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The Relation between the Rate of Interest and Investment in Post-Keynesian and Neo-Ricardian Analysis

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Is there an inverse relation between the rate of interest and investment as Keynes leads us to understand? Recently this question has been posed yet again. In a debate over the role of finance, Professor Kregel has written "There is no disagreement [between Kregel and Asimakopulos, ed.] that it is the movement of the rate of interest as a result of decisions to increase investment which is the key variable limiting investment" [Kregel, 1986, p. 94]. Yet Professor Garegnani has written that the results of the Cambridge Capital Controversy demonstrate that, in general, there is no inverse relation between the rate of interest and investment. [Garegnani, 1978]. Thus this paper will undertake, in part I, to investigate three theories which purport to demonstrate that such a relation does exist. The first theory is that put forth by Keynes in the *General Theory*. The second, attributable to Paul Davidson, we take as representative of the Post Keynesian view of investment and the rate of interest. The third, developed by Edward Nell, we take as reflective of the views of (some) Neo-Ricardians.

In each case we demonstrate that the existence of an inverse relation between investment and the rate of interest depends on the existence of diminishing returns (which may occur on either the supply or demand side, i.e., diminishing utility), a condition which may not always hold in an economy. In part II of the paper we demonstrate that an inverse relation between investment and the rate of interest may be obtained by replacing the questionable concept of diminishing returns with Kalecki's "principle of increasing risk." We end, finally, with some comments on the basis of the relationship between investment and the rate of interest when viewed in the light of Kalecki's principle.

KEYNES' THEORY OF INVESTMENT

In chapter 11 of the *General Theory* Keynes develops his theory of investment in terms of the supply and demand price of capital[1] [Keynes, 1964, p. 137]. The supply price of capital is defined as that price which would just induce a manufacturer to produce an additional unit of capital. The demand price of capital is defined by $\Sigma Q_r d_r$, where Q_r is the prospective yield from an asset at time r, and d_r is the present value of \$1 deferred r years at the current rate of interest. The equilibrium amount of investment occurs at the point where the demand price for capital equals the supply price.

According to Keynes, the demand and supply price of capital vary with the amount invested due to changes in the prospective yield and to increased pressure on the facilities used to produce capital goods. In Keynes' words:

> "If there is increased investment in any given type of capital during any period of time, the marginal efficiency of that type of capital will diminish as the investment in it is increased, partly because the

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> prospective yield will fall as the supply of that type of capital is increased, and partly because, as a rule, pressure on the facilities for producing that type of capital will cause its supply 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" [Keynes, 1964, p. 136].

Thus, the demand price of capital is inversely related to the amount of investment expenditure, while the supply price is positively related to the amount of investment expenditure. An increase in the rate of interest, by reducing the discounted prospective yield, brings about a reduction in the demand price of capital and hence leads to a reduction in the amount of investment expenditure. Graphically, an increase in the interest rate shifts the demand for investment curve to the left, as in figure 1, where the curve shifts to $\Sigma\ ^1Q_r\ d_r$.

Now the existence of an inverse relation between investment and the rate of interest depends on the slopes of the curves in figure 1. To see this, assume both that prospective yields remain constant as investment increases and that increases in capital goods can be supplied at a constant price. We thus have figure 2. As long as the demand price exceeds the supply price, investment will increase. An increase in the rate of interest which shifts the demand price schedule to $\Sigma\ ^1Q_r\ d_r$ will have no effect on investment as long as the demand price is greater than or equal to the supply price, i.e., there is no inverse relation between investment and the rate of interest. Once the interest rate rises to a level which brings the demand price below the supply prices, investment falls to zero. Since the relation between the interest rate and investment depends on the slopes of the demand and supply for investment schedules, it is important that we identify (or discover) the economic arguments underlying the assumed shapes of the curves.

Keynes does not provide much discussion, beyond the paragraph quoted above, to explain why the curves have the assumed shapes, apparently believing the reasons to be self-evident. With respect to the rising supply price of capital, it seems clear that Keynes is assuming the existence of near universal diminishing returns. With respect to the falling demand price for capital, things are not as clear. It is evident that the demand price for capital falls because of the declining prospective yields which occur as the amount of investment increases. But why do prospective yeilds fall? Keynes does not directly answer this question, but two possibilities exist. The first is that Keynes may be assuming that the marginal

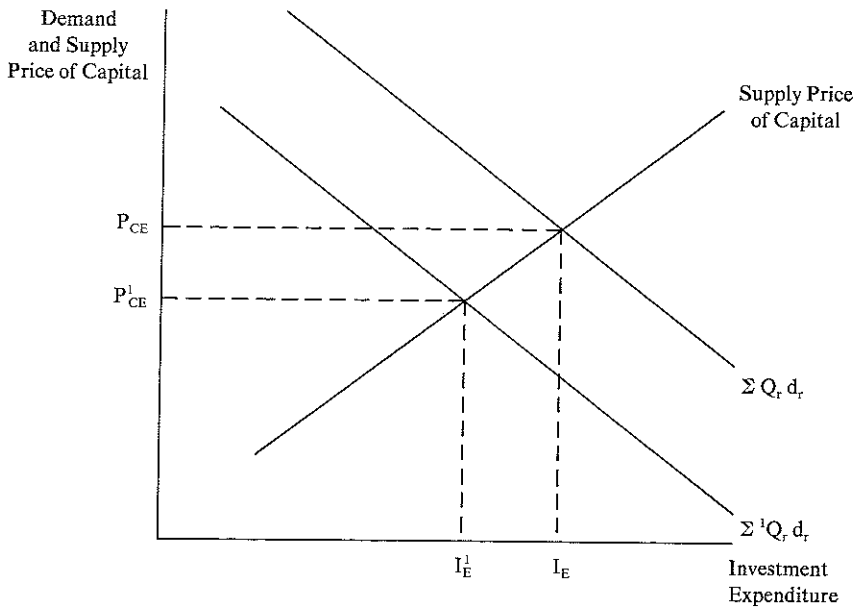

Figure 1.

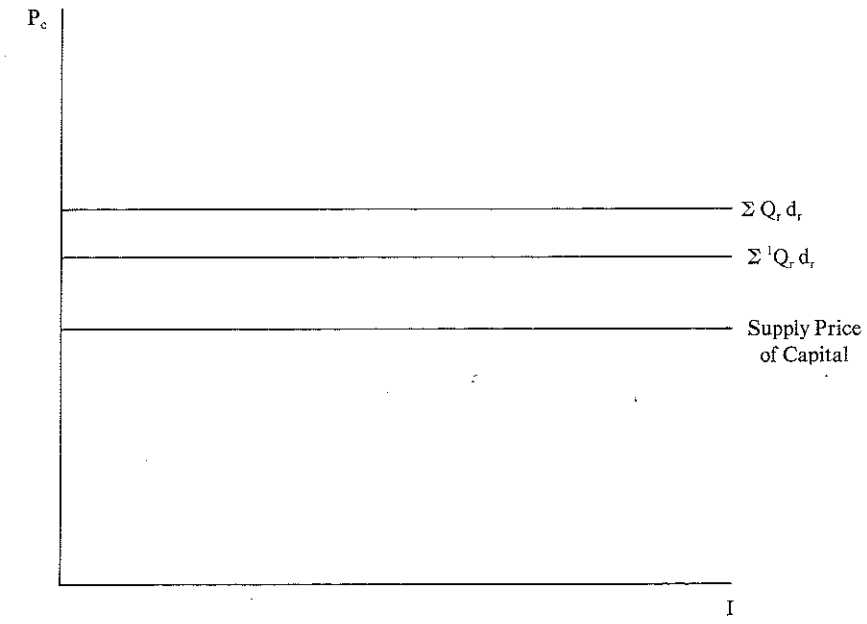

Figure 2.

productivity of capital declines as capital increases. In this case, the amount of output produced by each extra unit of capital falls, thus bringing about a fall in the yield. While this interpretation is possible, it is at least somewhat questionable in that Keynes, in the appendix to Chapter 14 and Chapter 16 of the *General Theory,* expressed deep skepticism concerning the marginal analysis which underlays neoclassical capital theory. More likely is a second possibility, stressed by Keynes in Chapter 16 of the *General Theory,* that it is the valuation of output of each extra unit of capital which declines as investment increases. [Keynes, p. 213]. The decline in valuation is evidently brought about by a fall in the prices of the additional output which is produced with the larger investment, a fall necessitated by the need to sell a larger output to consumers who experience diminishing marginal utility as amounts consumed increase. The fall in price, with productivity unchanged, then results in declining yields. It thus appears that Keynes' analysis rests on the assumption of diminishing returns and/or diminishing marginal utility. Now we shall have more to say concerning these assumptions, particularly as they relate to the aggregate supply-aggregate demand version of the *General Theory* which has become the hallmark of Post Keynesian economics. Before doing so, however, we shall consider Davidson's theory of investment both because of his theory's similarity to Keynes' work, and because our comments with respect to the above assumptions are relevent for the aggregate demand—aggregate supply approach of post Keynesian economics.

DAVIDSON'S POST KEYNESIAN MODEL

In *Money and The Real World* [Davidson, 1978], Davidson puts forth an analysis of the determination of the price and quantity of capital which we take as representative of the post Keynesian position.

According to Davidson, the quantity of capital and the amount of new investment are determined by a supply and demand analysis which, in equilibrium, leads to an equality between the demand price for capital and the flow supply price of capital. The mechanisms which bring about this result are described as follows. First, let $Q_r = (q - c)_r$ be the expected yield for a unit of capital at time r, where q is the expected money value of output (net of running expenses) which can be obtained by assisting some process of production or supplying services to a customer, and c is the costs (including wastage) of carrying the asset

over the period. [Davidson, p. 62]. Next, let d_r be the present value of one dollar deferred r years at the current rate of interest. Then $\Sigma Q_r d_r$ is defined to be the demand price of investment. The demand price can be plotted versus the quantity of capital, yielding the inverse relation graphed in figure 3 as D_k.

Flow demand for capital, d_k, is now added to D_k to obtain the total demand for capital, $D_k + d_k$ in figure 3. On the supply side, Davidson takes the existing stock of capital as a given, based on what has been inherited from the past. This is given as S_k in figure 3. Finally, the flow supply schedule, $S_k = I_g$ (where I_g = gross investment), is given as a direct function of the price of capital. Equilibrium is reached at the point where $(D_k + d_k) = (S_k + s_k)$, or at P_F and K_3. Net investment is equal to $K_2 - K_1$.

In order to demonstrate the role diminishing returns play in this theory, the following must be noted. Though the demand price for investment is given by $\Sigma Q_r d_r$, the D_k Curve in figure 3 declines as K increases because $Q_r = (q - c)_r$ declines as K increases. This is so since Davidson states "A higher rate of discount, with any given set of expectations about the prospective money yield of capital, will entail a leftward shift in the stock demand for capital schedule." [Davidson, 1978, p. 81.] Thus, since changes in the discount factor, d_r, shift the demand for capital curve, it must be changes in Q_r which cause the decline as we move along the schedule. Moreover, Davidson writes, "... the rate of discount will be related to the rate of interest, if the latter changes, *ceteris paribus*, the former will change. Thus the rate of interest can be used as a proxy for the rate of discount as a variable which explains investment" [Davidson, 1978, p. 81]. An increase in the interest rate causes the stock demand for capital curve to shift leftward as in figure 4, leading to a drop in net investment. Thus, there is an inverse relation between the rate of interest and investment.

Finally, Davidson notes: "It is the effect of a change in the rate of interest on the discounting process, and hence on the demand for capital schedule, which links the money rate of interest to the level of investment output. Hence the money rate of interest rules the roost—the activity in the capital goods sector—in the short run by limiting the demand for capital." [Davidson, 1978, p. 82].

The above analysis clearly makes use of an inverse relation between the interest rate and investment to demonstrate that "too high" an interest rate can limit investment, and hence lead to unemployment. Though diminishing returns have not been explicitly mentioned, they do play a causal role in the inverse

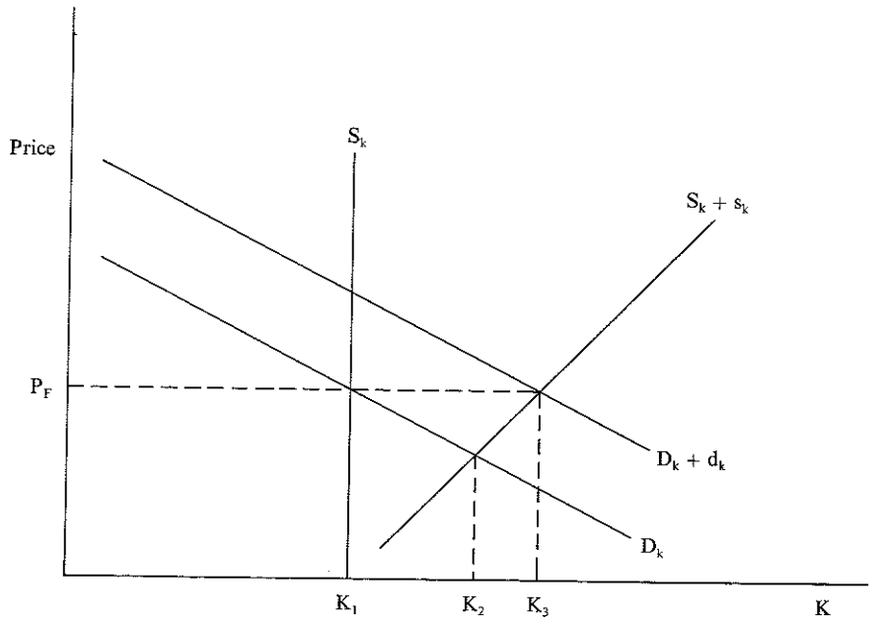

Figure 3.

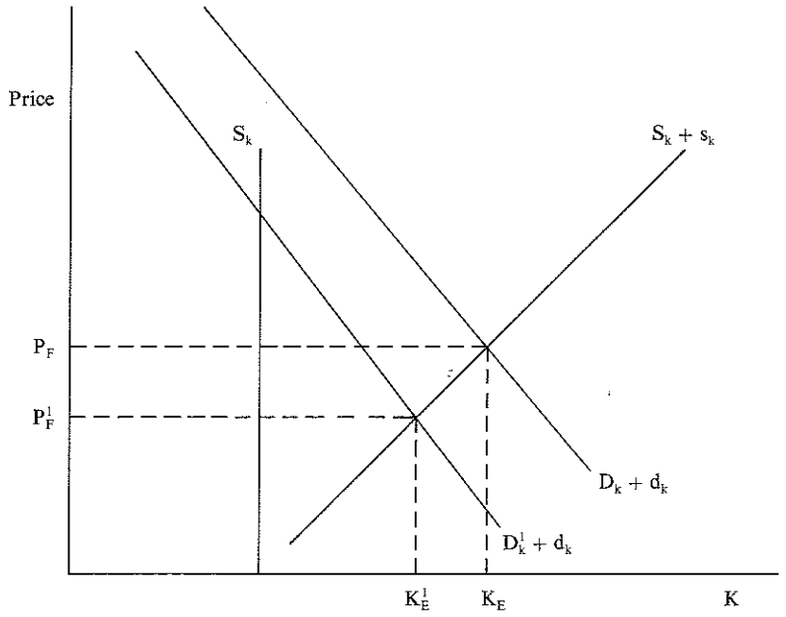

Figure 4.

relation posited by Davidson between the demand price of investment and the quantity of capital. As noted above, this relation is based on the view that $Q_r = (q - c)_r$, the expected yield on a unit of capital, declines as the quantity of capital increases. The question is, why? Clearly, Neoclassical analysis would make the claim that Q_r declines because of the decline in the marginal physical product of capital. This, however, is the relation undermined by the Cambridge Capital Controversy, and Davidson is well aware of this critique [Davidson, 1972, p. 82]. Indeed, it is evident he wishes to avoid an assumption of diminishing marginal productivity (in the Neoclassical sense) for he states: "In other words, as fixed capital becomes less scarce, its prospective yield in terms of a future income stream falls relative to its flow supply price, even if capital goods have not become less productive in the physical sense." [Davidson, 1978, p. 91]. But the question still remains, why?

One could perhaps posit that c, unit carrying costs, rises as K increases. But there is no obvious reason why this should be so, and Davidson does not explicitly assume this. Even if this were the case, it would still be necessary to posit some relation between q and K in order to know how $q - c$ varies with K. This is precisely the sticking point, according to the Capital Controversy debate, because there is no systematic relation between capital and its productivity. There is also the possibility that $q - c$ falls simply because entrepreneurs expect it to fall. (Recall that $q - c$ is the expected yield). Now it is certainly the case that there may be occasions when $q - c$ falls solely as a result of expectations. This might occur, for instance, in situations where there is a great deal of uncertainty (perhaps even ignorance) with regard to future revenue flows and where, as a result, "animal spirits" become pessimistic. However, if it is the case that there is no necessary physical relation between $q - c$ and K, as the Capital Controversy asserts, then it seems to be placing too much weight on expectations to believe that entrepreneurs systematically expect $q - c$ to decline as K increases when 1) there is no necessary reason for this and 2) there may well be times when the actual value of the yield does not decline with K, in which case expectations would be systematically incorrect. There thus appears to be no explanation for a systematic inverse relation between $q - c$ and K based on diminishing productivity, yet Davidson asserts that such a relation holds due to some type of diminishing returns though not, in Davidson's view, the type posited by neoclassical economists.

There is another possibility, suggested by some post Keynesians, though not Davidson, which might explain the downward slope of the demand for Capital Curve. This is the suggestion that it is diminishing utility which leads to a downward sloping demand curve for capital.[2] This argument would procede as follows. As the capital stock increases, the amount of output supplied would also increase. If diminishing utility is present, a larger output can only be sold at a lower price, and it is this lower price which reduces the return on capital, hence bringing about the downward sloping demand for capital curve. For this argument to hold, however, certain empirical conditions would have to be met. To see this, note that since diminishing productivity is no longer being assumed, the economy must be characterized by constant (or increasing) returns to scale. If we assume that the money wage is constant, then unit labor cost is constant as output changes. If the price of output is falling as output is increasing, then the mark-up must be falling as well. Whether this result agrees with the empirical evidence is at least somewhat questionable. Moreover, if this result does obtain for an economy, then the post Keynesian aggregate supply curve would be shifting down as output increases, a result not explicitly made in most Post Keynesian models.

Another way to view this condition is as follows. Recall that a given demand for capital curve is based on a given rate of interest. As the demand for capital increases, the mark-up (and hence the rate of profit which depends on the mark-up) falls (as shown above). Presumably, the demand for capital will increase until the rate of profit is equal to the given money rate of interest. The downward slope of the demand curve for capital is then explained by the fact that the larger capital stock leads to a larger output, which, in the presence of diminishing utility, can only be sold at a lower price. This lower price brings about a decline in money returns, hence reducing the demand price of capital. This process continues until the rate of profit (based on the mark-up) reaches equality with the rate of interest. Thereafter, there is no further increase in the demand for capital. Thus, the degree to which the demand price falls as output increases clearly depends on the degree to which diminishing utility obtains in the economy. If the degree of diminishing utility is small, then the demand for capital may expand to the full employment level before the rate of profit is brought into equality with the rate of interest. If the interest rate now increases, the demand for capital curve will shift to the left, however, the new equilibrium may still be such that the demand for capital is at its full employment level, i.e., there is no decline in investment as the interest rate increases. (This of course depends on the interest rate not rising above the rate of profit corresponding to the full employment rate). Thus, the degree of diminishing utility must be sufficient to ensure that this does not occur, if an inverse relation between investment and the rate of interest is to exist. But, there is good reason to believe that utility will diminish slowly, in the process outlined above, for as price is falling, with constant unit labor costs, income is being re-distributed from profit to wage income. Since income is increasing, the consumption of all goods can increase. Diminishing utility is generally concerned with the case of increasing consumption of one good, holding all other goods constant, and not the case wherein the consumption of all goods rises as income rises. Nevertheless, whether there is sufficient diminishing utility is an empirical issue. We conclude, then, that in this case the downward sloping demand for capital curve requires both diminishing utility and the condition that equilibrium is characterized by equality between the rate of interest and the rate of profit.

Before turning to Professor Nell's analysis, two points remain to be discussed. First, in private correspondence, Professor Davidson has informed us that he is willing to relinquish the assumption of diminishing returns, and hence now views the demand curve for capital as a horizontal line. (Davidson, 1988). An increase in the interest rate now shifts the demand curve for capital downwards, and, with an upward sloping supply of capital curve, leads to a reduction in the quantity of capital, thus maintaining an inverse relation between the interest rate and investment, according to Davidson. In our view, however, this argument does not avoid an assumption of diminishing returns, for as Davidson states in *Money and the Real World,* ". . .the flow supply schedule, in a competitive environment, will reflect short-run rising marginal costs because of diminishing returns in the investment-goods industry. . . ." (Davidson, 1978, p. 25). If Davidson relinquishes the assumption of diminishing returns, then both the demand and supply curves are horizontal. Since capital will be purchased only if the demand price is greater than or equal to the supply price, there will be a demand for capital when the demand curve lies above the supply curve, or when the two curves coincide. This has two implications. First, since both curves are horizontal, the

equilibrium quantity of capital is indeterminate. Second, if the demand curve lies above the supply curve, an increase in the interest rate, while lowering the demand curve in the manner described by Davidson, does not reduce the demand or supply of capital unless the demand curve falls below the supply curve, in which case the quantity of capital will equal zero. Thus, there will not, in general, be an inverse relation between the interest rate and investment without the assumption of diminishing returns. We conclude, therefore, that Davidson must be assuming some form of diminishing returns, since he does state that an inverse relation between the interest rate and investment exists.

Second, it should be readily apparent that our comments concerning diminishing returns in Davidson's theory apply equally to Keynes' work, since both use the same demand-supply price of capital model in explaining the determination of the relations of the interest rate to investment.

NELL'S MODEL

Davidson and Keynes are not the only economists who assume that some type of (non-neoclassical) diminishing returns are responsible for the inverse relation between the interest rate and investment. For Edward Nell, whose work we take as reflective of the Neo-Ricardian position, assumes exactly the same view [Nell, 1983, p. 96]. Nell incorporates this assumption into a Sraffian model, and it is instructive to see both how such an assumption leads to an inverse relation between the interest rate and investment, as well as what the lack of such an assumption would imply about the relation between investment and the rate of interest.

Nell's aim is to re-formulate Keynes' Chapter 17 argument concerning the cause of unemployment. Recall that in this chapter Keynes states that unemployment develops because of three things: 1) the money rate of interest falls slowly (or remains at a high level) because of the essential properties of money, 2) the marginal efficiency of capital decreases as investment increases due to diminishing productivity, 3) equilibrium occurs when the marginal efficiency of capital is equal to the rate of interest on money. Thus, if the interest rate is high enough, investment may be brought to a halt (due to the declining MEC caused by diminishing productivity) before full employment is reached.

Nell criticizes Keynes' position because of its assumption of diminishing productivity. In Nell's view, the assumption of general diminishing productivity is too strong. [Nell, 1983, p. 96]. Moreover, such an assumption is unnecessary according to Nell, if one utilizes Sraffa's work to formulate the above argument concerning unemployment. In particular, Nell defines the MEC to be the ratio of output to means of production for Sraffa's Standard Commodity, i.e., the standard ratio. This ratio is determined by that basic commodity with the lowest own-rate, i.e., that basic commodity with the lowest ratio of amount produced to amount used up in the production process. By virtue of the construction of the standard commodity, all of the basic commodities in the system have an own-rate equal to the standard ratio, hence equal to the MEC. Prices, then, adjust in order to bring about a situation where the rate of profit is uniform in all industries, and equal to the MEC. In Nell's words "Hence we do have a theory of relative prices: they are governed by the condition that the rate of profit be equalized in all sectors and be equal to the general MEC, which in turn equals the standard ratio, which, finally, is governed by the commodity with the lowest such ratio. [Nell, 1983, p. 98].

Now suppose that the economy moves to a higher level of output characterized by an increase in at least one of the input-output coeffcients, i.e., there are diminishing returns in the production of at least one of the commodities. This is a weaker assumption than Keynes' assertion of general diminishing returns, for only one commodity need experience such an effect. Intuitively, one can see that the maximum per unit profit in the standard system must now be lower, since a higher input requirement generates a smaller surplus, which must be shared by all commodities in order to yield a uniform return. More formally, the Frobenius-Perron theorem tells us that the maximum eigenvalue is an increasing function of the unit input requirements. Thus if one input-output coefficient increases, so will the maximum eigenvalue. Since the maximum rate of profit in the standard system equals $1/1 + L^*$ where L^* equals the maximum eigenvalue, the maximum rate of profit falls as one unit input requirement rises. If the wage rate is taken as given, then the uniform rate of profit must fall. Thus, Nell's argument is that some type of diminishing

returns occurs as output rises, leading to a reduction in the uniform rate of profit. This rate will continue to fall, i.e., output and investment will expand, until the point where the uniform rate of profit is equal to the rate of interest. Hence, if the rate of interest rises, investment and the level of output will fall in order to generate a higher uniform rate of profit. Note, then, that an inverse relation between investment and the rate of interest arises because of two things: 1) diminishing productivity, and 2) the equilibrium condition which asserts that the rate of interest must equal the rate of profit.

While Nell has reached this result without making the strong assumption concerning diminishing productivity which Nell believes Keynes to have made, it is also true that this result calls into question the existence of an inverse relation between interest rates and investment in general. If constant (or increasing) returns to scale prevail up to the point of full employment, no decline in the rate of profit will occur. As long as the current rate of profit is equal to or greater than the rate of interest, investment and output will expand to the full employment level, i.e., there will not be an inverse relation between the rate of interest and investment. (Unless the rate of interest were so high that it exceeded the rate of profit, in which case investment would be zero). As Nell himself notes, Sraffa's view, as stated in his 1926 article on the issue of returns, held that the general presumption ought to be in favor of the existence of constant returns [Nell, p. 93]. If this view is accepted, then one ought to hold that in general an inverse relation between investment and the rate of interest does not exist.

Even if diminishing returns do prevail in one industry, this experience is not sufficient to obtain the relation posited by Nell, for it could be the case that increasing returns characterize some other industry, which would tend to increase the maximum rate of profit in the standard system. Thus, one must look at the entire pattern of change in the technological coefficient matrix as output changes in order to derive the inverse relation between the interest rate and investment, and there does not appear to be any a priori guarantee that the maximum rate of profit must decline as output increases.

A SUMMING UP

What may we conclude on the basis of the analysis thus far presented? In Nell's case, it is evident that an assumption of diminishing returns is required to derive the relation between investment and the rate of interest. In the case of Keynes and Davidson, it is clear that both include assumptions of diminishing utility and/or diminishing returns as essential concepts in deriving the inverse relation between investment and the rate of interest. But the existence of wide-spread diminishing utility is questionable given the argument noted above (p. 8) concerning the re-distribution of income which occurs when yields decline due to falling price levels. The diminishing returns argument is also suspect once diminishing returns due to declining marginal products of capital are ruled out, as they must be, given the conclusions of the Capital Controversy. What is the basis for believing in the existence of systematic diminishing returns? Neither Davidson nor Nell specify to what systematic non-neoclassical, diminishing returns are attributable, and it is clearly not self-evident that these unexplained factors always outweigh forces tending to bring about increasing returns. In sum, diminishing returns appear to provide too flimsy a foundation upon which to rest an inverse relation between investment and the rate of interest. The natural question to ask, then, is if there might not be a more satisfying basis for this relation? In the next section of the paper we demonstrate that such a basis does exist in Kalecki's principle of insufficient risk.

KALECKI'S PRINCIPLE OF INCREASING RISK[3]

In a 1937 article entitled "The Principle of Increasing Risk," Kalecki developed a relation between the rate of interest and investment which does not require the use of assumptions about diminishing returns (Kalecki, 1937, pp. 440–447]. Let P_m be the maximum of prospective profit to an entrepreneur resulting from a given size of investment, k. If ρ is the rate of interest and σ an allowance for risk, then the entrepreneur's prospective gain, g, is given by: $g = P_m - (\rho + \sigma)\, k$. The entrepreneur maximizes gain at

the value of k that satisfies the expression:

$$\frac{dP_m}{dk} = \rho + \sigma \tag{1}$$

Kalecki calls dP_m/dk the marginal efficiency of investment, and examines two cases. In the first case, ρ and σ are assumed constant as k varies while the marginal efficiency of investment is assumed to fall as k increases. The decline in the marginal efficiency of investment schedule is explained by large scale dis-economies and elements of imperfect competition. Kalecki rejects this case because the assumption of dis-economies "seems to be not very realistic," while that concerning imperfect competition, while realistic," does not cover the gound." [Kalecki, 1937, p. 442]. But if the marginal efficiency of investment schedule is taken as horizontal, the size of investment can only be determined if changes in ρ and/or σ occur as k changes, and this is where the principle of insufficient risk enters.

Why should ρ and σ rise as the size of investment, k, rises? Kalecki provides two reasons:

> "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 an 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 with successive portions of credits above a certain amount with rising rate of interest." [Kalecki, 1937, p. 442].

Thus, either the entrepreneur incorporates the higher risk associated with a higher level of investment into his/her profit calculations, or, failing such a calculation on the part of the entrepreneur, ρ is increased by those providing the finance needed to undertake the higher level of investment. Kalecki focuses on the first case, which is depicted graphically in figure 5. In this graph the level of investment is at k_E. Suppose now that the rate of interest rises, shifting the $\sigma + \rho$ curve to $\sigma + \rho^1$. We see in the graph that the level of investment falls to $k_{E'}$. Thus, an inverse relation between the rate of interest and investment is derived on the basis of increasing risk, rather than through the use of diminishing returns.

SOME COMMENTS CONCERNING THE USE OF THE PRINCIPLE OF INCREASING RISK

The use of the principle of increasing risk as a substitute for diminishing returns carries with it certain implications which we can only sketch out in the remainder of this paper. First, the principle is perfectly consistent with Keynes' theory of investment, and is capable of explaining the slopes of the investment demand and supply curves postulated by Keynes.[4] Recall that the demand price of capital is equal to a sum of discounted prospective yields. As the amount of investment increases, so does the level of risk, according to the principle of increasing risk. This greater risk should be reflected in a greater discounting of the yields associated with the higher level of investment. That is, the demand price for capital declines not because of diminishing returns reducing the size of yields, rather it declines because the higher level of risk attached to such yields leads entrepreneurs to discount them more heavily. Thus it is d_r, rather than Q_r, which falls as the level of investment increases. Alternatively, if entrepreneurs do not include this added risk in their profit calculations, the cost of borrowing the funds needed to finance the added investment will rise. Thus the supply price of capital, re-defined to include the price just necessary to induce the producer of capital goods to produce another unit of capital *plus* the cost of inducing the financier to lend the extra finance necessary to undertake the investment, will be an increasing function of the level of investment. A similar argument could be used in both Davidson's and Nell's theories. In Nell's theory, rather than having the rate of profit fall as output increases until equality is reached between the rate of profit and the rate of interest, the increasing risk associated with higher investment and output raises the level of interest rates until the point of equality is reached between the interest rate and the rate of profit.

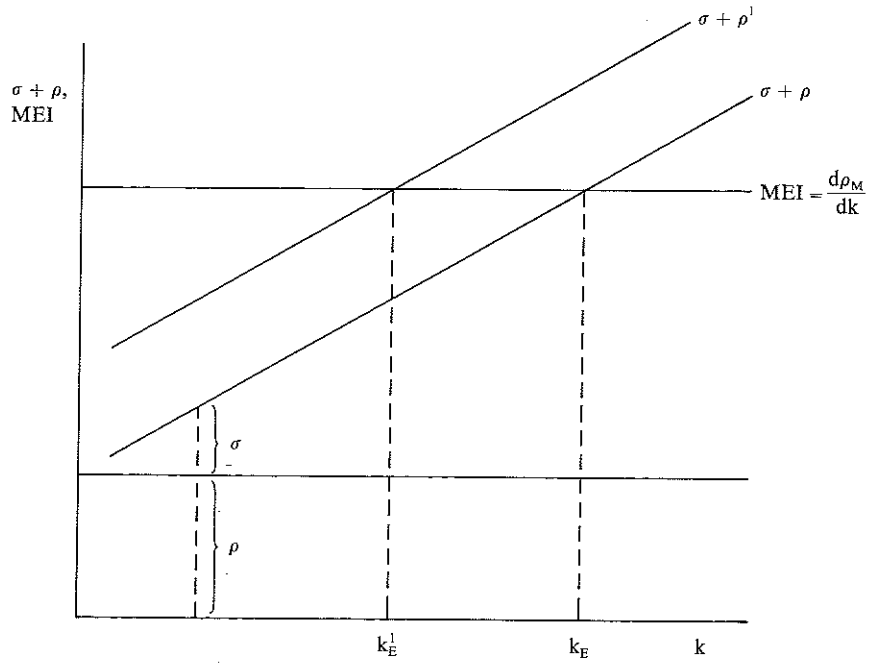

Figure 5.

Second, and perhaps more importantly, an investment-interest rate relation based upon the principle of increasing risk is inconsistent with an assumption of long run equilibrium. Indeed, one of Kalecki's purposes in writing the 1937 article was to explain why firms of different sizes could be started at the same time in the same industry. [Kalecki, 1937, p. 443]. Explaining how his theory differed from the classical theory, he wrote: "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." [Kalecki, 1937, p. 445].

One may perhaps go further and claim that the investment-interest relationship is fundamentally a dis-equilibrium relation. Consider an example in which firms are alike in all respects. Nominal output, PY, is divided between payments to workers, WL, and total profits, TP. A bargaining mechanism establishes a (constant) division between the wage share and total profit share given by P_s (profit share) = k W_s (W_s = wage share k, a constant). Under these conditions we can derive the standard Kaleckian price mark-up relation given by $P = k_w (WL/Y)$ where $k_w = 1 + k$. Note that we could just as easily have written this relation as $P = k_p (TP/Y)$ where $k_p = 1 + 1/k$. Assume further that all interest payments are paid out of total profits, and that the division between interest payments and retained profit (that is—the part of total profit remaining after interest is paid) is also constant. Let I = interest payments = rQ, where r is the rate of interest, Q the amount borrowed to undertake investment. If P_R equals retained profit, then $TP = P_R + I = (1 + k^1) I = (1 + k^1)$ rQ, where k^1 represents the constant division between retained profit and interest. From $P = kp (TP/Y)$ and $TP = (1 + k^1)$ rQ we obtain a price mark-up given by $P = k_i r Q/Y$, where $k_i = k_p (1 + k^1)$. Finally, assume that firms do not calculate the added risk factor in their investment decision-making process, thus creditors raise the interest rate, r, as the level of investment increases. What happens as r increases? Under the conditions given in the example, with constant markups, an increase in r will bring about an increase in P, the price of output. Since firms, by assumption, do not include risk in their calculations, the discount factor remains unchanged. But, the level of prospective yields rises due to the increase in prices. Indeed, given the constant shares assumption, the

demand price will rise sufficiently to maintain the level of investment, i.e., increases in the interest rate do not cause a decline in investment. In effect, firms pass on higher interest rates through higher prices, with output decisions remaining unchanged.

What the above example suggests is that interest rates have an impact on investment when increased interest rates cannot be passed on through higher prices. This, in turn, suggests that the interest rate-investment relation exists precisely because firms are not identical. Thus, they cannot count on being able to increase the price of output when the interest rate they face increases, since differently situated firms in the same industry may not be facing the same rising rates. This could occur, for instance, if some firms have financed more of their investment from internally generated funds than have other firms. Lastly, the example suggests that the factors influencing the distribution of income among wage, profit, and interest income also play a role in the investment-interest rate relation. If these forces change as output and the level of investment alter, so too will the relation between the interest rate and investment. Obviously, all of these points require further development.

NOTES

1. Keynes states in Chapter 11 that the demand-supply approach is equivalent to the view that investment is carried to the point where the interest rate is equal to the marginal efficiency of capital. We develop the demand-supply price approach for consistency with later parts of the paper.
2. We are indebted to Basil Moore and Wendy Rayack for pointing out this argument to us.
3. See [Mott, 1984–85] for a more detailed discussion of this principle.
4. Mott notes that Keynes had an analogous concept in his distinction between borrower's and lender's risk. See [Mott, 1985-86, p. 65], [Keynes, 1964, p. 144–5].

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