

Materials Flow and Life

Materials flow types ~~is~~ equate turnover with  $\Delta$  materials flow, therefore oppose it.

But <sup>when</sup> you ~~shift~~ shift capl. to shorter forms, ~~by~~ you lengthen~~ing~~ the short lives. This can reduce net mtl. flow.

It also spreads given K over more land, & in a form comply to labor. Thus  $\Delta$ s demand for work.

✓ Putting this all together is major effort. FMT is basis for good start.

As in FMT, work out basic model simul. use many material e.g.

Conclusions must be carefully stated, avoid tautology, etc.

1. Adding one year to life adds more to value of shorter life.
2. Adding 10% to life also adds more ~~to~~ % of to value of shorter life.
3. On the other hand, a given outlay will add more years of life to longer life. (in eq.)
4. A higher  $i$  ~~with~~ is not a means to shorten all lives. It shortens longest lives, whose PV is more sensitive to  $i$ . This releases capt. to  $\Delta$  lives of shorter ones.

Again, state carefully, formally.

a) For given capt. stock,  $i$  ~~is~~ serves to allocate only. Analogy to land rent. Vulgar error is to see rent driving people away from better land. <sup>†</sup> Analogous vulgar error is to see  $i$  reducing invt., when ~~inv. is const.~~  $K$  is const. Actually, rent &  $i$  both force more invt. use, one of land, one of  $K$ .

b) For variable  $K$  stock,  $i$  serves to attract more by immigration; as well as better use of <sup>any</sup> given unit.

c) For traps, w. too little (soft) ripe  $K$ ,  $i$  is signal of shortage, but not cause of it. There has been much blaming of shortage on  $i$ , as though it caused the problem. Actually, it alleviates problem.

<sup>†</sup> Or seeing hi price on water reducing intensity of land use.

4  
(This is the  
major 'ec. of longevity')

One reason that K is productive is a saving on carcass intels., when things last longer. I cannot promise everything. However it is a matter of balance.

a) To ~~cause~~ save intels. the direct approach, as always, is better: raise price of intels. If you force down i, this lets K go into K-int. prodn (extraction) of intels., e.g.

b) Hi price of intels. at  $C_0$  causes longer lifes, to ec. on intels. But also subs. labor for intels. jobs are maintained then less by turnover than by  $\Delta$  labor content of  $C_0$ . This is substituting labor for land intels. <sup>†</sup>

(Hi price of land-space has reverse effect, but it is salvagable at end.)

c) Can probly show that longevity correlates w. hi <sup>ratio</sup> of intels. to work in  $C_0$ . Heavy, costly intels. required. Best lumber, e.g. - white labor takes cuts + fabricates short-lived things, odd pieces.

Art works are an exception - probly not a rule. Performing arts, e.g., are reverse. Arch. + city planing. "art works" are intel.-int.

<sup>†</sup> Useful to distinguish Land as space or site, v. land as intel. site = Land<sub>1</sub>; Materials = Land<sub>2</sub>.

There are eqs. of longevity, analogous to eqs. of scale. I have written on these before. Spreading  $i$  head over time. If we ignore  $i$ , or let  $i=0$ , there are a max. — + v.v.

Thus, hi  $i$  tells us to sacrifice intls. in order to save  $K$ . Only the one-note, fundamentalist materials-flow minimizers wd. object.

But now if we partition the mkt., pump cheap  $i$  into hq. This raises  $i$  elsewhere. Try to show there is a net waste of intls.

What  $i$  does is tell us it is more valuable to add one year each to lives of 6 items of fast  $K$  than 6 years to one item of slow  $K$ .

In staggered terms, cf. 2 groups, A + B.

A.  $n = 100$  yrs. Replace 1% of carcasses ea. yr.  
Now raise all lives to 101 years. Replace  $\frac{1}{101} \approx .99\%$  each yr.

B.  $n = 1$  yr. Replace 100% of carcasses ea. yr.  
Now raise all lives to 2 years. Replace  $\frac{1}{2} = 50\%$  each yr.

(You also save land, (or fructify less). Spread  $K$  over half as much land by doubling  $n$ . But recall (from FMT) that ~~as  $i$  increases~~ higher  $i$  means lower rent.)

In both A + B, there are 100 carcasses.

If  $i = 0$ , either alt. is equally good, as far as ~~raising~~ <sup>raising PV.</sup>  
~~raising PV.~~ ~~the effect of  $i$  is to direct~~

But Effect of  $i > 0$  is to lead you to B.

But B cuts replant. in half, while A reduces it by 10% only. Thus B saves more on int'l.  
 also saves on land.

Tax & int'l. bias favor A - thus forcing us away from B.

On next p., codify some of basic math, & tables.

# I. Sensitivity of PV to $u$

## A. Absolute sensitivity

$$PV = \frac{1 - e^{-iu}}{i} \quad (1)$$

$$\frac{d(e^{-iu})}{du} = -i e^{-iu} \quad (2)$$

$$\frac{d(PV)}{du} = -\frac{1}{i} (-i e^{-iu}) = e^{-iu} \quad (3)$$

## B. % sensitivity. ~~See Table I, B.~~

$$\frac{d(\ln PV)}{du} = \frac{e^{-iu}}{PV} = \frac{i}{e^{iu} - 1} \quad (4)$$

(4) is the sinking fund factor, a decreasing fn. of  $u$ . It decreases very rapidly when  $u$  is small.

C. Elasticity.  
 then to  $\Delta n$  alone.

This relates %  $\Delta PV$  to %  $\Delta n$  rather  
 i.e., divide denom. by  $\underline{n}$ .

$$\frac{\frac{d(\ln PV)}{dn}}{\frac{d(\ln n)}{n}} = n \frac{i}{e^{i^*} - 1} \quad (5)$$

(5) is also a decr'g fn. of  $\underline{n}$ , but much slower  
 than (4).

Table I, C: Values of (5) at  $i^* = .07$ .

|                 | $i^* = .07$ | $i^* = .01$ | $i^* = .12$ | $i^* = .04$ | $i^* = .10$        |
|-----------------|-------------|-------------|-------------|-------------|--------------------|
| $\underline{n}$ | (5)         | (5)         | (5)         | (5)         | <del>(5)</del> (5) |
| .25             | .99         | .999        | .98         | .995        | .988               |
| .50             | .98         | .99         | .97         | .990        | .975               |
| .75             | .97         | .99         | .96         | .985        | .963               |
| 1.00            | .96         | .99         | .94         | .980        | .951               |
| 2               | .93         | .99         | .88         | .96         | .90                |
| 3               | .89         | .98         | .83         | .94         | .86                |
| 4               | .86         | .98         | .78         | .92         | .81                |
| 5               | .84         | .98         | .73         | .90         | .77                |
| 10              | .69         | .95         | .52         | .81         | .58                |
| 15              | .56         | .92         | .36         | .73         | .43                |
| 20              | .46         | .90         | .24         | .65         | .31                |
| 30              | .29         | .86         | .10         | .52         | .16                |
| 50              | .11         | .77         | .01         | .31         | .034               |
| 100             | .006        | .58         | .00007      | .07         | .00046             |