The Principle of Increasing Risk

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THE subject of this paper is the determination of the size of investment undertaken in a certain period by a given entrepreneur. He intends, for instance, to build a factory producing a certain product. He is faced with given market conditions: he knows the price of the product in question, the level of wages and of prices of raw materials, the cost of construction and the rate of interest. Besides he has some rather vague ideas as to the probable future change of prices and costs. This knowledge is the basis for the planning of investment, i.e., for the choice of the amount of capital k (measured in terms of money) to be invested and the method of production to be applied.

With a *given* amount of capital k and a given method of production the entrepreneur is able to estimate the series of future returns (differences between revenues and effective costs) $q_1, q_2, \ldots\ldots q_n$ during the prospective life of the factory. We shall call the rate ϵ at which the series of returns must be discounted in order to obtain the amount invested k—the efficiency of investment,[1] whilst by prospective profit p we denote the product $k.\epsilon$. Now we can assume that with given amount invested k the entrepreneur chooses such a method of production as would maximise the efficiency of investment or what amounts to the same (k being given) the prospective profit $p=k\epsilon$. Thus to every value of k there corresponds a definite value of maximum prospective profit p_m:

$$p_m=f(k).$$

Now the method of production being chosen for each value of k the entrepreneur has still to define the optimum k, i.e., the size of investment. He must charge the capital invested at the market rate of interest and make also some

[1] This definition is identical with that of Keynes' marginal efficiency of an asset.

allowance for risk whose rate we denote by σ. Thus the entrepreneur's prospective gain g is:

$$g = p_m - (\rho + \sigma)\, k.$$

The entrepreneur will obtain the maximum gain at the value of k which satisfies the equation

$$\frac{dp_m}{dk} = \rho + \sigma$$

and this value of k is the optimum amount to be invested. Now $\frac{dp_m}{dk} = f'(k)$ is nothing else than the efficiency of small capital addition dk to the amount invested k – supposing that both k and $k+dk$ are invested with optimum method of production. We shall call $f'(k)$ marginal efficiency of investment. We can consequently say that the size of investment k_o is determined by that level at which marginal efficiency of investment is equal to the sum of the rate of interest ρ and rate of risk σ.

As can be easily seen from the chart the optimum amount k_o to be invested is finite only if marginal efficiency of investment falls when k exceeds a certain value. This fall may be caused by: (1) large scale dis-economies; (2) imperfect competition. The first reason though generally admitted seems to be not very realistic. It is quite clear that its technological interpretation is wrong: it is right that every machine has an optimum size but why not let ten (or more) machines of given type work? Thus only the argument of difficulties of management arising out of the large scale of enterprise remains. But also that is doubtful (why not start ten factories instead of one with

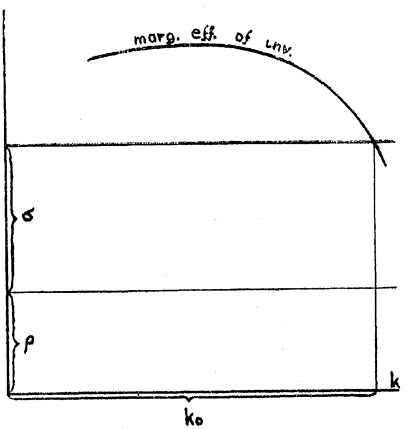

FIG. 1

ten independent directors ?) and at any rate concerns only such industrial giants as are far above the average size of existing enterprises.

The explanation of the limited size of investment by imperfect competition is more realistic but also does not cover the ground. The imperfection is often slight and in that case immense enterprises would be planned.[1] Further the imperfect competition cannot explain the fact that in a given industry at the same time large and small enterprises are started. Thus there must exist a factor restricting the size of investment which we have not taken into account in the above argument.

II

We have assumed till now—as is usually done—that the rate of risk is independent of the amount invested k. And it is this assumption which has to be dropped, I think, in order to obtain a realistic solution of the problem of "limited investment."[2]

There are two reasons for the increase of marginal risk with the amount invested. The first is the fact that the greater is the investment of an entrepreneur the more is his wealth position endangered in the event of unsuccessful business.

The second reason making the marginal risk rise with the size of investment is the danger of "illiquidity." The sudden sale of so specific a good as a factory is almost always connected with losses. Thus the amount invested k must be considered as a fully illiquid asset in the case of sudden need for "capital." In that situation the entrepreneur who has invested in equipment his reserves (cash, deposits, securities) and taken "too much credit" is obliged to borrow at a rate of interest which is higher than the market one.

If, however, the entrepreneur is not cautious in his investment activity it is the creditor who imposes on his calculation the burden of increasing risk charging the successive portions of credits above a certain amount with rising rate of interest.[3]

[1] If the competition is perfect and the marginal efficiency is greater than the sum of rate of interest and risk, k_0 is infinite (see Fig. 1).

[2] The principle of increasing risk was already used in my article "A Theory of the Business Cycle," *Review of Economic Studies*, February, 1937, pp. 84–85.

[3] See M. Breit, "Ein Beitrag zur Theorie des Geld- und Kapitalmarktes," *Zeitschrift fuer Nationaloekonomie*, Band VI, Heft 5, p. 641.

The amount invested k_0 is now given by the condition that the marginal efficiency of investment is equal to the sum of marginal risk σ and the rate of interest ρ. The $\rho + \sigma$ curve is not a horizontal curve as in Fig. 1 but an upward sloping one. The point of intersection with the marginal efficiency curve determines the size of investment and this point exists even in the absence of large scale diseconomy and imperfect competition (Fig. 2).

Now the various sizes of enterprises started in the same industry at a given moment can be easily explained. The smaller is the own capital of an entrepreneur investing the amount k the greater the risk he incurs. For his possible losses bear a greater proportion to his wealth and—since the amount of credits considered by his creditors as "normal" is in a certain proportion to his own capital—the danger of "illiquidity" is greater too.

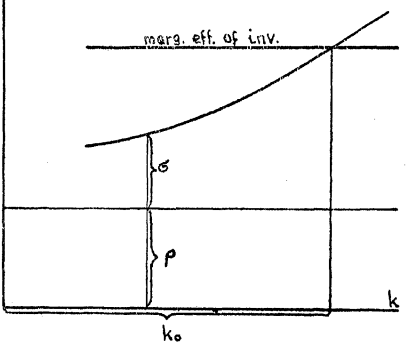

FIG. 2

Thus the smaller is the own capital the higher lies the $\rho + \sigma$ curve and—as is easy to see on the chart—the smaller is the amount invested k_0. The enterprises started in a given industry at a given moment are not of equal size because the own capital of entrepreneurs is not equal. The "business democracy" is a fallacy: the own capital is a "factor of investment."

III

In the case represented in Fig. 2 we have constant returns to the scale (the imperfect competition is neglected) and thus constant marginal efficiency of investment. Thus the marginal efficiency curve represents a constant method of production.

Let us now consider what happens if the rate of interest

is lowered. The $\rho + \sigma$ curve shifts down and its point of intersection with the marginal efficiency curve moves to the right (Fig. 3). The method of production applied by the entrepreneur in his plan does not change whilst the size of investment increases. *Consequently so long as we can consider the influence of imperfect competition as negligible and thus have constant returns to the scale the change in the rate of interest does not affect the method of production admitted by the entrepreneur in his plans but only the size of investment planned.*

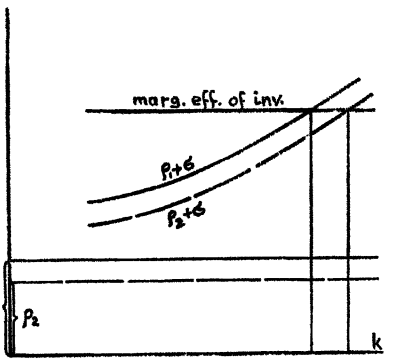

FIG. 3

This statement seems to be in contradiction with the classical theory of marginal productivity of capital and labour but the contradiction is only apparent. The point of departure of the classical doctrine is a drastically simplified model of production in which the quantity of product is a definite function of the amount of "real" capital and labour used. The necessary condition of equilibrium is the equality between the marginal productivity of each factor and its price divided by the price of product. In the case of constant returns to the scale (homogeneous production function) this is also a sufficient condition for long run equilibrium, for with constant returns the marginal productivities' equations exclude the existence of the entrepreneur's gain. If the rate of interest falls, a shift towards a new long run equilibrium must take place in which the marginal productivity of capital is lower, that of labour higher, and more capital is used in proportion to labour. But the theory says nothing about the immediate influence of the fall of the rate of interest on the *plans* of the entrepreneur. Such a fall in the case of constant returns to the scale (and if our principle of increasing risk is not taken into account) must create a tendency to plan investment of infinite size and with indefinite method of production (every method applied on infinite scale gives an infinite

profit). Only after the output of the product is suddenly increased its price falls and this makes again possible the restoration of long run equilibrium in which the marginal productivity equations are satisfied.[1]

Thus our problem was quite different from that of classical theory. We examined the planning of the entrepreneur in a given situation which in general is *not* the position of long run equilibrium. We tried to find the factor limiting the size of the investment planned which, as we see, is non-existent in the classical theory in the case of industry subject to constant returns to the scale and not in the position of long run equilibrium. And also our statement that the fall of the rate of interest does not affect the method of production but only the scale of investment plans referred only to the *plans* but not to the situation arising out of their realisation.

The classical thesis of the low rate of interest causing the use of more capitalistic method of production was often applied not only for long run equilibrium position but also for entrepreneurs' planning in "disequilibrium." This interpretation is of course wrong and as we have shown above, if we neglect imperfect competition and introduce the principle of increasing risk the fall of the rate of interest has no immediate effect on the method of production applied in the plans of entrepreneurs.

IV

One intricate point is still involved in the matter above examined. We mean the problem of the *rate* of investment decisions per unit of time. But before dealing with it we shall transform the Fig. 2 a little. We subtract from the ordinates of both marginal efficiency curve and $\rho + \sigma$ curve the rate of interest ρ and thus obtain the marginal net profitability (marginal efficiency minus rate of interest) curve and the marginal

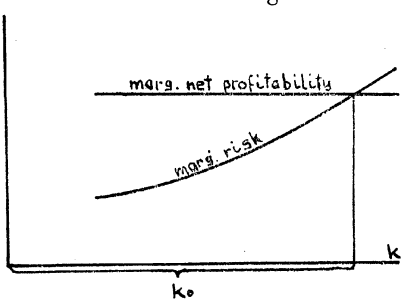

FIG. 4

[1] This treatment is however quite formal, for in reality cumulative process arises which causes (if the rate of interest is not raised) either hyperinflation or fluctuations about the new position of long run equilibrium.

risk curve. The point of intersection of these two curves gives of course the same value k_0 as above.

Let us divide the time into equal periods Δt short enough to consider the economic situation, i.e., the level of prices, wages, etc., as constant within the period (the change of this situation is thus to be imagined as concentrated at the beginning of the period). In each period the entrepreneur takes so much of investment decisions as to equate at the end of it the marginal risk to the difference between the marginal efficiency and the rate of interest. Thus it would seem that no investment decision at all will be undertaken in a period if the " economic situation " remains the same as in the preceding one, because the point of intersection of the marginal risk curve and the marginal net profitability curve lies on the ordinate axis at the beginning of the period considered. This is, however, wrong. For one thing does change in the position of our entrepreneur: during the period Δt he saves in general a certain amount s. Δt out of his income.

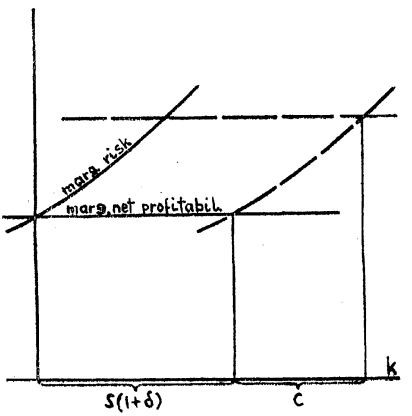

FIG. 5

This accumulation of savings causes a parallel shift of the curve of marginal risk to the right. For the entrepreneur can invest the new accumulated amount without reducing his safety or increasing illiquidity. He may invest even more: if the relation of his net indebtedness (difference

between debts and claims) to his own capital is δ, he can freely invest $s(1+\delta)\ \Delta t$.[1]

Such is then the amount of investment decisions if the situation in the period examined is the same as in the preceding one. If, however, this is not the case and the net profitability curve has shifted, also an amount c due to the change of the economic situation will be invested (see the chart). The investment planned during the period Δt consequently amounts to $s(1+\delta)\Delta t + c$ and thus the rate of investment decisions during the period is:

$$d = s(1+\delta) + \frac{c}{\Delta t}.$$

$\frac{c}{\Delta t}$ depends on the velocity of change of marginal net profitability. We denote it by v and thus have:

$$d = s(1+\delta) + v.$$

This equation means that *the rate of investment decisions of a single entrepreneur depends on his capital accumulation and on the velocity of change of marginal net profitability.*

[1] It is now clear that the marginal risk + rate of interest curve dealt with in the preceding paragraphs must be taken in the position at the end of the period in which investment activity was considered.