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# Capital, Time, and the Interest Rate

By FRANK H. KNIGHT

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I. IN view of the history of human thought and the character of its contemporaneous workings, it is more than possible to doubt whether there is any general connection between men's reasoning and the conclusions which purport to rest upon it. Indeed, this is not much less true in the history of the natural sciences prior to the age of experiment, than it is in other branches of so-called thinking (with the exception of religion). There is a similar difficulty in tracing a definite relation between the professed conclusions of thinking and actual behaviour, particularly where social relations are involved. However, it seems unavoidable for one who makes his living by alleged intellectual activity to assume that there is some connection between reasoning and conclusions, and to pretend that there is some dependence of better action upon better beliefs.

*If* there is any connection between reasoning and conclusions, and *if* "correct" economic theory has any superiority of any kind over that which is incorrect, there can be no greater "service" to economic thought than that of striking any blow tending to free it from the incubus of the generally accepted theory of capital in most of its aspects. Reference is made to the "wage fund" theory of the early classical writers as modified by Jevons, Böhm-Bawerk, and Wicksell, and disseminated chiefly by Böhm-Bawerk. In these notes, the formality of even summarising the history of this doctrine will be completely subordinated to the task of making the simplest possible statement of the essentials of a sound theory. The contrast between these essentials and the Böhm-Bawerk position can best be covered by incidental comments in the course of constructive argument. It need only be added here that the doctrines to be eliminated include all notions of any definite relation between quantity of capital and the "length of the production process," or "time" in any form except the basic

one of a dimension in summing any process, and include also the notion that the production process, under the ordinary conditions of capitalistic industry, has any determinate time length.

2. Three empirical facts form the basis of a sound theory of capital. The first is the simple "technological" fact that it is possible to increase the volume (time rate) of production after any interval by the use during that interval of a part of existing productive resources—in large part the *same* resources previously and subsequently used, for producing "current consumption income"—to produce, *instead* of current consumption income, instruments or agencies of various sorts, tangible and intangible, which when produced become "productive" of *additional* current income. This activity or process we call *investment*. A second basic fact is that the process of investment is actually, normally, carried on in large volume, on a competitive basis, in economic societies of the type to which ordinary price theory relates. That it continues to be carried on means of course that the possibility is not exhausted by taking advantage of it; in fact, the quality of investment opportunity is not seriously affected—especially not adversely—by the investment actually carried on in an ordinary accounting period or interval, say, of the order of a year, for which calculations are made. The third essential fact is an "institutional" one. There exists a general market in which productive resources or income sources, and also pecuniary incomes as such, are freely bought and sold.

Under these conditions the phenomenon of capital accounting inevitably arises, giving expression and precise form to the economic rationale of all activities which involve saleable productive resources. (It is to be noted that in the typical competitive economic society not all productive resources are saleable; in fact, a minor fraction are so, these being called "property," in contrast with "labour," which is "free.") The operation of capital accounting converts every saleable productive resource into a pure quantity of "capital." The theory of capital accounting under the conditions named is virtually the sum and substance of the theory of "interest" as a *rate of return on capital*.

3. There is no necessary error involved in developing the theory of capital and interest in the general form employed by Jevons, and his followers. This form centres in the use of an isosceles triangle to diagram an especially simple case—the case in which a productive instrument or income source is

created by "expenditure" at a uniform rate for a given period, and then used up at a uniform rate in an exactly equal period. The precise meaning of an income source, of the rate and period of building up and of tearing down, the nature of the starting point, the expenditure, the return, and the end-point, are questions which can be fully discussed only by developing the theory of the process as a whole. The point here is simply that the history of every new capital item involves an ascending phase—a construction period of some shape and length—followed by a phase of utilisation. We must notice at once, however, that the utilisation of an item may or may not represent a "descending" phase. That is, the "use" of the productive agent (income source) may or may not involve "using up," including loss of sale value from any cause. If it does not, the second phase of the diagram is a horizontal straight line parallel to the base (which is a time axis) and extending from the maximum point of the ascending phase onward to infinity. Where using up, wearing out, depletion, or decline in rentability from any cause is involved, it may represent a virtually infinite variety of changes in the income source itself or outside of it, and the entire curve of capital-quantity (value) for a given identical agency may have an infinite variety of shapes, even rising and falling, and any horizontal length, before falling to "zero" (see below). Moreover, all using up is a technical detail; all capital is normally conceptually, perpetual, as will be shown later.

It is to be emphasised that there must be a utilisation part of the diagram, either finite or infinite; its base cannot be zero. A productive instrument means any "thing" which has saleable value, and any such item must yield some return over some period of time. It is unreal to think of any value experience as instantaneous or lacking a time dimension. Furthermore, the utilisation of a thing created by economic production must be the result of planned activity, and it is clearly impossible to value by anticipation an instantaneous experience not thought of as leaving a more or less enduring change of state, either in the subject or in his environment. This is true even if we assume that it is possible to imagine an instantaneous experience as such, which it rather clearly is not. The only primary value magnitude possible for economic thought is *consumptive income*, a pure service, a pure intangible, a flow, at some intensity, for some interval. Any concrete thing which has value (capital or wealth) is valued merely as a source of such a

future consumption income. This proposition, if not immediately self-evident, must become so in the further course of the argument. The relation between quantity of wealth and the different variables or dimensions involved in such an income-segment is one view of the problem of interest.

4. The essentials of the theory of capital and interest may be stated in four or five main propositions. First: The amount of capital "in" any item, i.e. the theoretical sale value of any productive instrument or property item at any moment, is determined mathematically as a "present worth" by discounting its future yield (assumed to be known) back through time to the moment of valuation, at a uniform rate.<sup>1</sup> This applies, with necessary but obvious qualifications, to any moment for which the value may be struck; but it is convenient to consider the moment at which the capital first reaches its maximum value, which is the end of its "construction period." Second: The amount of capital represented by any item is *also* determined mathematically (under economic conditions, meaning correct foresight and planning) by its "construction cost." But—and this is especially important—the construction cost always and necessarily includes two elements. The first is the arithmetical sum of payments to the previously existing productive agencies which are employed in creating the new item in question. These payments are of the nature of income to the owners of the agencies, and may be made at any interval, or from moment to moment as the services in construction are rendered. The second element is an accumulated "carrying charge" on each increment of such outlays from the moment when each is incurred to the moment of valuation of the instrument. Third: Because every increment of cost incurred must yield a return at the same rate over the whole period for which that increment is invested, the carrying charge is accumulated at the same rate as is used in discounting any increment of income to arrive at its present worth. The fourth statement sums up the first three: The construction cost is equal to the present value

<sup>1</sup> Anticipated changes in the "going" rate introduce complications which will not be considered here. They could be dealt with by finding an equivalent uniform rate through all future time. Under regularly fluctuating physical conditions such as the seasons, the discounted value of an instrument may fluctuate like that of a bond in connection with accumulation and disbursement of the interest. But such fluctuations cannot contravene the principle that no item of saleable property will be kept in possession unless it is yielding income in some form, at the same rate as any other property in the market for which it might be exchanged. But such refinements are outside the scope of this survey of principles.

of the anticipated yield, *when the rate at which carrying cost of direct outlay items is accumulated is the same as the rate at which future direct yield is discounted*. Fifth: Any "investment," i.e. any creation of an income-yielding item, is made under the condition that the *rate* in the foregoing statements is the maximum possible in the technical circumstances—including present and anticipated prices of products—of the economic situation in which it is made. This economic situation or "economic society," is to be understood as an "area" within which there is both (a) freedom of choice among investment opportunities and (b) a free market for the purchase and sale of capital items, for "cash"—meaning really the exchange of income-segments of varying duration and volume against each other.

5. At this point a few general "remarks" may possibly forestall certain confusions. (1) The yield of a capital item here means the imputed yield, which is the sale value of some service rendered, valued at the instant at which it is rendered—(assumed to be in the future at the moment of valuation of the instrument) less (a) payments to other agents co-operating with the instrument in question, and (b) payments covering all upkeep cost for the instrument but excluding provision for its replacement at the end of its service life if this is limited. (2) The service rendered by a capital item may be of widely varying sorts, such as (a) a contribution to the increasing value of another item under construction; (b) a current monetary return; (c) a current "satisfaction" of any sort including mere pride or pleasure of ownership to the owner of the item; or (d) an increase in the value of the item itself. (Such an increase may result from any of a multitude of causes.) This last item (d) applies only at moments before the maximum point in the growth of the item; but it is essential to understand that any increase in value is a value-income, equivalent to, because exchangeable for, any other income of equal value, irrespective of the current application to the item of any productive services other than merely holding it for the increase, i.e. *not* selling it. The relations between consumption income and increase in capital will receive more detailed consideration presently.

(3) On the cost side (ascending phase), the direct outlays incurred will practically always include a proportion, which may be small or large, of payments to pre-existing "capital items." These, of course, may take the form of "rent" in the

ordinary business sense, a payment to the owner of a concrete instrument for its use, or of "interest," paid for the use of "capital," a sum of abstract value.<sup>1</sup>

(4) The form of the capital item, like the nature of the income yielded (see No. (3)) is immaterial to the theory of capital and interest. In particular, the theory fits the case of the original "wage fund" conception of capital as the "support" of labourers. It is, however, necessary, if one is to have any theory of imputation as between such capital and labour, to introduce the modification which is the "contribution" of Jevons, popularised in a muddled form by Böhm-Bawerk, and refined mathematically by Wicksell. This modification consists of noting that the "production cycle" involved in the theory (almost entirely unreal in life) must be variable and that a longer cycle calling for a larger subsistence fund must make possible a greater yield from the same labour (and any other productive instruments apart from the "subsistence" itself). Only so do we provide for variable proportions and diminishing returns in connection with the capital (subsistence), and in the absence of these features the production cycle adopted by managers would of course be zero in length.

(5) It is exceptional if ever that the capital account with a particular instrument really ends at the zero point. In

<sup>1</sup> In the abstract it might have been thought unnecessary to explain to "economists" that rent and interest are different contractual forms for the same income, and not payments for different kinds of services or different distributive "shares." But they generally have been and generally still are treated in economic literature as the latter. Similarly, it might, in the abstract, have been supposed unnecessary to remark explicitly that the construction cost of any capital item will, with negligible exceptions, include payments in considerable proportions to pre-existing capital items or capital. The nonsensical assumption that capital goods are produced by labour or by "primary factors" other than capital itself, calls for reference because the writings of the Böhm-Bawerk school make this assumption.

It may be in order to note explicitly that the Böhm-Bawerk theory, or at least a theory correctly worked out along the same line, may be quite "correct" as an exercise in pure logic, i.e. with reference to the imaginary situations under discussion. The objection to it is that it has no relation to any typical case of capitalistic production, perhaps strictly speaking, to any particular case in all history. Even as regards the very first infinitesimal increment of capital to be recognised at the beginning of economic life on earth, it would be merely fanciful to assume that it was produced under economic conditions by pre-existing "primary factors." Wicksteed, writing in criticism of Jevons, in 1889, thought it unnecessary to develop or dwell upon a remark which really includes most of what this paper consists in developing and dwelling upon. See his article, "On Certain Passages in Jevons's Theory of Political Economy," *Quarterly Journal of Economics*, Vol. III, pp. 219-314, reprinted in Robbins' Edition of *The Common Sense of Political Economy*, pp. 734-54; see especially the third paragraph from the end of the paper. I may remark that Wicksteed seems to me slightly over-modest in saying in the following paragraph that he has "made no attempt to carry the theory of capital and interest beyond the point at which Jevons left it."

all ordinary cases there will be an appreciable, and often a large, residual or salvage value to be carried over into an account with some other instrument, or into the general capital account of the owner.

6. Possibly at a somewhat lower level of obviousness than the observations grouped in the preceding section (but still obvious enough, surely) is the fact that in a property system the element in the increase in cost of a capital instrument under construction which represents the accumulating carrying charge cannot possibly be attributed ("imputed") to the productive agents which contribute the other element in the cost, namely the summated direct outlays. It is of the essence of property, or in other words of capital accounting, that the part of the value corresponding to this part of the cost will accrue to the (owner of the) new instrument itself. This party to the transaction is functionally separate from the owners of the productive agencies external to the "growing" instrument, even if he happens to be the same human being. For purely theoretical illustration, let us assume that a capital instrument were to be constructed by the expenditure of a thousand dollars' worth of "labour" distributed uniformly through one year and that the interest rate is 5 per cent. per annum. The value of the instrument when finished at the end of the year will be \$1,025. This \$25 of "surplus value" over and above the direct outlay cost can only be imputed to the instrument itself, i.e. to the "capital" invested in it as this capital increases cumulatively. In the kind of world in which we live and think, there must be some such "bearer" (tangible or intangible) of the accumulating investment. This bearer at any stage of construction is a productive instrument, a capital good as well as a quantity of capital, and correct accounting must impute to it its rigorously definite share in the final result.<sup>1</sup>

<sup>1</sup> This is an appropriate point to insert a reference which must be made somewhere to what is perhaps the most mysterious feature of traditional value theory, namely, the "labour theory of value," more especially in the form of the doctrine that "labour produces all wealth." (The doctrine pervading the whole classical literature, that production means production of wealth, is an equally mysterious idea, since the bulk of what is produced is always current consumption income, and this alone figures under the stationary conditions so dear to the heart of the theorist; in fact the production of wealth is a questionable category, for production naturally implies consumption, and there is no consumption corresponding to wealth creation, in the same or any other interval, for the income later yielded by the wealth must be imputed to the wealth itself, and not to the agencies which created it; but development of this theme would be too much of a digression here.) The point to be noted here is simply that as regards economic—not technical—rôle in production and distribution, no classification



7. The preceding discussion has run in terms of a capital account set up for or "with" an individual capital instrument. In a progressive society it is much truer to the essential relations to take the standpoint of a capital account "as such," i.e. an account in terms of the total quantity of investment or capital belonging to an individual or enterprise, without reference to the concrete instruments in which it is "embodied." From this standpoint, all capital is inherently perpetual. If a particular capital instrument "wears out," or for any other reason ceases to be "rentable," its replacement by another instrument or other instruments of the same earning power (with or without a growth accretion) is to be taken for granted as a technological detail. In accounting terms there is no difference between replacement and maintenance, "eventual"<sup>1</sup> replacement being included in maintenance as a matter of course. And, as a matter of course, it makes no difference for theory whether an instrument is replaced by one similar physically (or psychologically, in the case of intangibles), or by one dissimilar in any way whatever. Significant is only the fact (which is a fact) that the quantity of income-earning capacity in society as a whole is maintained or increased.<sup>2</sup>

of productive factors has any validity. With reference to other issues, it becomes necessary to distinguish between *saleable* productive instruments and those which are not saleable, meaning in practice "free" human beings, which again, in modern society, means all human beings. This, of course, is a purely "institutional" difference. More technically stated, the difference between labourers and other productive instruments is that one of the latter type can be assumed to be the subject of a capital account, while this is true only to a very limited degree, if at all, of the free labourer.

As regards "land," it is sufficient to note that in economics, "by-gones are forever by-gones"; any existing capital instrument must in fact be taken "as is." If one becomes interested in the history of an existing capital instrument as a question on its own account, it must be traced back either to the sort of productive activity here under consideration or to an economic discontinuity, or some mixture of the two, the typical situation representing a mixture in nearly any proportions.

<sup>1</sup> "Eventual" is, of course, used here in the European sense of "in the event."

<sup>2</sup> Under rigidly stationary conditions each instrument would of course be replaced by an identically similar one. Replacement by an instrument of a technically different kind or by one embodying a greater investment and corresponding productive capacity creates no difficulty for the theory of capital as related to a particular enterprise. We do have to assume, at least as a first approximation, and until other conditions are explicitly stated and dealt with, that the future earning capacity of a particular instrument is completely foreknown at the time of its construction. In that case it makes no difference what is the cause of any decrease in earning capacity, or what changes in the instrument, if any, are connected therewith. An instrument may, of course, be "written off," in whole or in part, out of earnings, and the investment so written off transferred elsewhere independently of any physical "wearing out" of the instrument. As a matter of fact, a large part of the capital of society is invested in intangibles not subject to physical wear or deterioration—though they may require expensive upkeep!

Indeed, it makes no difference to the general theory of capital, from the standpoint of the market as a whole, if the individual owner decides to disinvest and consume his capital. This decision will not affect the life history of the particular instruments in which the capital has been invested, and its only effect on the total capital situation in the society will be a slight redistribution of ownership, and the elimination of a small increment of growth which would otherwise have taken place. A capital item once produced becomes an indistinguishable fraction of the total capital of the economic system, and even in the event of gradual social disinvestment, it would be meaningless to attempt to say when or in what connection this particular increment ceased to exist.

8. The pure theory of capital and interest can be briefly stated in the form of a little simple algebra—i.e. for the special case of straight-line relations in construction and in yield. Let us assume that a capital good is constructed by the expenditure at a uniform rate of  $S$  dollars per year for  $C$  years, and that it will yield a uniform imputed return (above “upkeep” but without depreciation provision) of  $R$  dollars per year for  $L$  years. (The year and the dollar of course stand for any time unit and any money unit). Letting  $i$  represent the rate of simple interest per annum, the accumulation of one dollar per year for  $n$  years is given by the familiar formula

$$\frac{(1+i)^n - 1}{i},$$

and the present worth of a future income of one dollar (payable at the end of each year for  $n$  years) is

$$\frac{(1+i)^n - 1}{i(1+i)^n}.$$

Letting, for simplicity,  $A$  stand for  $(1+i)$ , i.e. for the “amount” (principal plus interest) of one dollar for one year, the fundamental principle of interest is expressed by equating the cost of the capital good with the present worth of its anticipated yield. That is,

$$\frac{S(A^C - 1)}{i} = \frac{R(A^L - 1)}{iA^L}, \text{ or}$$

$$SA^L(A^C - 1) = R(A^L - 1). \quad \text{Equation I.}$$

This equation must be solved for  $i$  (i.e.  $A - 1$ ) in terms of the—and no small part in physical things not subject to deteriorative change. (The special significance of *unanticipated* changes will be considered later.)

known quantities of the situation. As remarked, it is assumed that the investor behaves "economically," i.e. that he chooses that line of investment, of all those open in his market, which makes his  $i$  the greatest. With reference to the left-hand side of the equation, this means securing maximum capital value for the investment of a given value in payments to pre-existing agencies; with reference to the right-hand side, it means securing maximum yield from a given total investment, including in the investment the accumulated carrying charge.

But as already explained, the realistic way of looking at the matter is that of viewing capital once invested as perpetual, even when the instrument in which it is first invested happens to have limited life. The common-sense view of interest is that of a rate of return *after* maintenance of the principal intact. To represent this algebraically, we merely introduce a depreciation item, to provide for replacing the original instrument (or a "sinking fund" to replace the "capital") at the end of its service-life.<sup>1</sup> The simplest assumption is that it is built up by a uniform instalment out of the imputed income of the capital good in each year. The rate of interest, in this view, is simply the imputed yield for one year ( $R$ ), less the proper deduction for depreciation (replacement—really maintenance) divided by the investment, that is, by the entire cost of the capital good. The annual instalment required to accumulate one dollar at the end of  $n$  years is the reciprocal of the accumulation of one dollar per year for  $n$  years, or

$$\frac{i}{(1+i)^n - 1}$$

And the investment is, again, in our symbols,

$$\frac{S(A^c - I)}{i}$$

The expression for the interest relation then is:

$$i = \left\{ R - \left[ \frac{S(A^c - I)}{i} \times \frac{i}{A^L - I} \right] \right\} \div \frac{S(A^c - I)}{i} \quad \text{Equation II.}$$

A few steps of algebraic rearrangement will show that this equation is identical with the preceding one. Such equations have to be solved by methods of approximation, and where

<sup>1</sup> In the special case where construction period and service-life are equal, the capital goods are replaced as they wear out and no special accounting different from routine maintenance is involved. This was the assumption of the wage-fund theory in its simplest form, relative to an annual cycle. Cf. Smith, *Wealth of Nations*, Book II, Ch. III.

accumulation and yield are not linear with respect to time (as of course they never would be in reality), the computation will involve integration.<sup>1</sup>

9. It should now be clear why the "length of the production process" has nothing to do with the case, and in fact no real meaning. As long as capital is maintained by replacing the capital goods, *if* their life is limited, by others of any form with equal earning capacity in imputed income, the durability or service-life of the good is a mere technical detail (and whether it is replaced by another like itself or different, and whether by the same individual owner or someone else, is likewise immaterial). "Of course," the longer the construction period of a given capital good, for the same investment of the services of other agencies, the greater will be the total investment after adding the accumulated carrying charge, and the greater must be the imputed income, for a given service-life or in perpetuity, in order to provide a given rate of return; and, "of

<sup>1</sup> For continuous compounding at "force of interest"  $i$ , it is only necessary to replace the  $A$  in the equations by  $e^i$ , the amount of one dollar for one year on this assumption.

Since income is the primary economic reality, wealth being merely a source of or title to future income, and since in a stationary or growing society where the future is correctly foreseen, income is essentially perpetual, the truest view of interest is that of a stepping-up of *income* by abstaining from consumption and investing for some interval. The simplest situation is a case where the abstinence period or "construction period" is one year and the resulting capital good itself is permanent, so that in the equations  $C$  is unity and  $L$  infinity. Then either equation I or equation II immediately reduces to

$$i = R/S; \text{ (or, } r + i = \frac{R + S}{S}\text{),}$$

where  $S$  is the cost of the instrument (equal to a year of income-flow at the annual rate  $S$ );  $R$  is the new increment of perpetual income due to the investment, in addition to the former income of  $S$  per year, which is resumed after the investment period; and  $i = R/S$  or  $S = R/i$  is the ordinary capitalisation formula. If  $C$  is not unity,  $S$  is replaced by  $\frac{S(A^C - 1)}{i}$  and if  $L$  is finite,  $R$  must be reduced by the proper depreciation

charge. (Payments may be made according to any consistent time distribution.)

The main proposition is easily seen without setting up any equations. The ordinary view of interest is the ratio between annual net income (after maintenance of principal) and the principal itself. But the principal of a new investment is some income for some period, a segment of the same income in perpetuity. So the interest itself is an increase in an income; and the rate of interest is the increase for one year divided by the base at the beginning of the year. When the base is a one-year segment of a previous uniform flow, no interest enters into it. Interest, then, in the most fundamental view, is the percentage by which a perpetual income can be increased in volume by abstaining from consumption of one annual instalment and allowing it to accumulate by investment in some income-yielding agency. ("Increase" was the ancient designation for interest.) The actual rate in any market is the measure of the best investment opportunities open in the capital market in question. (Cf. *Excursus* at end on interest in terms of supply and demand.)

course," the longer the service-life of the good, the greater must be the total (undiscounted) imputed income over the period as a whole in order to have a given total present worth. But it is completely artificial to fix attention upon the additively summated imputed return of a capital good for its service-life as a whole—even assuming that the service-life, and hence the aggregate service, are not infinite for the identical concrete capital good. The primary reality is income, a rate of service-value through time, and in a society which is not planning for the end of all things, all property income is perpetual. The significance of durability in an item of wealth is merely that the more durable it is the larger is its net yield, other things being equal, because a smaller annual deduction need be made from the same imputed yield to provide for depreciation, i.e. eventual replacement.

Thus in constructing any item of wealth, making it more durable is one way of making it yield a larger net return. It is "one way" among, be it noted, accurately speaking, an infinite number. There is literally no limit to the number of ways in which the investment in a given enterprise or project can be made to yield a larger return in value terms. It is taken for granted, of course, that any of the possible ways, including provision for longer life, will be used if and in so far as it does not cost anything, and if and in so far as it does not cost more than it yields. That is, the investment in *any feature* of a project which makes the result more "rentable" (including longer service-life) will be carried to the point at which further investment ceases to increase the rate of return as defined in the equations above. Similarly, using a longer period of construction is, *when it is used*, merely one method, among an infinite number, of reducing the total construction cost. It is a mere technical detail on the same level as any other detail affecting cost, and will not be further considered here. (Nor will the reasons, in nature, for the fact that time is a factor in the cost of any operation, that there is generally a "natural" or minimum cost speed which can be *increased or decreased* only at a cost.)

What the Böhm-Bawerk school's position amounts to is simply selecting these two details which are of the same significance as any of an infinity of other details, giving the two together the false designation of length of the production process or degree of roundaboutness, and pretending that this is all that is involved in the rational calculation and administra-

tion of investment. As a matter of fact, every one of the infinite number of such considerations is like this one in every significant respect. Increased rentability in any form must be purchased at an increasing cost per unit (one item in which *may* be a lengthened period of construction). In other words, increasing investment in any particular item or detail must yield "diminishing returns," or there will be no economic problem of investment.<sup>1</sup>

It is difficult to comment seriously on theorising based on such assumptions. Let us suggest a moment's scrutiny of an illustrative case, such as building a house. Truly, it is possible to increase one's net income from the house by building it in such a way that it will yield a given rental, above all current expenses (including upkeep but not depreciation), for a longer period of time. The reason, to reiterate, is that the rental yield in any income period must be reduced by a smaller deduction to provide for ultimate replacement, in order to arrive at the net return on the investment. The investor, behaving economically, will make his house more durable as long as the resulting increase in the net yield exceeds the general market rate of return on its additional cost, meaning merely, of course, that it is in excess of the rate of return obtainable on investment in any alternative opportunity open. (It is surely unnecessary to elaborate the assumption of a free

<sup>1</sup> In its original wage-fund theory form, the Jevons-Böhm-Bawerk theory of capital assumed fixity of proportions between capital and labour in a fixed production cycle and gave investors no choice at all. Only in the application of labour-plus-capital to land were there alternatives of choice in proportion and an economic problem. The division of return between capital and labour was also treated as "fixed," in some way which we can only vaguely infer. Land rent is the one income for which a rational process of price determination can be read into the classical writers; it was wages-plus-profit which was really "residual."

Jevons and Böhm-Bawerk, as already noted, modify the theory by assuming (as Ricardo also really did, for that matter) that the production cycle is variable and that the use of a longer cycle yields a larger product from the same labour, while requiring a larger stored-up wages fund to support it. It is not clear whether even Wicksell contemplates different relations or curves in this respect from different investment opportunities open to the same investor at the same time. All the writers clearly argue or assume that increasing the time between production and consumption is the universal meaning of increasing investment.

There is, in fact, one significant theoretical difference between this investment in durability and the infinity of other modes open to any investor at any time (and between lengthened construction period and other costs). Time is measurable objectively, and the interest relation, with the peculiar compound interest curve, enters into the calculation of both the cost and the yield of any capital good. Hence many features of the time distribution element in cost and in return are calculable *a priori*, while technical and utility considerations and their curves must be derived from empirical knowledge of facts.

or perfectly competitive market.) The same investor will naturally behave in the same way in the face of the infinitely numerous other ways of making his enterprise yield a larger return. As regards a house, these extend from building a bigger house to improving the finish of the door knobs. But all such things are only the beginning of his alternatives for investing more capital. He may build two houses instead of one, since what is included in a particular investment project is purely a matter of accounting convenience. Or, it may be a factory or railroad instead of a house, or a general assortment, accounted for as different projects, since the project as a unit is also irrelevant. In each of these possibilities, construction period and durability are *details*. The number of possible ways of investing more capital, apart from increasing the durability of instruments, is really an infinite number of infinities.

10. There is a connection in which the durability of capital goods, which is one of an infinity of details in its effect upon the amount of investment and size of return, does have the utmost significance on its own account. Economic life is carried on in a world subject to change, partly anticipated, and more or less accurately, and for a shorter or longer period before it occurs, but largely unpredictable. It is, therefore, of the utmost importance to have capital in such a "form" that it can be shifted from one field of use to another. Most capital goods, viewed concretely, are more or less specialised to particular uses. But in a general way, if the service-life of a good is shorter there is an additional degree of freedom in moving the investment in it into other uses, since it is possible to invest the replacement fund in an instrument of a different kind.

There is no simple or definite relation between service-life and mobility, and the limitations on the achievement of mobility through choice of short-lived forms of investment particularly need emphasis. Only within narrow limits can a particular, short-lived instrument be "liquidated" without liquidating the entire technical organisation in which it is used, or at least carrying out a far-reaching transformation in the set-up as a whole. The limitations apply especially to unanticipated changes, and, in the main, only unanticipated changes are in point at all. All capital is inherently completely mobile with respect to any change foreseen as to date and character at the time the investment is made. That is, in the absence of

miscalculation, no investment will ever be made unless the yield, during the period in which it will actually afford a yield, has a discounted value equal to the cost.

Since there is so much confusion regarding the significance of durability, it may be worth noting that construction for an emergency or a dated special occasion of any kind is likely to run in this regard to one or the other of the two extremes. It will take the form in part of instruments which will depreciate as nearly as possible to zero within the limited period in question and in part of highly durable units, with the maximum value for recovery and utilisation elsewhere. The second course, again, may involve either adaptation for some other special use, or standardisation for building into a wide range of complexes such as are generally met with. The general principle is that the mobility of capital is overwhelmingly a matter of planning for either a particular transfer or for mobility in the abstract, through general availability; it is completely mobile with respect to any correctly anticipated change, and with reference to unforeseen changes its mobility is in general rather limited. Of course, prediction has the dimension of distance in time as well as that of accuracy.

In other words, an important, if not the main, factor actually determining the choice in investment between capital goods of different degrees of durability is what is loosely referred to under the term "uncertainty" (not to be confused with insurable risk), rather than efficiency. It would probably pay to build capital instruments with much more durability than is generally done if their construction could be *accurately* adapted to *remote* requirements. And presumably they *would be* made more durable, if the investors had more confident predictions regarding the future, however accurate their predictions turned out to be. But unforeseen changes may increase as well as decrease rents, and the greater gambling element in operations looking to the distant future may attract as well as repel. Any simple general statement regarding the human reaction to uncertainty is mere guess and assertion, and there is no clear meaning of "rational" behaviour in the face of uncertainty.

11. In the real world the relative economy of instruments of different durability is distributed more or less at random in relation to other types or sources of rentability. That is, while there is perhaps some technical interconnection between increasing the durability of an instrument and giving it

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enhanced power to render saleable service in other respects, the correlation is certainly not high; and in general there is no serious limitation on the possibility of combining any degree of durability with widely varying degrees of other qualities making for efficiency in a "particular use" (whatever that may mean in reality) or making for efficiency in general. The limitation is probably negligible, when we recognise the freedom of investing in different "uses." Similar statements hold for increased construction period in relation to other costs. It is imaginable that this might not be true, that the economy from increased durability of instruments or increased construction period, or both, might be so great over so large a part of the productive field as to give rise to a "premium on present enjoyment" as a real factor affecting the choice. In a society in which conditions are as they are, and in which a large part even of the net return from investment is continuously reinvested, no such premium can arise.<sup>1</sup> Where a sufficient proportion of the investment opportunities open afford their maximum rate of return in connection with a

<sup>1</sup> (Excursus on Discount of Future.) There is literally no "sense" in the notion of an inherent reluctance to postpone, or preference of present to future enjoyment, as a general principle embedded in human nature, rational or sentimental. Jevons saw this clearly. No one wants his present or immediately prospective enjoyment all transferred to the future, but no more does anyone want all his future enjoyment transferred to the present. There is no presumption, *a priori*, as to which a normal human being would choose if compelled to consume both to-day's and to-morrow's rations of food either to-day or to-morrow. Either alternative would in general mean a sacrifice in comparison with consuming to-day's rations to-day and to-morrow's rations to-morrow. If we think of months instead of days the sacrifice is serious, and if we make it years it will be fatal. In a world where "food" is scarce and where technical facts enable one to have an increased ration to-morrow or next year in exchange for any portion of to-day's or this year's ration, there is a presumption that, *other things equal*, some postponing will be done—in comparison with a uniform distribution through time as a base-line or zero point. But other things are far from equal. Life is short and youth shorter, and both are uncertain as well. The permanent and cumulative saving and investment we actually and typically find in the world cannot be explained in any degree through comparison between present and future enjoyment, or "waiting" and being paid for waiting. It is hardly possible that the average saver lives long enough for the total return on his saving at ordinary interest, and with allowance for losses even in "safe" investments, to amount up to the income sacrificed in saving, if the whole return were consumed, and it is not. The difference between consuming now and after one is dead is hardly to be viewed as a mere difference in time, and consuming in the infinite future is mathematically identical with not consuming at all. The only possible basis for interest theory is simply to assume some indifference curve between current income as consumption and as increase in wealth. Wealth, viewed socially and objectively, is perpetual income capitalised, but what it means psychologically to the individual accumulator is a problem outside the sphere of the price theorist. All that the individual can do is to invest at the market rate, determined by technical opportunities open, whatever fraction of his current income he prefers, on such terms, to have in the form of wealth rather than in the form of current consumption.

moderate construction period, i.e. period of postponement of setting-in of income in consumable form in excess of cost outlays, and where the continued, fairly rapid growth in the total of investment is taken for granted, the only prejudice against investment involving remote realisation is the uncertainty or "risk" connected therewith. In reality most investments not only begin at a fairly early date to yield their income in consumable services (rather than increase in sale value—i.e. the "construction period" is of moderate length) but in addition they begin fairly soon to yield more than interest on cost in this form, and entirely liquidate themselves in a moderate period of time. This additional flow of consumable services is ordinarily treated as a replacement fund, but is available for consumption or for reinvestment in any form and field of use at the will of the owner.

In such a world the ordinary operations of the market bring about complete equality in the rate of net yield of all investments, regardless of the distance in the future at which they will yield a return in consumable form. The owner of any durable or non-liquid investment can always realise the yield accruing in the form of capital increment in consumable form instead, by selling to someone else a part of his holdings, or, if they are physically indivisible, by creating a lien. And, conversely, of course, the owner who gets his return in the form of consumables and desires to keep on accumulating, can always reinvest. In such a world, to repeat, the accounting view, which is the logical view, is that all investment is perpetual, yielding a uniform net income in consumable services throughout future time. The alternative to perpetuation of the income, barring loss through miscalculation (which involves an economic discontinuity) is the reverse process or disinvestment. But in a stationary or growing society disinvestment by an individual owner in no wise involves actual reconversion of "capital" into income, i.e. of perpetual income into income for a short period at a correspondingly higher time rate.

12. The distinction between capital and income is logically absolute, lying at the very conceptual foundations of a property system, and the imputation of product cannot be carried across a transformation of either into the other. When new capital is created, a new source, quantitatively, at least, of income appears on the books. It is true that when such a new income source appears as the result of economically planned activity, involving the use for this purpose of resource services

deliberately diverted from use in creating currently consumed income, the capital value created is quantitatively equivalent to the consumption income sacrificed in its creation, and must be accounted for as income for the interval in which its production is carried out. But, as was remarked above, such accounting "income" belongs to a totally different category from income in the sense of consumed services. As Professor Fisher in particular has pointed out, such income is merely the present book value of consumption income due to accrue in the future, and to count the present worth of a future income as present income and then count the future income itself is logically a clear case of double counting. Without in any way questioning the necessity of balancing the books in the current interval by treating the new capital as income, it none the less remains true that there is a fundamental difference between the use of productive capacity to create more productive capacity and its use to create consumption income. The choice between the two uses is absolute. The new, "future" income, when it comes to be created by the new capacity, can in no wise be imputed to the old capacity which created the new capacity; it has to be imputed to the new capacity! When savers, in investing, "abstain" from the current consumptive use of productive capacity in order to create consumption income in the future, they *abstain*; to call it "waiting"—a change introduced a generation ago as an "improvement"—is misleading and false.

No definite or finite amount of the absolute quantity of consumption services produced by a capital instrument or increment of capital can be connected with the activity used to create the capital. The only imputation possible would be that of a "strip" of perpetual income, and this would be possible accounting procedure only for an accountant balancing the books "as of" the end of time. The only quantitative or logical bridge between a capital-producing activity and the income from the capital produced is the discounting process; and if the bearer of future consumption income is treated as product in the period in which it is created, the consumption income itself, when it begins to accrue, must not be imputed to the same activity. New capital can be treated as income only when the books are balanced and new accounts opened for a new interval, a real new beginning.

13. Regarding the "length of the production process" as an independent problem, several distinctions must be drawn.

It is, of course, possible to time any particular transformation of material between the "raw" and the "finished" state, whatever the nature of either. It will hardly be contended that this interval represents the time spent in "producing" the finished good. It is possible also to time the construction of a "capital good," meaning an auxiliary instrument of some kind not thought of as being directly consumed, but rather as serving in the transformation of other material from a raw to a directly consumable form. It is possible also to time the "using up" of such a capital good (in those cases where it is in some defensible sense used up; as already noted, a capital instrument is rarely if ever completely used up). And, one can add the construction period and the using-up period for any instrument, if one has sufficient curiosity to justify the effort. What it would mean is a question; the dates might be of interest to a historian of some sort; they certainly do not bound a "period of production."

The patent fact is that we may give a fairly realistic or defensible meaning to either the beginning or the end of a production process, but that if we do identify either, it is never possible to say what would be meant by the other boundary. If we take a certain small increment of consumption, say, drinking a glass of milk, it would never be possible to give any sensible answer to the question when that glass of milk was produced, or when its production "began." Or, conversely, we may take a definite increment of productive activity, such as feeding the cow; then, it would never be possible to say when the results of that increment of activity would be consumed, or when the process of consuming them would "end." If production is regarded as a process occupying time, its only beginning is the beginning of time, and its only end is the end of time—or, we might say, the beginning and end of social economic life. In the only sense of timing in terms of which economic analysis is possible, *production and consumption are simultaneous*. For the production of new wealth there is no corresponding consumption, and if there ever is or ever comes to be absolute disinvestment, there will be no production corresponding to the excess of consumption over production which results.<sup>1</sup> The technological process of producing and using up

<sup>1</sup> It is to be noted that there is no correspondence even between the cost of a capital item and the possible realisation, unless its creation is planned for realisation at a known date and under known conditions. Nor is there any relation between the annual maintenance cost of an item and the amount of deterioration it will undergo if not adequately maintained.

any particular thing is time-consuming, beginning when the account with that thing is set up, and ending when the account is closed, but this interval has no relation to a time requirement for producing any particular item of enjoyment.

Viewed in economic terms, production means the rendering of services, and it is self-evident that a service can only be produced when it is rendered, and only enjoyed or consumed at the same instant.<sup>1</sup> A service which creates value other than instantaneous enjoyment does so by creating some form of capital which will subsequently *produce* enjoyment, and it cannot be considered as produced twice. In economic life apart from new net investment or disinvestment for the system as a whole, consumption and production are instantly simultaneous. In a growing society (growing in the sense of capital accretion only), that part of production which results in new capital is continuously and instantaneously balanced on the books by the new capital created. But no consumption *ever* corresponds to such production, and it is production only from the standpoint of accounting for, and directing, the utilisation of productive resources used for capital growth.

14. The connection in which the notion of a lapse of time between production and consumption has practical meaning has been indicated in general terms. It does require time to change the direction of production or the mode of use of productive instruments, or the capital they represent, to meet *unanticipated* changes in conditions. (Only capital instruments and capital are in question in the present discussion; the problems of the mobility of labour are quite as important, and indeed closely connected; but they have to be treated separately.) It is commonly true that changes in the character of productive activity become reflected in changes in the physical form of consumable output only after a considerable lag. There is no disposition to minimise the importance of studies which in any way shed light on such relations or on the rationale of production control where lags are involved. This problem has almost endless ramifications. Some of the speculations of the Böhm-Bawerk school about capital have

<sup>1</sup> The entire classical conception of production, rejecting services and including only the creation of additional wealth, is exactly inverted. Cf. J. S. Mill, *Political Economy*, Book I, Ch. III, Section 4, first sentence of second paragraph. Smith, apparently, meant to include the *reproduction* of capital: *Wealth of Nations*, Book II, Ch. III. Ricardo uses the concepts of productive labour and productive consumption without attempt or pretence at definition, but may be assumed to accept Smith's position.

more or less bearing on the problem in one aspect or another, though there is only a vague general relation between (a) quantity of capital, (b) durability of instruments, and (c) (im)mobility. And such lags in no wise measure or mark off time boundaries of production as such, or of any specific process of production. They are to be studied simply as what they are, lags in the changes of form or rate of output behind changes in the input of productive services.

In economic terms, i.e. value terms, what is "produced" by any activity is an increment of value; and if economic activity is rationally directed under conditions of perfect competition, to every increment of activity will correspond an instantly simultaneous equal increment either of consumption or of new wealth representing present worth of future consumption—which, however, will be accounted for as product as it is consumed. This double counting is, as noted, essential for the rational control of capital creation and use.<sup>1</sup> Any unanticipated change in conditions will create a discrepancy more or less extensive and widespread between the historical cost of capital instruments and their value on the capitalisation basis; it should go without saying that in any such a case, the historical cost will be treated as if it did not exist. The amount of capital is always the capitalised value of an expected future stream of services. When conditions change, capital simply appears or/and disappears, and is written up or written down without reference to "production." Such an event is not a part of the economic sequence, which consists of acts correctly related to consequences, but represents a discontinuity. Capital is perpetual in so far as economic principles obtain and economic reasoning is applicable—and will be so until investment plans begin to be made with reference to the end of the world or some millennial state, in which wealth and income will cease from troubling. Wealth is bought and sold (as well as created) and gets its measure as wealth on the basis of perpetuity; any "risk" involved in any case is allowed for and cancels out in the large in so far as risk itself is measured or correctly estimated and treated rationally, "economically." The reason for keeping records of historical cost is merely that

<sup>1</sup> There should be somewhere in this paper a general reference and acknowledgment to Professor Fisher's writings on capital and income. But detailed comparison is outside the scope of the enterprise. Fisher's *interest theory* is a different matter. Cf. *Journal of Political Economy*, April 1931. (This article contains errors, which the writer hopes to take up and correct in the near future, but the main argument on interest theory is still believed to be sound.)

knowledge of the past is the only source which human beings have of knowledge of the future. But in so far as they have correct knowledge and direct their capital creation in accord with it, cost will be equal to capitalisation value, and the tendency of the two to be equal is the basis of the general theory of capital in a system in which it is being created under economic conditions. For the rate of interest which determines the value of all existing capital goods is determined exclusively at the margin of growth, where men are comparing large, short segments of income-flow with thinner streams reaching out to the indefinite future. Action is based on the assumption that the capital itself, the earning capacity, will be intact at the end of any project limited in time, if not as a separate act, "disinvested." Disappointed expectations are not explicable in terms of economic sequence, which means the maximising of return from limited means by correct allocation among competing uses. The quantity of capital in an existing thing depends on the rate of interest and its earning power in any field in which it may have earning power, in that in which its earning power is greatest if it has such in a number of fields.

15. As regards the relation between quantity of investment and the time required for production, a few remarks on possible meanings and the probable facts may shed light on certain confusions. (1) In connection with the initiation of a new "line of production" (whatever that may mean), there is little doubt that *ordinarily* a greater investment in more elaborate preparations will mean that some number of the earlier units of output will come on the market at a later date than would have been the case with a smaller investment. But additional investment may have the purpose and result of shortening this waiting period; and in any event it is only a question of time until the total output reaches a figure which would only have been achieved at a *later* date using less capitalistic methods. Otherwise stated, production will presently arrive at an *n*th unit which reaches the market at an earlier date, and the longer production is kept up the greater will be the interval by which each succeeding unit is advanced in time by the investment.<sup>1</sup>

<sup>1</sup> Any net saving and investment naturally means a temporary reduction in consumption somewhere and a subsequent increase somewhere, raising the total rate of consumption in the system above that obtaining before saving started, the increase measuring the rate of return. In terms of *income* sacrificed for an interval and ultimately more than made up, the notions of roundaboutness and waiting have some meaning,

(2) Increased capital investment may either increase or decrease the length of time required for the processing of any particular material, from beginning to end or between any two physically definable stages.

(3) Increasing investment in any field may go with either an increase or a decrease in the durability of the capital instruments used, or in their construction period, or in the sum of the construction period and service-life. There is probably a slight empirical correlation between amount of investment and both service-life and construction period; for making instruments more durable *is* one way of investing more and securing a larger total return, and the minimum cost of more durable construction probably goes with a longer construction period on the average. (4) More durable instruments *tend* to involve immobility over a longer period, and with correspondingly increased risk (if not certainty) of throwing away unused potential physical capacity when they come to be discarded and replaced, somewhere, in some form. This fact undoubtedly works in favour of the choice of shorter-lived rather than longer-lived instruments in many cases, as where products are subject to frequent unpredictable changes in style. And in such fields as heavy industry, increasing investment carries with it a tendency to increasing inflexibility and risk of loss through shrinkage of demand for the product. It probably takes longer, and/or costs more, to contract than to expand in such cases, and this fact is certainly significant for cycle theory. But, again, the effect of uncertainty is itself uncertain. And labour immobility is probably at least as significant in cyclical stoppage as is immobility of capital, and price inflexibilities (including wages, rent, etc.) are surely more important than either; but the issues raised are outside the scope of the present discussion.

16. The argument regarding the theory of capital as time may be summed up by pointing out that the theory rests on three fallacious assumptions. The first is that capital is produced (and reproduced in any sort of cycle) by labour or "primary factors" in any sense. This is palpably absurd; "labour," "capital instruments," and "land" are in the first place categories of no homogeneity within themselves and of extensive overlapping, and in the second place, however productive agencies may be classified, it is evident that each is

*though the individual who gets the excess, after twenty years or so (considerably more, unquestionably, on the average), will generally not be the one who did the "waiting."*



produced and continuously reproduced (when at all) by the co-operation of all, including itself. (Completely durable instruments, if there are any, form an exception as regards reproduction, unless the supply is being increased; they form no exception as regards original production in so far as they originated under economic conditions.) The second fallacy is the equally absurd notion that the reproduction of instruments of any kind can be considered as economic production. There is, "of course," no product yielded by an agency until after full provision has been made for maintaining it, or the investment in it, intact, in the value sense. Replacement, if and when, and to the extent that, it happens to be involved, is distinct from routine maintenance only in technical detail. The difference is irrelevant for general theory, except as regards mobility for meeting unforeseen changes, and the connection between service-life and mobility is vague and narrowly limited at best. (Let us take the space to repeat that in liquidation an entire technical production unit will generally be largely involved; also, that the mobility of investment is generally and mainly a matter of correct foresight and planning.)<sup>1</sup>

The third fallacy (in the theory of capital as time) is the notion that the product of a capital instrument (determined by imputation) is or can be treated as the product of the economic activity creating or reproducing the instrument itself. This is admittedly not quite so palpable as the other two fallacies. But it is surely obvious that the net yield of an instrument cannot be counted *both* as the product of the instrument and as the product of the activity which created it. And if this is admitted, it is surely not open to serious discussion which of the possible alternatives must be chosen.

<sup>1</sup> The only possible conception of capital production which does not limit it to additions to the total capital in a system must include all productive activity which does not immediately yield a direct want-satisfying service. (The rearing and training of labourers must be treated as pure consumption unless the labourers are treated as capital by setting up appropriate accounts, which is impossible in a free society.) A large part of capital reproduction and some new production is routine maintenance (over-maintenance) or upkeep and the result cannot possibly go through the current market. Another large part, involving technical production of instruments for replacement, does not go through the market, as production is organised. In view of these facts, and of the general principle that the value of any capital instrument is a mere result of capitalisation, with allowance for a market estimate and evaluation of "risk," it is hard to see how a concept of a price level for capital goods—as used, for example, by Mr. Keynes—has any intelligible meaning.

## EXCURSUS ON INTEREST IN TERMS OF SUPPLY AND DEMAND

Since capital is merely anticipated income, capitalised at a certain rate, and since the production of any concrete item of capital includes, in addition, an element of interest, a discussion of the capital concept should include some development of the theory of the interest rate. The foregoing treatment has not attempted to go behind or beyond the fact that, in general, capital instruments are produced and reproduced at a cost, fixed by technical conditions in the situation, with the consequence that the value, or the quantity of capital represented, is theoretically determined by cost, in some sense. The equality between this cost-determined value and the value as determined by discounting anticipated yield was shown to involve a mathematical theory of the interest rate in any investment operation. (Of course, the only cost which determines the value of any *existing* capital item is "reproduction" cost, and not necessarily the cost of producing a physical duplicate, but the minimum cost of producing an "equivalent" item, i.e. an item which will yield the same net perpetual value return.) No statement that a value is "determined" by a cost should be allowed to stand without some examination of the shape of the cost curve, since it goes without saying that only under conditions of constant cost can cost be said to determine price, without taking into account the simultaneous influence of demand and the equilibrium between the two. On the other hand, it should also go without saying, at this date in history, that when cost is constant, it does "determine" price, meaning that the price will be equal to the cost (if the commodity is being produced at all) whatever the nature of the demand may be. The algebraic analysis given above (p. 266) assumed that an investment is made under the most favourable conditions technically open in the market or economic system in question or, in other words, that the resulting net perpetual money income is produced at the lowest possible cost, including interest during construction. We shall now undertake a brief survey of the problem of the cost curve for net perpetual income or, in more general terms, of the theory of interest as a problem of supply and demand and equilibrium.

For several reasons, discussion of the problem of interest in terms of supply and demand requires especial care. In the first place, both capital and income are measured in monetary units, and either may be regarded as the commodity, with the other as the price; we may think of the interest rate, meaning a perpetual income expressed as a fraction of the capital, as a demand price for capital, or of capital as the demand price for perpetual income. In addition, it must be kept in mind that in reality the flow of capital into the market in exchange for perpetual income is itself a rate in time. As is the case in all equilibrium price analysis, the equilibrium price is one at which a commodity flows into the market and out at the same rate. There are many possible ways of drawing supply and demand curves to analyse the behaviour of the capital market. In the present connection, it seems best to consider only the

conception which is simplest and most fundamental. This means taking the view, which has been taken throughout the foregoing pages, that a capital instrument is desired, bought, valued, and produced (when produced) as the embodiment or bearer of a known net perpetual income. Production of "capital" means the production of such capital instruments; thus, it is best to consider perpetual income, or capital goods measured by the perpetual income which they yield, as the commodity, and the savings of the investor as the price. Supply, then, means the amount of new perpetual income (in dollars per year) created per unit of time, and demand the net savings brought to market per unit of time and offered in exchange for such perpetual income. Price is to be thought of as "years' purchase."<sup>1</sup>

Capital (in income-yielding capital instruments) is a commodity produced at a cost, and its supply curve is a cost curve. That is, in so far as there is any economic "theory" of supply in the case of capital,<sup>2</sup> it rests on a cost curve measuring the value which the productive resources used in creating any capital item would have in the only other alternative market use, namely the production of current consumption income. Price equilibrium in the field of capital production means such a rate of interest that savings flow into the market at precisely the same time-rate or speed as they flow into investment producing the same net rate of return as that which is paid savers for their use. This rate, again, will make equal the "marginal utilities" of the current income sacrificed by the savers and the prospective perpetual income.

<sup>1</sup> Both magnitudes, as must be kept clear, are assumed to be measured in monetary units, "dollars." The dollar is taken arbitrarily as the unit of value. The special problems raised cannot be taken up here, but one point must be emphasised: Value itself is a property of consumption income, not of wealth—of a stream or rate of flow, not a thing existing at a moment. Wealth is always a derivative category, involving the rate of interest; it is always capitalised consumption income. As suggested on an earlier page, the primary economic reality (utility or want-satisfaction) must be thought of as a flow, but not a flow "of" anything which can exist without flowing. It is like light, not like, for example, water. The notion of a quantity of wealth involves not merely integration over time as in the case of light (candle-power hours, or lumens), but in addition the process of discounting; for wealth is always relative to *future* income with respect to the moment at which the quantity of wealth is "struck," its "value" determined, and the distribution through future time vitally affects the value.

<sup>2</sup> This question of the extent or limits of the validity of any theory of supply would call for extended discussion, impossible here. It is in order only to make clear the assumption, that any "economic" cost, any cost which can be said to be equal to economic value and to determine the latter in a general quantitative sense, is alternative-product cost. That is, it represents the payments to productive resources which would otherwise be used, at the margin, to create some "other" product of equal market value. The limitations of such cost theory are rather sweeping; other margins corresponding to other uses of productive capacity are very commonly operative, but these non-market alternatives are valued only individually and subjectively. Similar limitations apply in principle, but much less extensively in practice, to utility theory on the consumption side. The notion that price measures marginal utility is valid as a general proposition only for a society in which every consumer consumes every product and is free to change the proportions of different products in his consumption budget continuously, instantly, and without cost.

The theory runs in terms of net additions to total investment. Such additions need not be of considerable positive magnitude, and may even, within certain limits, be negative, without invalidating the argument. The heart of the matter is that if there is a *highly elastic* opportunity generally open for converting "present wealth" (really a large income for a short period of time) into perpetual future income, the terms (rate of interest or years' purchase) on which this conversion is possible will strictly "determine" the terms on which all exchanges between present and future income or wealth will be effected, regardless of the volume of the latter. That is, "consumption loans" are to be completely disregarded in the causal analysis. (As a matter of fact, consumption loans can never be of very great volume in any system, in comparison with production loans, since in general the amount of adequate security for a purely consumption loan is extremely limited; but this point need not be laboured.) It is necessary only to understand the meaning of elasticity in the statement above, and the fact that the elasticity is actually enormously high; in fact it is infinite, as regards the situation at any instant of time.

In the view of the interest relation here taken, with income the commodity and capital the price, the elasticity in question is elasticity of supply, high elasticity meaning an approximation to constant cost. That is, high elasticity means that a given fractional variation (say, 1 per cent.) in the amount of perpetual income produced in unit time (the amount of saving and interest) will result in a relatively much smaller fractional or percentage variation in the "price," i.e. the "cost," i.e. in the present case, the amount of "present wealth" which must be sacrificed to produce an additional unit of perpetual income. If the second fraction is zero, i.e. if investment results in no change at all in the terms of investment, we have rigorously constant cost, and cost rigorously determines the price, years' purchase of income.

That changes in the rate of saving and investment produce relatively little change in the rate of interest in a moderate period of time, and absolutely none without the lapse of some time, is a proposition which does not need much arguing. New investments represent additions to all the investment previously made in all past time. The amount of such investment cannot indeed be stated quantitatively in any other way than as the capitalised value of existing income sources under existing conditions. But no uncertainty in measurement affects the fact that the addition made in any short period of time is relatively small. No one who knows anything about the use of capital in industry needs to be told that the possibilities of further investment are practically unlimited, even in the absence of other social changes opening up new fields of "demand for capital,"—in the present view, new opportunities for creating perpetual incomes without increase in their cost. At least it is obvious that the rate of interest, or productivity of capital, could never reach zero, since there is rarely any ultimate limit, even in an individual

industry, to the possibility of increasing output by further investment. The interest rate could be zero only if all products known, empirically or in imagination, into the creation of which capital in any way enters, were free goods. The only question has to do with the amount of fall in the rate of yield which would result from a given amount of capital investment. In the first place, we must assume no other change to take place. Some idea of the scale of the magnitudes involved may be gained by suggesting as a guess—probably a conservative one for our argument—that doubling the total wealth of society would halve the rate of return. (This does not mean “unit elasticity” in the correct technical sense, but the argument is the same.) On this supposition, the interest rate would fall logarithmically to about half its initial value, each generation, assuming also the highest rate of saving observed in “boom” times.

The proposition that the rate can only change through time, not at all, instantly, is self-evident, but calls for a little discussion to clear up the contrast with the treatment of price equilibrium in the case of commodities, as a timeless or instantaneous phenomenon. In reality, the price of a commodity such as wheat is subject to the same principle; forces operating to produce change could only become effective at some finite speed. In the case of a commodity such as wheat, however, the effect can theoretically be treated as instantaneous because the theory relates to an *equilibrium* price, and there is at any instant an equilibrium price corresponding to conditions at that instant. Equilibrium price theory is always supplemented by some theory of market price to explain discrepancies due to lags in adjustment. The theory of equilibrium price is relevant for a commodity because it can be assumed that the actual price does not diverge very much or very long, and is as likely to be on one side of the equilibrium point as the other. As a matter of fact, it is the equilibrium price which is the concern of producers in their plans, much more than the quoted price at the time plans are made.

In the case of capital and interest, all these elements in the problem are reversed. There is no equilibrium price which has any meaning, and the only price which theory can discuss is a kind of market price, though with some qualifications to be noted presently. It is true that the “Marshallian” theory of interest runs in terms of an equilibrium, and that Schumpeter has “developed” the doctrine by arguing, or asserting, or assuming, that the equilibrium point is zero.<sup>1</sup> Very simple considerations which cannot be elaborated here will show that while it is correct to argue that “other things equal” the accumulation of capital must tend to lower the interest rate, there is no reason for arguing that the process of accumulation at a descending rate would ever come to rest even with other changes eliminated. That the rate could never be zero, or probably even very near to zero, has already been remarked.

And it is fallacious, *a priori*, to argue that other things could possibly be equal. Apart from the inadmissibility of such an assumption, in view

<sup>1</sup> Cf. Lionel Robbins, *Economic Journal*, 1930, pp. 194-214, especially 211 ff.

of the bare fact that the time over which other changes would have to be abstracted is indefinitely long, there is the further fact that the accumulation of capital immediately involves effects which change the conditions of accumulation. It is needful to mention specifically only one of these: accumulation and investment must increase the real income of society (if not of the savers, then of others), which will make saving easier, and there is no reason, *a priori*, why this change alone might not counteract the effect of the reduced incentive to save in the form of a progressively lower rate. Other changes are of course involved which would work in the same direction, and in fact it is an almost purely arbitrary assumption that a reduction in the rate of interest will result in a lower rate of accumulation, even if everything else were absolutely unchanged. Historically, new "demand for capital" has opened up rapidly enough to prevent any general fall in the interest rate.

The primary fact, oversight of which vitiates most discussion of the theory of interest, is that the only situation of which we have any knowledge in capitalistic society is one in which total investment is growing at a fairly rapid rate; the only time when this is not clearly true is when conditions are dominated by war or the economic disorganisation called "crisis," so that the ordinary price relations and controls are inoperative. The heart of a correct theory of interest is the fact, corresponding more or less to infinite "elasticity of demand for capital," that the investment market is capable of absorbing savings at the maximum rate at which they are forthcoming, with only a very gradual decline of the rate of return through time, other things equal, and the further fact that changes which do occur in the "other things" (partly in consequence of the growth of capital, but effects in a "historical," not an economic sense) actually prevent any general decline. With opportunity to invest to an indefinite extent and at a practically unvarying rate constantly open, no one will pay more or take less for any sort of loan than the rate obtainable by investment at the margin of capital growth.<sup>1</sup>

The false impression that this quasi-elasticity is fairly limited may be accounted for by failure to consider a theoretical limitation on the notion of an instantaneous market rate already alluded to. It is true that the market cannot instantly adjust itself to rapid, *unanticipated* changes in the rate of flow of savings into the market without changes in the rate. This is purely a matter of planning and uncertainty and the effect of imperfect foresight. It requires time to plan for investment, and at any moment investment (actual construction of income-bearing goods) is being carried on at a fairly definite rate. If savings suddenly begin to come into the market much more rapidly than the rate planned for (whether correctly or not) by entrepreneurs and promoters in the aggregate, a temporary "glut" and fall in the rate will follow naturally. And, conversely, if the flow of savings is too slow to carry out the plans actually in course of execution, a sort of distress demand will send the

<sup>1</sup> This would be true with little qualification even in a retrograde society, but that is not in point here.

rate upward. Such facts as these undoubtedly enter into Professor von Hayek's confusion regarding the relation between the length of the production process and the analysis of the business cycle. But under no conditions is there a valid basis for arguing that either more investment, of itself, or more rapid investment, need be associated, *either* with investment in more durable instruments, *or* with a lengthening of the construction period.

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