The Supply Price in the Marginal Efficiency of Capital

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The volume of investment, as determined by the marginal efficiency of capital (MEC), is one of the most frequently used and perhaps the least completely explored and inadequately analyzed concepts in macromodels following the lines staked out by Keynes. In the original setting Keynes gave about equal stress to the *supply price* of capital equipment and to the expected flow of earnings on the investment goods over time. Also, the appropriate interest rate was to come from *outside*, as independent of the MEC, though this, too, in some otherwise profound studies of capital theory, has tended to be (mistakenly) identified with the marginal efficiency of capital.

Simply put, we can write:

(1) $$\frac{\text{Expected (discounted) annual earnings flow}}{\text{Market price of new equipment}}$$
$$= \text{MEC (as a percent).}$$

As Keynes pointed out, the MEC was, in essentials, tantamount to Irving Fisher's "rate of return over cost," or Marshall's "marginal productivity of capital," or the "internal rate of return" of the literature following Keynes.

Subsequent Keynesian literature tended to draw its investment or MEC function as in Figure 1, and to write the investment equation as:

(2) $$I = I(r), \text{ where } I = \text{investment.}$$

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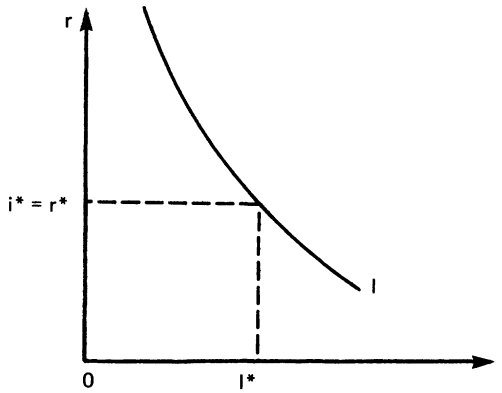
Figure 1

The one (minor) criticism of (2) could be in calling r "the" interest rate rather than distinguishing the interest rate ($= i$) from the marginal efficiency of capital ($= r$). Nonetheless as in equilibrium the two are conceived to become equal, no great harm was done in the short-circuiting which gave a single identity to different entities.

In what follows the importance of the separation will become clear. Also, the reconsideration will have practically nothing to say about the numerator in (1), namely, the expected earnings stream; its subjectivity, uncertainty, futurity, has been amply discussed through the years in both the general theory of macroeconomics and in the more specialized investment theory literature.[1] Almost the whole of our attention will go to the denominator of (1) which deals with the *supply price* of equipment which, given appropriate demand conditions, will become the market price. Any quarrel or difference of opinion, and the point which compels clarity, is the supposition that the supply price of equipment is "constant," representing a horizontal perfectly elastic supply curve.

The problem may be put this way. If the price of a particular item of capital equipment, say a particular type of factory building, or one containing a given amount of floor space, was invariant, and never changed, and listed in sales manuals at P_{k1}, then the I-function in Figure 1 would be an apt illustration. At i^* a volume

[1] A particularly thoughtful account appears in Douglas Vickers, *Financial Markets in the Capitalist Process* (University of Pennsylvania Press, 1978).

of investment of I^* would be set in place. To be sure this does not show us the volume of *physical* investment (Q_i^*) for $I^* = P_i^*Q_i^*$, so that I^* is an amalgam of both implicit prices *and* physical quantities.

Keynes on the marginal efficiency of capital

Before proceeding to analyze the supply price of the capital equipment (P_k), we might pause to consider what Keynes said on the subject; his remarks still remain luminous in comparison to those who have sidestepped the issue. His chapter on the MEC (Chapter 11 in the *General Theory*) is a notoriously short one, barely eleven pages long, but pregnant in ideas on the MEC and on borrower's and lender's risk. The major ideas for our purposes are the following:

> Over against the prospective yield ... we have the *supply price* of the capital-asset, meaning by this, not the market-price ... but the price which would just induce a manufacturer newly to produce an additional unit of such assets, *i.e.* what is sometimes called its *replacement cost*.

And:

> ... the relation between the prospective yield of one more unit of that type of capital and the cost of producing that unit, furnishes us with the *marginal efficiency of capital* of that type. (p. 135)

> The reader should note that the marginal efficiency of capital is here defined in terms of the *expectation* of yield and of the *current* supply price of the capital-asset. (p. 136)

> If there is an increased investment in any given type of capital during any period of time, the marginal efficiency of that type of capital will diminish ... partly because the prospective yield will fall as ... that type of capital is increased, and partly because, as a rule, pressure on facilities for producing that type of capital will cause its supply price to increase; the second of these factors being usually the more important in producing equilibrium in the short run, but the longer the period in view the more does the first factor take its place. (p. 136)

Shortly thereafter, on the rate of interest, Keynes wrote:

> I would, however, ask the reader to note at once that neither the knowledge of an asset's prospective yield nor the knowledge of the marginal efficiency of the asset enables us to deduce either the rate of interest or

the present value of the asset. We must ascertain the rate of interest from some other source. . . . (p. 137)

Obviously, for Keynes the "other" source for ascertaining the rate of interest was in the demand-supply of money, i.e., liquidity preference. Some unnecessary confusion has been engendered through the years in calling relation (2) an "investment" or "MEC" function, and interpreting r as sometimes the MEC and sometimes the interest rate: the two are distinct though they coalesce in equilibrium.

But the bigger set of problems attach to the *supply price* of capital equipment. Note, too, that each type of equipment has a different supply price so that Keynes did not commit the folly of supposing that capital consisted of a homogeneous blob, as did some subsequent Keynesians who have been often chastized for the practice by Mrs. Robinson.

The supply price of capital goods

Few (any?) expositors of Keynesian models have ever included, to my knowledge, any reference to the supply price of capital equipment in any function such as (2), though individual expositors have, from time to time, insisted on the importance of the supply price of capital equipment; my own recollection specifically includes Abba Lerner, Hyman Minsky, Paul Davidson, Lorie Tarshis, Paul Wells. Undoubtedly there have been a good number of others, though the point has not been accorded the universal emphatic stress due it in accounts of the theory of employment. Stephen Leroy has recently made it the subject of a full-blown study.[2]

How then are we to handle the supply price of capital equipment in the theory of investment, considering that the dimensions of the question involve equipment price and quantity, and both of these variables are absent from the function stated in (2), or from its schedule drawn in Figure 1? A suggested procedure follows.

Consider Figure 2a, where a family of individual I-schedules of the type specified in Figure 1 is drawn, and each attached to a different supply price of equipment—thus each curve possesses a different denominator of equation (1) acting as a parameter. Thus

[2] I have seen this study in Xerox, though I confess that I do not recall any of the particular content. I have invited Professor Leroy to make comment on my own technique for handling the theory or any other aspect of the study.
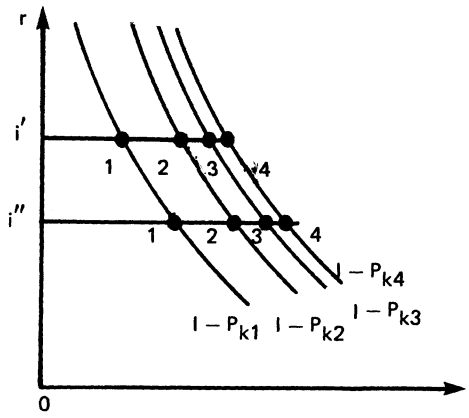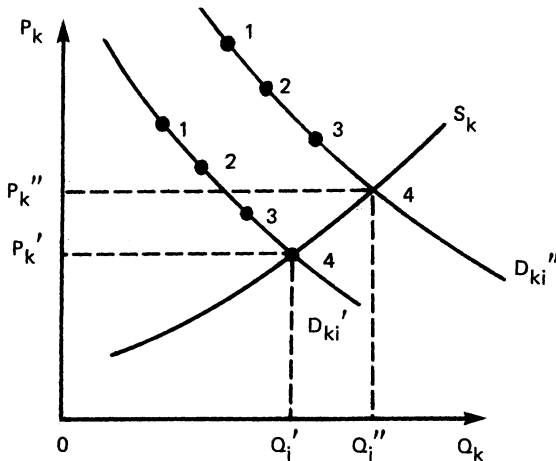
Figure 2a

Figure 2b

$P_{k1} > P_{k2} > P_{k3} > P_{k4}.\ldots > P_{kn}$. As prices of the type of capital equipment in mind fall as we move rightward, the I-function expressing the MEC *increases*. As we take a given absolute price fall in P_k, in amount $\Delta P_k < 0$, this works out to an increasing percentage price fall. Nonetheless, as Keynes remarked, because the prospective yield on the equipment is likely to tumble as the asset becomes more plentiful, the successive curves in the family have been drawn closer together: the family of curves shows "more togetherness" as we move rightward.

Suppose, now, following Keynes's injunction, we take the rate of interest "from some other source," as given by the theory of

liquidity-preference (or loanable funds, for those who are attached
to this formulation: at the moment this is not an issue). If the in-
terest rate is i', then we are moving across the chart field in Figure
2a at i' and picking off investment volume quantities at an interest
rate of i'. Transcribing the investment amounts to Figure 2b,
which contains the P_k prices which rotate each MEC or I-curve in
Figure 2a, we are able to generate the D_k functions in Figure 2b
with each D_k related to a different rate of interest, with its slope
given by the variation in MEC resulting not from an interest rate
movement nor from earnings expectations but by a decline in the
market price of the equipment.

Reading Figure 2b, if i' prevails and with the supply price of
equipment given by the curve S_k, then the competitive equilib-
rium price for capital equipment will be P_k' with the amount of
physical equipment shown at Q_i'. If a rate of interest of i'' rules,
then (with $i' > i''$) the D_k function is shifted, to D_{ki}'', with the
price of equipment running up to P_k'' and the output of the cap-
ital good at Q_i''.

Thus, once we *know* the rate of interest, then the curve family
of Figure 2a which contains the separate MEC schedules enables us
to trace out the appropriate demand for equipment function in
Figure 2b and, with the supply curve of equipment, determine its
market price. The analysis thus comes to rest upon the rate of in-
terest given "from some other source." Some aspects of the analy-
sis are thus reminiscent of Keynes's remarks on finding the appro-
priate savings schedule where to know it required first a knowl-
edge of the level of income which itself required the rate of inter-
est "from some other source." (See GT, p. 181.)

So long as capital goods are not homogeneous, we have, in ef-
fect, to draw separate MEC, D_k, and S_k functions for each type of
capital good. Although the analysis thereby borders on the
tedious, no great matters of principle are involved. Likewise, for
those who are sensitive, even offended, by the reference to "the"
interest rate, this assumption can be dropped, and more realism
imparted, by taking for each firm, and thus for each borrower, the
rate of interest appropriate to each case. Further, insofar as
monopoly prevails in each market for capital goods, the competi-
tive assumption can be discarded in favor of drawing, in lieu of the
supply curve S_k, a marginal cost curve and attaching appropriate
marginal revenue curves to each D_k.

But these qualifications are more or less elementary, and easily incorporated, once the concept of capital goods prices is made part of the analysis with the rate of interest coming "from some other source." The analysis, as rendered, captures (I think) in graphics the essence of what Keynes meant to convey in his pages on the subject.