits among the "younger Austrians." For Mises this can be done by paraphrase and quotation from his socioeconomic testament, *Human Action*, (3rd ed. 1966). For Hayek we have to use three of his many works, issued respectively in 1960, 1976, and 1979 and discussed in that sequence.

In *Human Action* Mises viewed government almost exclusively as "the social apparatus for compulsion and coercion" whose "essential function is to inflict punishment" (p. 70). He also insisted that "cyclical business fluctuations" are "a product of government interference with business conditions designed to lower the interest rate below the heights at which the market would have fixed it" (p. 366). "Firmly committed to the principle of intervention, governments try to check the undesired results of their interference by . . . measures which are nowadays called full-employment policy, unemployment doles, arbitration of labor disputes, public works by means of lavish spending, inflation and credit expansion. All these remedies are worse than the evil they are designed to remove. Assistance granted the unemployed . . . makes it easier for the unemployed to remain idle; it is a means of making unemployment last rather than making it disappear" (p. 776). And finally we are told that "it is highly probable that the funds of charitable institutions in capitalist countries would suffice" (in the absence of present social security and social assistance or relief, to take care of millions of indigent among the aged, the disabled, the long-term unemployed, *et al*) "if interventionism were not to sabotage the essential institutions of the market economy" (p. 840).

As compared with the negative view of Mises, Hayek in *The Constitution of Liberty* (1960, reissued 1978) has a more positive perception of the role and functions of government in the national economy. First there are "clearly desirable services . . . which will not be provided by competitive enterprise because it would be impossible to charge the individual beneficiary for them" (p. 223). Examples are sanitation services and road maintenance. Then "there is . . . undeniably a wide field for the noncoercive activities of government . . . and a clear need for financing them by taxation" (p. 257). He mentions provision for the "indigent, unfortunate and disabled" and he also recognizes the need for government "to take the initiative in such areas as social insurance and education" (p. 258). Subsequently he concedes the necessity for legislation to make the public assistance and social security programs compulsory (pp. 285-86), and also for programs for national health insurance (p. 298) and unemployment insurance (p. 301).

At the same time he objects to have these programs centered in one vast federal bureaucracy, for "no system of monopolistic compulsory insurance has resisted . . . transformation into something quite different, an

instrument for compulsory redistribution of income" (p. 289). He also sees "an overwhelming case against free health services for all" (p. 298), and he views as "wholly irrational (the) objection to a 'means test' for [social welfare] services which are to be based on need [and this has] led to the absurd demand that all should be assisted irrespective of need" (p. 303).

While Hayek is opposed to income redistribution via a progressive tax system, he still favors a mildly graduated income tax to the extent needed "to compensate for the tendency of many indirect taxes to place a proportionately heavier burden on the smaller incomes." But, apart from this he insists on a tax at a rate that is strictly proportional to income (p. 316). Moreover, that tax rate should also be subject to an upper limit. "What is needed is a principle that would limit the maximum rate of direct taxation in some relation to the total burden of taxes" namely "to a maximum marginal rate of direct taxation at that percentage of the national income which the government takes in taxes" (p. 325). Thus, if total taxes take 25 percent of national income, then 25 percent should also be the maximum rate of taxation on individual incomes.

As for monetary policy, Hayek is undecided about whether that policy should be guided by "rules" or "discretion" given to the monetary authority (p. 334). His preference is for an automatic "commodity reserve standard," provided it were to be adopted by the leading industrial nations. Such a standard, he claims, would give us "all the advantages attributed to the gold standard without its defects" (p. 335). However, the aims of monetary policy should be both price stability and high level employment stability. But in the event of a conflict between these two aims, then the aim of price stability must take precedence (p. 337).

Let us assume with Hayek that the public assistance, social security, and health-insurance programs, and also those sundry features of the systems of taxation and government expenditures which redistribute incomes, have all been justified on pleas for "social justice" by various political constituencies. Then, in his essay, *The Mirage of Social Justice*, in vol. II in his series on *Law, Legislation, and Liberty* (1976), Hayek declares the term "social justice" [is] entirely empty and meaningless. But to demonstrate that a universally used expression, which to many people embodies a quasi-religious belief, has no content whatever and serves merely to insinuate that we ought to consent to a demand of a particular group, is much more difficult than to show that a conception is wrong" (Preface, pp. xi-xii).

Granted that "social justice" is subject to many interpretations. Granted also that it can be so extended as to restrain severely the scope for liberty under the rule of law, and can result in a social order which is virtually totalitarian. Must we, therefor, reject out of hand institutions which have been set up under that plea in a democratic manner with democracy and liberty under the rule of law intact? Hayek apparently does not go that

far. Yet, he insists: "'social justice' can be given meaning only in a directed or 'command' economy, such as an army, where individuals are ordered what to do" (p. 69).

At the same time Hayek goes on to say: "There is no reason why in a free society government should not assure to all protection against severe deprivation . . . an assured minimum income, or a floor below which nobody need to descend . . . provided to all those who, for any reason, are unable to earn in the market an adequate maintenance; this need not restrict freedom or conflict with the Rule of Law" (p. 87).

In view of this statement, evidently most of the program Hayek visualized in the *Constitution of Liberty* would survive under sundry safeguards, into which we cannot enter here, despite his strictures against "social justice." There seems, then, to have been some change in his position as between 1960 and 1976, but precisely what we cannot tell, for he adds by way of a conclusion: "the claim of this chapter that in a society of free men the term 'social justice' is devoid of meaning, *cannot be proved*. A negative assertion never can" (p. 96). We must leave this problem of logic in abeyance, though I am still of the opinion that there are many circumstances in which it is possible to prove the absence of something that was assumed to be present.

Now we turn to Hayek's current economic stabilization proposals as expressed in his tract *Unemployment and Monetary Policy* (1979). His position there is indeterminate on an important point. However, his general contention is that "the present unemployment is the direct and inevitable consequence of the . . . full employment policies pursued for the past twenty-five years." (p. 39). But, "in general . . . a temporary 'full employment' position might be approached, if by employment through public works . . . consumer demand is prevented from falling substantially. To directly stimulate investment . . . will draw workers into jobs they will expect to be permanent but that will end as soon as the source of this expenditure dries up" (p. 41). Then, "inflation, in order to achieve the goal aimed at" (to keep a given level of employment from declining) "would have to accelerate constantly . . . The argument is often advanced that inflation merely produces a redistribution of the social product while unemployment reduces it, and . . . represents the worse evil. This argument is false because inflation becomes the cause of increased unemployment" (p. 11).

"Keynes gained acceptance for the fatal idea . . . that unemployment is predominately due to an insufficiency of aggregate demand . . . This formula of employment as a direct function of total demand proved so . . . effective because it seemed to be confirmed . . . by the results of quantitative empirical data" (p. 7.). However, "the true, *though untestable*, explanation for extensive unemployment ascribes it to a discrepancy between the distribution of labor (and other factors of production) among industries . . .

and the distribution of demand among their products. This discrepancy is caused by a distortion of the system of relative prices and wages. And it can be corrected only by a change in these relations . . . by establishing those prices and wages at which supply will equal demand. *But we can never know beforehand* at what structure of relative prices and wages such an equilibrium would establish itself . . . We are therefore also *unable to demonstrate* a statistical correlation between the distortion in relative prices and the volume of employment" (p. 8, emphasis supplied).

"What can be done now? The first necessity is to stop the increase in the quantity of money—or at least to reduce it to the rate of real growth of production" (p. 15) "Prevent recession from degenerating into depression . . . by all suitable means" (which are *not* specified!) (p. 16.). "Primary aim: stable money, not unstable 'full employment' " (p. 17).

At this late stage no attempt will be made to evaluate Mises's and Hayek's economic diagnoses and prescriptions, but we take it that as "libertarians" they are both defenders and followers of democratic traditions. Now suppose that, via instructions to their representatives in Congress, the vast majority of the people refuse to dismantle the social security system in order to test Mises's hypothesis that private charity will adequately take care of the several large categories of the indigent. Suppose they also decline to scuttle public works and other reemployment programs, especially since Hayek cannot say for sure that this will correct the supply-demand distortions he points to. And suppose they will also not agree to go back to the international gold standard nor to Hayek's commodity-reserve standard as the framework within which to confine monetary policy actions, then what advice will Mises and Hayek give us?

Are there not from the standpoint of Hayek and his followers some measures of a second-best nature they think might serve? Apparently not, for the prescriptions given are all of an all-or-none nature. They postulate an economic order of well-nigh Simon-pure competition, with great factor mobility in response to moderate price changes, with easy entry and quick exit of firms regardless of size and scale into all industries. They take almost no cognizance of the fact that the institutional framework of our economy has changed considerably since the turn of the century.

Organizations for all groups of firms, small and large, with common interests, and organizations of professional persons, farmers, blue-and-white collar workers, civil servants, *et al*, have replaced the earlier "atomistic" and unattached firms, and the millions of unorganized employees of all kinds. The significant and imperfect competition in the "free market" is between group organizations or collective pressure groups of various kinds, and their competition is not confined only to the market but extends also to the political arena.

In this *Constitution of Liberty*, Hayek seems to have become aware of this, for he admitted that: "The most conspicuous gap in the following

survey is probably the omission of any systematic discussion of enterprise monopoly. The subject was excluded after careful consideration mainly because it seemed not to possess the importance commonly attached to it . . . But what can be done effectively in this field must take the form of . . . gradual improvement of our law of corporations, patents, and taxation . . . Current policy fails to recognize that it is not monopoly as such, or bigness, but only obstacles to entry into an industry or trade and certain other monopolistic practices that are harmful" (pp. 264–65).

Wicksell helped to bridge the apparent dichotomy, current in the literature of economics until the 1930s, between price determination under free competition and under monopoly by his discussions of Cournot's problems of monopoly, duopoly, and polypoly and of Edgeworth's analysis of isolated exchange, and by stressing the pervasive nature of less strict forms of imperfect competition (*Lectures-I*, pp. 83–100). As he put it: "The most important objection [to the marginal utility theory of value] is, no doubt, the fact that our assumption of *free competition* is, and can be only *incompletely realized* in actual life" (*Lectures-I*, pp. 71–72, emphasis in the original).

Wicksell went on to emphasize that free competition can only exist in conditions where economies of scale are insignificant. In a review he wrote of Pareto's *Cours d'Economie Politique* (1896) he made this more explicit by stating that:

Freely competitive production will not bring about this result [maximization of the social product] in cases where production occurs under increasing returns. In such circumstances attainment of optimum output requires intervention into free competition by subsidy or otherwise, so as to motivate firms to expand until they are producing at least cost. Since the resulting industrial expansion may give rise to monopolies, industries or enterprises subject to increasing returns may be especially well suited for socialization, or at any rate for operation under comprehensive public regulation (ZVSV, 1897, p. 161).

Wicksell found monopolistic competition—he called it partial monopolies—to be prevalent in the retail field, where it was based on joint costs, location advantages, and consumer ignorance (i.e., consumers needing the services of retailers as expert buyers and informants about qualities of commodities). Moreover, the relatively small capital requirements for setting up in retail trade, and the relative easy entry of new firms in it resulted in overcrowding with "too many small retail firms for the good of consumers and store owners alike—hence higher retail prices than necessary under more rational location conditions" (*Lectures-I*, pp. 86–88).

He went on to say "The correct remedy [for too many retailers and unnecessarily high retail prices] is *clearly the formation of some organization among the buyers*. [By this he most likely meant a consumer cooperative

association.] But so long as such an association does not exist—and between persons in different positions in life and without more intimate bonds, it is extremely difficult to establish—the anomaly must remain that competition sometimes raises prices instead of lowering them, as one would expect” (*Lectures-I*, p. 88, emphasis supplied).

In another tract, *Allianser mellan Arbetare och Arbetsgifvare* (Alliances between Workers and Employers, 1902, hereafter *Alliances*) he considered the effects of industry-wide producer cartels based on collective bargaining agreements between the industry’s employer association and the union to which the workers belonged. Such cartels had developed in the closing decades of the nineteenth century in England, Germany, Austria, and Switzerland. At the time of his writing this cartel or “alliance” movement was also just reaching Sweden, with a cartel developing among the country’s processors of beet-sugar.

A sales cartel could readily be created by the great majority, two thirds or more, of the firms in an industry to form an association to maintain specified, uniform minimum prices for their products, and also agree for the individual firms to observe certain supply restraints or market quotas. Such an organization need not involve any direct agreements with the workers. But to strengthen the usually vulnerable sales cartels, agreement with an organization, a union, of the employees of the firms in the cartel would be necessary. Only on that basis would nonmember firms, anxious to cut into the cartel’s market, be prevented from doing so by being deprived of the labor necessary for production. Accordingly, the associated cartel employers would agree with a union of their workers to hire only union members at wages and working conditions (usually better than existed prior to the formation of the cartel) negotiated in a collective bargaining contract. The union for its part would agree not to strike against any member of the cartel during the term of the contract, and also not to allow any of its members to go to work for any firm that was not a member of the cartel.

Both sides, the employers and the union, would elect an equal number of representatives to a contract enforcement committee. All disputes concerning interpretations of the labor contract and all grievances would be referred to this committee. Majority decisions by that committee would be binding on both parties, and if it could not get a majority decision on some issue, that matter would then be referred to an impartial arbitrator, whose decision would be equally binding, (*Alliances*, pp. 16–18).

As the following indicates, while Wicksell had mixed feelings about the prospects of such cartels, he did not view them, as Adam Smith would have, as necessarily ending in a conspiracy against the public. Instead he took the position that:

It would be wrong to consider them [employer-worker cartels] simply as attempts by the producers to enrich themselves to an extraordinary extent at the cost of the con-

suming public. It is most likely that such an aim has most often been the driving force behind the formation of such cartels. But it does not follow from this that that is the only significance of the cartel movement. For one thing, if all industries become cartelized, the extra gains aimed at by these combinations would vanish. We must recognize, however, that these combinations as such do embody a force which in a genuine economic sense gives rise to reduced costs and increased productivity, by which the producers surely gain, however, without necessarily requiring sacrifices by others. Indeed the gains may be such as to be shared also by other classes in society (*Alliances*, pp. 9–10).

As he put it:

The very fact that a consensus about a peaceful division of the market among the firms in the cartel takes the place of the usual wild hunt for customers, has the effect of relieving production of several dead-weight costs, which must be regarded as the costs of economic rivalry or warfare under free competition. Among these costs, which add neither to consumer satisfaction nor to the quality of the output, are the expenses for intensive advertising campaigns, the hiring of extensive sales staffs, the use of price discrimination and related marketing strategies. These are costs which every unattached firm views as necessary evils to be indulged in order that the firm shall not be forgotten and be pushed out of the market by more aggressive competitors (*Alliances*, p. 10).

In view of the considerable economies or savings in marketing costs that cartels could achieve, Wicksell thought that, *cet. par.*, it would not be in their interest successively to raise their minimum prices, but rather first to maintain them and later gradually lower them in order to benefit from expansion of production and sales due to increasing demand. Still he was well aware that employer-worker cartels may,

from a consumer point of view become very similar to the old closed guilds, the function of which was to maintain [unnecessarily high] prices of commodities in order to benefit the producers, masters as well as journeymen, without thought for the consumers' interest . . . [But] . . . experience shows, as I have stressed, that the very combination [of employers and workers in a cartel] can occasion gains or genuine economies which do *not* require sacrifices by others (*Alliances*, p. 25).

The leading principle is this, that organization is always to be preferred to anarchy [in the labor market and product market both] and the most complete and therefore appropriate organization is one which includes both workers and employers in the same industry or trade (*Alliances*, p. 22).

But there are limits to what cartels can achieve, for:

no organization, no matter how complete, can change the general conditions of production . . . which affect in a similar manner, workers, employers, producers, and consumers, in one word, the people as a whole (*Alliances*, p. 26).

Finally, when it comes to conflicts between cartels, for instance between raw materials cartels and cartels of manufacturers of finished products, the solution must be sought and achieved in the same manner as in the case of general strikes, in the political arena (*Alliances*, p. 30).

These, then, were Wicksell's observations about and insights into imperfect competition. They do not add up to a systematic analysis of the many different facets of this phenomenon. But they provided suggestions or starting points, rather than as with Hayek to leave this subject in limbo, for later research, which was to receive a powerful push forward by the well known works of Joan Robinson and Edward Chamberlin in the early 1930s.

NOTES

1. I have borrowed the designations "older" and "younger Austrians" from Hutchison (1981), 203–232. There the founders of the Austrian School, Carl Menger, Friedrich von Wieser, and Eugen von Böhm-Bawerk, are the "older Austrians." The "younger" ones are their primary followers, Ludwig von Mises and Friedrich von Hayek, as well as a third generation followers of Mises and Hayek, notably Ludwig Lachmann, Israel Kirzner, Murray Rothbard, among others. The works and activities of these third generation "Austrians" will, however, not be discussed in this article.

2. This article has been translated as "Carl Menger (1921)" in Lindahl (1958), 186–192.

3. Menger's value theory covers 1–257 of his *Principles of Economics* (1871), and Wieser's elaborations on this theory span 1–113 of his *Natural Value* (1888).

4. The concept of complementarity is used more broadly in Austrian than in other capital theories. Usually we say certain factors, e.g., masonry and carpentry labor, are complementary in building a house, and we confine this concept to a given act of production. The Austrians apply this concept in a multi-stage or "pipe-line" fashion. Let some investors form a construction company to build not just one but several hundred houses to develop a new neighborhood. For each house masonry and carpentry labor will be complementary. But in addition, and more importantly, the investors have to consider whether, at full capacity production elsewhere in the economy, they can get (i) the concrete needed for pouring foundations, then (ii) the pipes for plumbing, then (iii) the lumber for framing, (iv) flooring, (v) and walls, and then (vi) the electrical equipment, etc. They have to be concerned over whether they can get these materials in the proper quantities and with the *proper timing* or delivery sequence. In this sense stages (i through vi) of construction of the housing project are all complementary to one another. Shortages in any of the "higher" stages (i.e., earlier stages) will call for costly adjustments in the "lower" or later stages of the production sequence, and vice versa. Thus Menger's higher-order goods are complementary to those of lower order, because the high-order goods stand in some given production-structure or pipe-line sequence relation to first order (i.e., consumer) goods in the production of which the higher-order goods participate.

5. On the "product exhaustion theorem," see Stigler (1941), Chapters III on Wicksteed and X on Wicksell. For a shorter treatment, see also Uhr (1960), pp. 62–76.

6. On the Wicksell Effect, see Blaug (1978), 586–592; Swan (1956), 334–361; and Uhr (1960), 120–147, and (December 1951), 850–852.

7. The following statement by Hayek may explain why the "younger Austrians" neglect any extended discussion or treatment of imperfect competition:

The most conspicuous gap in the following survey is probably the omission of any systematic discussion of enterprise monopoly. The subject was *excluded* after careful consideration, mainly *because it seemed not to possess the importance attached to it* (1960, p. 264, emphasis supplied).

8. The primary source concerning the controversy about the possibility of "economic calculation" in a socialist economy is Hayek (1935). It features the essay by E. Barone, "The Ministry of Production in a Collectivist State," pp. 245–290, which is a translation of his article in *Giornale degli Economisti* (1907), where Barone mathematically proved the positive side of this controversy. Ludwig von Mises, among others, took the negative side, arguing the impossibility of any economic calculation under socialism, in the article "Economic Calculation in the Socialist Commonwealth," pp. 87–130, which is a translation of his essay of 1920.

Since this controversy was not settled by the essays in *Collectivist Economic Planning*, it arose again in Lippincott, B. E. (ed.), (1938). This volume seemed to give a definitive and positive answer about economic calculation under socialism. In addition this volume has by now become the *locus classicus* of the theory of "market socialism."

But old controversies rarely die and even fail to fade away, for it has been revived in a different context by Buchanan and Thirlby (1981), 4 ff. Finally, so far as we are concerned here, Mises' input of 1920 on the negative side of this matter, a contribution long considered refuted for good by the Lange and Taylor analysis of 1938, has been revived and been reinterpreted by Murray N. Rothbard in his essay "Ludwig von Mises and Economic Calculation Under Socialism," 67–77, in Moss (ed.), (1976).

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