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The Capacity to Generate Investment
An analysis of the long-term
determinants of investment

by

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Abstract

What do we know about long-term determinants of investment? It seems to me that both neoclassical and Keynesian theory of economic growth provide a poor answer to this question so important for any theory of growth and accumulation. If we consider the traditional theory in which the interest rate represents the key variable for studying investment decisions, both theoretical and empirical considerations suggest, as is well known, to change direction. In the Keynesian theories of economic growth, the investment decisions are reduced to the mechanism of adjusting the productive capacity to the demand according to the accelerator principle, whose use presupposes a constant full (or normal) utilisation of capacity, no technical change and a mechanical behaviour of firms.

I propose to adopt a different observation point and to regard investment decisions as the result of a series of inducing mechanisms by which these decisions are activated. After analysing the significance of satisfying the need to adjust productive capacity to expected demand and the need for profitability, I refer to the general characteristics of the actual working of competition and define the notion of capacity to generate investment understood as capacity to create and exploit new investment opportunities through inducing mechanisms linked with the innovative activity of firms. In the Hirschman, Perroux and Dahmèn tradition, these inducing mechanisms are defined in terms of dynamic linkages and are connected with four strategic factors in investment decisions: focusing mechanism and learned processes, complementarities and interdependences, expectations and uncertainty, growth in demand.

Abandoning the neoclassical paradigm, this paper disputes the antithesis between demand factors and supply factors in the investment determinants. Expected demand induces investment decisions as far as it is regarded as permanent and this forces an enquiring into the way in which expectations concerning the future demand are formulated. On the supply side, the technological characteristics of the investment, the economic reasons behind it (product innovation, opening up of new markets, goals of cost reduction), the decisions concerning localisation and the economic and social environment within which firms reach their investment decisions are considered crucial elements in the explanation of the long-term determinants of investment in a way wholly independent of the full capacity saving of the economy. (J.E.L. E22, O30.).

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1. Introduction

The starting point for the ideas that this paper aims to develop is dissatisfaction with the way in which the long-term determinants of investment are treated, both in neoclassical theory and the Keynesian theories of economic growth. In the traditional scheme of analysis, as is well known, productivity and thrift are the long-term determinants of investment and full employment savings. Given a monotonic investment function that is decreasing with respect to the interest rate, neoclassical theory explains why investment occurs (there is a move towards more capitalistic methods of production with the decrease in interest rate), and how much is invested, once the adjustment costs are taken into account. The interest rate represents the key variable for studying investment decisions. The critique of the traditional theory of capital has shown the impossibility of finding, in general, a monotonic decreasing relation between capital per employee (or output per employee) and rate of interest¹. Empirical studies systematically fail to achieve the result predicted by neoclassical investment theory².

In the Keynesian theories of economic growth the basic idea is that investment adjusts productive capacity to demand. Ever since the formulation given to it by Harrod (1939; 1948) we find a separation between justified investment and effective investment. The former is the investment that maintains full utilisation of the productive capacity in time. Justified investment is not the outcome of the investment programmes of firms but, rather, represents that volume of investment which, if achieved in time, finds full justification in the sense that entrepreneurs do not experience, on average, either over- or under-utilisation of their productive capacity. In this situation, as Harrod says, entrepreneurs would be satisfied with what they are doing (Harrod, 1948, p. 81). Effective investment, on the other hand, is the global result of uncoordinated decisions by many producers. Absent from Harrod and the Keynesian economists after him is a detailed analysis of the investment decisions of firms. These decisions are reduced to the mechanism of adjusting the productive capacity to the demand according to the accelerator principle, whose use presupposes a constant full (or normal) utilisation of capacity, no technical change and a mechanical behaviour of firms. Based on this assumed behaviour, there emerges the well-known “instability principle” that characterises the justified (or warranted) path of growth. So, we find ourselves up against a sort of paradox, according to which the assumed behaviour of the firms vis-à-vis investment decisions, when the economic system is not already on a warranted growth path, leads them increasingly to abandon that path.

This problem of instability disappears in the theories of growth subsequent to Harrod, not because it has actually been tackled and solved but, rather, because both the neoclassical

¹ See the contributions by Garegnani, Kurz, Hata and Pasinetti in Eatwell, Milgate, and Newman (1990).

² See Andrews (1951), Meyer and Kuh (1957), Clark (1979), Catinat *et al.* (1987) and Chirinko (1993).

and Keynesian models deal with growth and accumulation in terms of steady state equilibrium paths characterised by normal use of productive capacity (and, for different reasons, by conditions of full employment)³. There is, however, no reason to suppose that effective growth is characterised in general by a constant normal utilisation of the productive capacity. Both theories of growth display problems of instability when confronted by a divergence between effective growth rate and equilibrium growth rate⁴. Unless it be assumed that the economic system is in a continual state of equilibrium, the steady state equilibrium paths are neither interesting nor useful in studying investment decisions and the process of accumulation.

The present work chooses a different observation point from which to analyse the long-term determinants of investment. It is proposed to regard investment decisions as the result of a series of inducing mechanisms by which these decisions are activated. To this end, after analysing the significance of satisfying the need to adjust productive capacity to expected demand (§2) and the need for profitability (§3), we shall refer to the general characteristics of the actual working of competition (§4) and define the notion of capacity to generate investment (§5) understood as capacity to create and exploit new investment opportunities through inducing mechanisms linked with the innovative activity of firms. After providing (§6) a definition of these inducing mechanisms (dynamic linkages), we shall analyse the strategic factors in investment decisions (§7). In conclusion (§8) we shall collect together the indications emerging in the course of the paper in order to focus on the theoretical and empirical implications of our analysis.

2. Investment and adjustment of the productive capacity

The concept of capacity to generate investment, that will be employed in what follows to analyse the long-term determinants of investment, can be more precisely defined with

³ In Solow's model (1956) it is assumed that the effective rate of growth is equal to the warranted rate. Kaldor (1955-56) assumes that the effective rate of growth is equal to the natural rate. Hicks (1950) employs the instability principle to study the trade cycle (Harrod himself several times adduces the possibility of so using it). Hicks, too, assumes that the economy is on an equilibrium growth path, such that the cyclical mechanism itself, based on the working of the supermultiplier, depends on the hypothesis that the economic system be in a state of constant normal utilisation of productive capacity. We shall return to this point shortly.

⁴ For the neoclassical model, see Hahn (1987), p. 628. For Kaldor's model, it should be recalled that the mechanism through which the warranted growth rate adjusts to the natural rate is based on price variations with respect to money wages and the resulting modification in income distribution. This mechanism is conditioned by the hypothesis, explicitly advanced by Kaldor (1955-56, p. 231), that the effective rate of accumulation is equal to the natural growth rate. Vianello (1985) shows how the hypothesis that the system is in steady state equilibrium is crucial to the conclusion of the neo-Keynesian theories of growth (Robinson, 1962; Kaldor, 1955-56) according to which, in the long term, savings and investment can be increased on condition that real wages and consumption are reduced. Garegnani (1962; 1992) criticises the neo-Keynesian theories of growth based on changes in income distribution, showing how in the long term an increase in investment may generate, in principle, a corresponding increase in savings through the variation in productive capacity, without this necessarily entailing a reduction in consumption.

reference to two minimum requirements that any firm must satisfy in the long term: the creation and maintenance of an adequate productive capacity and the achievement of a minimum level of profitability. The first requirement will be dealt with in this section, the second in the following section.

We start with the definition of productive capacity. Productive capacity at a certain date is defined as the output obtainable from the existing productive equipment when the latter is used at state-of-the-art technical knowledge, and taking account of the technical features of the plant (including idle times for maintenance) and the organisation of work currently in force (working schedules, overtime and possibility of working in several shifts). This definition refers to the productive capacity at a moment in time. If we abandon this static context, as the present work requires we do, we must note that productive capacity changes in time because physical productive equipment adjusts to expected demand and because technical knowledge itself changes in time, even should the productive equipment remain unaltered. Productive capacity may therefore vary even solely as a result of learning processes⁵.

In the long term, firms set up the productive capacity that, given the demand expected in normal conditions and taking into account the expected improvements deriving from the use of the productive equipment, will enable them to retain a certain desired amount of unutilised capacity. The capacity installed by a firm (C) is thus in general greater than its expected demand in normal conditions (Y^e). The amplitude of this difference depends on the characteristics of the market for the products and, in particular, on the stability of the demand, on the uncertainty, on the degree of flexibility of the plant and, if need be, on the maintenance of an excess of capacity as an entry barrier⁶. The ratio Y^e/C is thus the degree of utilisation desired by the firm (although a certain amount of unutilised capacity may be imposed by technical conditions and, in particular, by the indivisibility of the plant). Unlike the short term, in which the productive capacity is given and its degree of utilisation varies with the variation in demand, in the long term it is the productive capacity that varies with the expected normal demand leaving unchanged the desired utilisation. The latter can vary only if the elements determining the ratio between C and Y^e change.

When the effects of changes in technical knowledge are to be considered, it is useful to refer to the productive capacity in terms of total hours/year and hourly productivity. To this end, we indicate with h^c the total hours/year of capacity, defined as the maximum numbers of hours/year of work, given the existing technical knowledge, needed to obtain C . For a

⁵ It must also be borne in mind that the productive capacity of an economic system depends on its sectoral configuration; for the productive capacity of each sector depends on that of all the sectors directly and indirectly linked with it, so that the presence of bottlenecks represents a constraint on the productive capacity of the system as a whole. This consideration holds good even if we argue at firm level: the productive capacity of a firm is not independent of the capacity of the firms supplying raw materials, intermediate goods and capital goods.

⁶ The concept of excess of productive capacity is analysed in Steindl (1952, chap. 2). On capacity utilisation in the long period, see Ciccone (1986), pp. 23-32.

given annual work schedule, a certain volume of employment is associated with h^c . The hourly productivity expected from the technology in use is simply defined as $\pi^e \equiv C/h^c$. Let us consider, for example, the effects of a technical innovation that enables the same productive capacity to be achieved by a smaller total of hours/year of capacity: h^c and, at the same annual work schedule, the employment will be reduced and the productivity expected from the new technology will be proportionally augmented.

Let us consider now the total hours/year corresponding to desired utilisation (h^n) defined as $h^n = (Y^e/C)h^c$. It is plain that, given the normal expected demand and the desired degree of utilisation, h^n depends on the technical knowledge that determines the total hours/year of capacity. So, any innovation that reduces h^c has the effect of reducing the normal total hours/years. The product $h^n\pi^e$, that defines the volume of normal expected demand, of course remains unaltered.

Note lastly that, in order to maintain the desired degree of utilisation, the productive capacity and, consequently, the total hours/year of capacity and h^n will vary in proportion to the normal expected demand. As a consequence, the hourly productivity expected from any given technology is not directly affected by variation of normal expected demand, but it might increase when the expansion of productive capacity takes place, as usual, by adopting new techniques.

By satisfying the requirement of capacity, firms acquire the productive capacity adequate to the demand expected in the relevant time period and forearm themselves against unexpected fluctuations in demand over time. A variation in the expected demand necessarily entails a variation in the productive capacity installed. The essential point, if we would analyse the adjustment of productive capacity, is that the expected demand that matters in deciding to invest is the demand held to be permanent (persisting) in relation to the time horizon relevant to investment decision-making. It would not make sense to suppose that firms decide to adjust their productive capacity in response to temporary variations in demand, since an excess of capacity is maintained precisely with the aim of dealing with such variations. Thus an over- or under-utilisation of productive capacity with respect to the normal one cannot be immediately taken as indication of an insufficiency (or excess) of productive capacity installed⁷.

⁷ The validity and interpretative range of all the analyses of investment decisions making reference to the supermultipliers (Hicks, 1950; Serrano, 1995; Bortis, 1997) is impaired by the assumption, underpinning the use of the supermultipliers, of constant normal utilisation of capacity. For it must be borne in mind that we cannot assume that growth takes place in conditions of constant normal utilisation of productive capacity, and that, in any case, productive capacity adjusts to expected demand only when the variations in the latter are held to be permanent. Therefore the supermultipliers cannot be employed to analyse the process of growth on the basis of the adjustment of the productive capacity to the demand. The argument is developed in Trezzini (1995). The idea that an over-utilisation (or under-utilisation) of productive capacity with respect to the normal one generates a (cumulative) process of creation (or destruction) of productive capacity also appears in Garegnani (1962; 1992). In this case, too, we must assume that we are dealing with an over- or under-utilisation held to be permanent.

It becomes important to enquire as to how the expectations are formulated concerning the expected demand in the relevant period of time. One possibility is to suppose that in formulating expectations about future demand, past experience of an over- or under-utilisation of productive capacity beyond a certain limit for a sufficiently long period of time is relevant⁸. From this point of view the decision to invest (or disinvest) in capacity in the face of a over- or under-utilisation of this kind must be interpreted as a decision regarding the adjustment of productive capacity to the level held to be necessary — while retaining the desired excess of capacity — for responding to a change in demand that experience suggests will not be transitory. Upward adjustment occurs through a decision to invest in capacity, downward adjustment through a decision not to replace plant that has become obsolete.

For a more detailed view of this point, we can consider the first type of adjustment as linked with the experience of an average over-utilisation of capacity (with respect to the normal one) that manifests through a positive average difference between actual degree and normal degree of utilisation of capacity over a certain period of time. However, this over-utilisation might not be a sufficient indication for amplifying capacity if it turned out to be very small. Probably, investment in capacity must be seriously considered only if it passes a certain threshold⁹. The second, downward type of adjustment is connected with the decision not to replace a portion of the capital goods that has become obsolete. Just as we did in expressing the upward adjustment, we can suppose that the firms decide not to replace a part of their capital goods that has become obsolete after practising an under-utilisation (with respect to the normal one) beyond a certain threshold and for a certain period of time. According to this hypothesis, the non-replacement of the obsolete capital goods serves to cut out the undesired excesses of productive capacity, while if performed in its entirety the investment in replacement leaves the productive capacity unaltered¹⁰.

3. Satisfying the profitability requirement

The necessary condition at which a firm installs the desired productive capacity is that, at the desired degree of utilisation, it shall achieve a rate of profit not below a certain

⁸ This idea must, however, be very carefully qualified. For the past trend of demand is not always a sufficient point of reference from which to formulate expectations of demand. This is especially so as regards the expectations of demand relating to new products and in general new markets, for which no information (or insufficient information) is available regarding the previous trend of demand. In such a case, no direct relation can be established between past experience and the formulation of expectations of demand. We shall return to this point later (see §7, point d).

⁹ That the adjustment takes place after a period, long or short, and in response to an over-utilisation, more or less elevated, will depend on a series of specific circumstances. In a first approximation, we may assume that certain elements are important, such as intensity of competition, uncertainty, and the attitude of entrepreneurs towards the risk of new entries.

¹⁰ Note that at sectoral level upward and downward adjustments may also occur through the entry and the exit of some firms.

minimum. This consideration introduces the second long-term requirement, regarding the profitability of the investment.

Let us firstly define the rate of profit expected by a firm, producing a single commodity, in the period relevant for its investment decisions (we assume it to be T years). Let us consider a given investment whose productive capacity is periodically restored through-out the period. Then, supposing a constant price of the investment good, the value of the investment in any year (I_t) remains unchanged at its initial level. The expected returns on the investment depend on both the expected commodity's price with respect to the expected costs of production and the expected capacity utilisation. Since it is the firm that acquires the productive capacity adequate to the expected demand in normal conditions, the expected net profit rate must be defined in correspondence with the normal degree of utilisation. As above, by h_t^n we indicate the desired capacity utilisation in hours/year and by π_t^e the expected hourly productivity, the trends of both depending solely on the expected technological improvements (recall that, for any given normal expected demand, the product $h_t^n \pi_t^e$, that defines the volume of the normal expected demand, remains unaltered). Moreover, by p_t^e we indicate the expected commodity's price, by w_t^e the expected hourly wage, by m_t^e the expected annual cost of raw materials and semifinished products and by d_t the annual depreciation. The net profit rate expected during the time period (r_t) is defined as¹¹:

$$r_t \equiv \frac{h_t^n (p_t^e \pi_t^e - w_t^e) - m_t^e - d_t}{I_t}.$$

The minimum rate of profit (\hat{r}_t) is represented by the real rate of return expected in the alternative employment of wealth (the opportunity cost for anyone investing in physical capital). If we assume that the alternative is the investment in non-risk-bearing financial assets whose expected rate of return is fixed in monetary terms, the minimum rate of profit is given by the money rate of interest (r_m) on the non-risk-bearing financial assets minus the expected rate of inflation (λ_t) plus a risk factor related to the sector (σ):

$$\hat{r}_t \equiv r_m - \lambda_t + \sigma.$$

Given the expected trends in wage rate, hourly productivity and cost of raw materials, there is a trend in time of the price for which $r_t = \hat{r}_t$. Substantially, the difference in time between r_t and \hat{r}_t depends on the difference between the expected price (p_t^e) and the price at which exactly the minimum rate of profit is obtained. In view of this, if we indicate this minimum price with \hat{p}_t , the expected rate of profit can also be expressed as follows:

¹¹ For a similar formulation, see Marris (1964), pp. 29-30, who refers, however, to the actual rate of profit.

$$r_t = \hat{r}_t + \frac{p_t^e - \hat{p}_t}{\hat{p}_t}.$$

At any moment, the expected price may differ from the minimum price for a variety of reasons. In particular, as we shall see in what follows, innovations create conditions by which, at least for a certain period of time, it is possible to expect a price higher than the (new) minimum price, and hence a rate of profit higher than the real rate of interest added with a risk factor¹².

Satisfying the profitability condition requires that along the time horizon relevant for investment decisions the expected rate of profit be not less than the minimum (although for some t the expected rate of profit could be less than the minimum rate of profit). If this condition is satisfied, the firm performs its investment, guaranteeing to whoever provides the financial means, in whatever way, a rate of return not less than that of alternative employment of wealth. If a firm were unable to ensure the minimum return, it could not perform new investments, not even to replace its capital; it would therefore be destined to exit from the market and its place would be taken by firms able to satisfy the minimum requirement of profitability. A variation in the real rate of interest — and, with it, in the minimum rate of profit — compels the firms to restore the minimum condition of profitability even if the adjustment to the new situation does not follow a compulsory path, since the desired result can be achieved either by increasing the price with respect to the money wage or by adopting production methods capable of increasing the hourly productivity (Bonifati, 1997, pp. 33-34).

4. Competition

At this point we must briefly discuss under what conditions the expected rate of profit can be held to settle at its minimum level. We refer to a situation in which the firms, as well as utilising their productive capacity in a normal way, also adopt the methods of production generally in use. In these circumstances, competition among both actual and potential producers will drive the price of the good towards the minimum level and will hold its variations in line with those of the costs. In the circumstances hypothesised, competition will in the long run play its levelling role according to the teachings of the classical economists. The firm that targets an objective of expected profitability above the minimum will see the actually realised rate of profit systematically reduced to its minimum level, so that — *if nothing changes* — in the long run it can only expect a rate of profit at the minimum level.

¹² As well as owing to innovations, the expected rate of profit may diverge from its minimum level both because a particularly low or high price of raw materials or intermediate goods is expected, and because of particular conditions on the demand side of the good produced that translate into an expectation of an especially high or low market price or into a temporary over- or under-utilisation of the productive capacity (Bonifati and Vianello, 1998, p. 116).

Competition, however, cannot be reduced to a merely levelling force. The same general principle that underpins the levelling role of competition — that is, the search for the most profitable investment — renders it a force that continually changes and disrupts the relatively settled situation in which the return on all the investments tends to be the same. From the point of view of the individual firm, the introduction of a new process, the creation of a new market or of a new product are reasons for having a target of expected profitability above the minimum. For, in all these cases, the firm that makes the first move acquires the power to fix a price higher than the minimum, at least for a certain period of time. Obviously the innovative firm does not obtain this power once and for all. It will have to come to terms with the competition that stimulates the adoption of new processes, the imitation and improvement of the new products, the price war on the markets for the products (made possible by the reduction of costs), and the birth of new firms.

Such considerations should suffice to make explicit that our starting point is not that whereby high rates of profit are to be related to a scant competition. On the contrary, high expected rates of profit are generated by competition and, in turn, generate a very strong competition, whose degree of intensity can be expressed not only, and perhaps not so much, by the number of firms but by the frequency of the moves and countermoves in the matter of innovations and variation of costs and prices (Clifton, 1987). What we wish to stress is that the levelling role of competition needs to be redefined in a dynamic context¹³. The working of competition as a whole involves, indeed, the continual co-presence of the tendency of rates of return (actual and expected) to fall towards the minimum level, and of the drive to create investment opportunities with expected rates of return higher than the minimum. This co-presence represents an important aspect of the actual working of competition. To refer merely to the satisfaction of the minimum conditions is therefore not sufficient for analysis of the competitive process. The real rate of interest added with a risk factor and the adequacy of the productive capacity represent, on the contrary, an important reference, both as a basis for calculations concerning the expected returns and in the analysis of the crises generated by the failure to achieve the aforesaid minimum conditions.

The effects of competition, as understood in this broader, fuller way, manifest in the change in what are generally considered to be the data of the economic system, i.e. technical production coefficients and composition of demand and production. The variation in the technical and consumption coefficients generates a structural dynamics of the quantities produced and the relative prices (Pasinetti, 1981; 1993).

¹³ With regard to the idea of competition based on innovative activity, the reference is, of course, to Schumpeter (1934, chap. 2) and Schumpeter (1942, chap. 7).

5. *The notion of capacity to generate investment*

In such a complex context, it seems reductive to think of the investment activity of firms with reference to the pure and simple maintenance of an adequate productive capacity and a minimum level of profitability. It appears more useful, instead, to start from the satisfaction of the minimum requirements of adequate productive capacity and profitability in order to define what we have termed the ability to generate investment, understood as the ability to create and exploit new investment opportunities through the search for new products, new markets and new production processes. In these terms the capacity to generate investment depends on the innovative activity of firms and is linked with the continual acquisition of new information and technical, management and marketing abilities through which the innovation process takes concrete shape. From the point of view of the individual firm, the development of these abilities is an essential element for maintaining one's market position with respect to competitors in an environment continually modified by the competition itself. This requires ongoing investment in physical capital and in management capabilities in order to be able to realise the necessary innovations and, if necessary, differentiation of product (Penrose, 1959, chap. 7, especially pp. 131-138).

It must be pointed out, however, that the notion of capacity to generate investment here proposed cannot be referred to the *individual* firm nor to the *sum* of the investment opportunities of the individual firms. Nor does the action of institutions in the fiscal and monetary field — important in defining the general conditions of accumulation — have any direct, mechanical relation to the volume of long-term investment. As we shall see in greater detail in what follows, it is the continual search by firms for new investment opportunities and the interaction, in various forms, between firms, and between them and the final users, that create the capacity to generate investment of a sector and of the economic system as a whole.

An important premise of the idea here put forward, to view the basic determinants of investment in terms of capacity to generate investment, involves the complex character of the action of firms in investment decisions, in so far as several changing elements come into play. The innovative firm, in the production both of consumer and capital goods, initiates a research activity accompanied by continual attention towards finding new solutions for the final users of its products. The ability to interact with its suppliers and its final users is the main feature of its action. Imitative firms respond to innovations, but the imitation is accompanied by an effort at characterisation and improvement of the products deriving both from an idiosyncratic element and from the specific abilities of the firms that imitate (Nelson, 1994). Moreover, the firms supplying intermediate goods to the final firms, whether they be innovative or imitative, must possess or create for themselves the abilities necessary to supply the new intermediate goods generally required for production of new final goods.

We shall return later to this series of relations on which an important part of the capacity to generate investment depends. For the moment, we can register that the notion of capacity to generate investment is a far cry not only from the traditional idea that the volume of investment depends, according to a function, on the real interest rate, but also from the idea that investment depends, in a definite quantitative relation, on the difference between expected rate of profit and minimum rate of profit. According to this view, firms confronting this difference need only to invest to the point where all the investments are achieved with a rate of profit equal to or above the minimum. However, it does not appear that such a quantitative relation can be defined in a systematic way. For we have seen how the firm must ensure the minimum rate of profit independently of the volume of investment realised, if it wishes to remain in the market. For that matter, if a firm is able to supply an expected rate of return higher than the minimum, this is owing to its capacity to create and exploit new investment opportunities. How high the expected profitability is and for how long it remains above the minimum depends on the intensity of the competition, which may act on several fronts: in certain circumstances the expected profitability is directly reduced by the expectation of a fall in prices due to competition, in others this expectation may be induced by an increase in investment that drives the productive capacity above the normal demand. These last considerations suggest that, in the formulation here proposed, achieving the minimum rate of profit — which marks the threshold below which investment is not made — whereas is the result of the competitive market process does not generally depend on the volume of investment performed¹⁴.

In the pages that follow the concept of investment capacity, now introduced, will be specified in the analysis of the conditions on which investment decisions depend in relation to innovations and growth in demand.

6. Innovations and dynamic linkages: the inter-sectoral character of the capacity to generate investment decisions

The possibility that innovations will generate investment depends on a whole series of inducement mechanisms through which technical progress is generated and diffused. An innovation, whether of product or of process, generates investment if it activates decision mechanisms through which firms plan an expansion and/or a replacement of productive

¹⁴ See Bonifati (1997). This conclusion diverges sharply both from the traditional idea, according to which the firm invests up to the point where the (expected) rate of return on capital is equal to its minimum level represented by the natural rate of interest, and from the Keynesian idea that investment is extended to the point where the marginal efficiency of capital is equal to its minimum level represented by the money rate of interest.

capacity. Each time such a decision mechanism is activated we can say that an innovation, or a series of connected innovations, has generated a linkage¹⁵.

Innovations arise and spread within a series of relations among the firms, and among these and the final users of goods and services. Linkages understood as inducement mechanisms have two basic features. Firstly, their establishment modifies the existing relations or creates them *ex novo* where they did not already exist. Linkages, therefore, do not reproduce the relations (of a technical or other nature) existing between the actors in the field. The second feature is their dynamic character. An innovation is able to generate linkages not only, and not so much, by its immediate effects on the investment decisions of the firm that first introduced the innovation, but rather because it creates a “structural tension” that involves a set of actors (producers and final users) by virtue of which it gives impulse to further innovations and further investment decisions¹⁶.

Hence, in order to focus on the relation between innovative activity and inducement mechanisms of investment decisions, we must refer to the essential and general characteristics of the generation and diffusion of technical progress.

The most general conclusion to be drawn from studies of technical progress is that the latter manifests as “a gradual process a cumulation of events where, in general, continuities are much more important than discontinuities” (Rosenberg, 1976, p. 192). Not that discontinuities are lacking: the great technical advances mark a radical break with the past. The essential point is that these great innovations take on a relevant economic importance only when they are diffused, and their diffusion occurs in connection with a whole series of improvements and changes in design project that turn out to be of decisive importance. The result of these ‘secondary inventions’ (Usher, 1955, especially pp. 533-540), is that, in the course of its diffusion, an innovation is slowly but continually modified, which effectively makes it impossible to separate an innovation from its diffusion¹⁷. The reduction in costs associated with an innovation is itself linked to the subsequent improvements brought in with the process of adoption (Enos, 1962).

¹⁵ Here we use the general idea of linkage originally introduced by Hirschman (1958; 1987) to study the processes of industrialisation in developing countries. Ideas similar to those of Hirschman on the industrialisation processes can also be found in Dahmén (1950) and in Perroux (1964).

¹⁶ See Dahmén (1989), p. 111. In order to explain the basic essence of the concept of “structural tension” Dahmén uses the following example from the history of the British textile industry: “Once the flying shuttle had come into use in the 1730s, there emerged an acute shortage of yarn. This induced a number of inventions and innovations in spinning shortly after 1750. These were so radical in nature that the weaving technology now fell behind. As long as this technology did not catch up with that in spinning, the spinners were plagued with serious overproduction problems. The invention of the mechanical loom toward the end of the century finally created the preconditions for balance among the different stages of production in the textile industry” (p. 120, note 2).

¹⁷ Carlson (1992) emphasises that inventors and entrepreneurs make assumptions about who will use new technologies and products. “These assumptions constitute a frame of meaning inventors and entrepreneurs use to guide their efforts at designing, manufacturing, and marketing their technological artifacts. Such frames thus directly link the inventor’s unique artifact with larger social or cultural values” (p. 177).

An innovation cannot be viewed in isolation, as though it were something already accomplished at its origin, thereafter to be diffused either instantly or with a certain delay. On the contrary, the change in knowledge that gave rise to the original innovation represents the first step in an entire sequence of innovations and new knowledge that emerges endogenously during the process of diffusion. Seen in this light, innovation proceeds from a collective activity that produces better results the ampler is its utilisation and the more disseminated is the spread of the information surrounding it (Allen, 1983). Learning and core competences are created and developed in individual firms in a context marked by close interdependence that, precisely through learning, changes continually.

Similar considerations apply to investment decisions, which are connected, not so much with the innovative activity of the individual firm, as with that performed in an interdependent system within which the innovations are developed and diffused. This is why the capacity to generate investment has an inter-sectoral character.

7. Strategic factors in investment decisions

Generation and diffusion of technical progress and related investment decisions substantially require that the inducement mechanisms underpinning the linkages come into being. These inducement mechanisms obviously depend on several circumstances, but the following general elements seem to be of particular importance.

(a) *Focusing mechanisms and learning processes.* The overcoming of economically important constraints — whether of technical, social, legislative, natural or other character — is the aspect that more than any other characterises the generation and diffusion of innovations. The possibility that an innovation will generate linkages (investment decisions) depends, in general, on the ability to move from comprehension of the problems posed by constraints to the solutions that give rise to an innovation¹⁸. This ability is acquired through many interacting forms of learning from utilisation, experience and interaction among producers, suppliers and users¹⁹. In this learning process interdependences, both in production and consumption activities, are particularly important.

¹⁸ Hirschman (1958, chap. 1) speaks of the necessity of inducement mechanism, able to activate the decisions favourable to economic development by improving the formation process of decisions. According to Rosenberg, technical progress springs from what he calls *focusing devices* through which ways of overcoming the constraints are found (Rosenberg, 1976, chaps. 6 and 11). In a recent work, Lane and Maxfield (1997) examine an actual case in order to show how interaction among the actors in the field can bring about a change in the way itself in which the agents involved view their own environment, thus creating new agents and new products. When this occurs, the interaction gives rise to what the authors term a “generative relation”. On the definition of the latter, see also Lane, Malerba, Maxfield and Orsenigo (1996).

¹⁹ Arrow (1962) and Rosenberg (1976, chap. 6). These forms of learning have a cumulative nature and can be achieved in ways that differ from firm to firm and according to the period and productive sector considered. To these must be added another that is congenital to the firm as organisation able to learn to learn. This process of

(b) *Complementarities and interdependence among productive activities and among consumer goods.* Every innovation, indeed, presents as a solution of constraints and, at the same time, as a generator of new constraints. At the centre of this process are the complementarities, in production as in consumption, whose presence causes a series of bottlenecks to emerge, the overcoming of which becomes a necessary condition for the innovations to be diffused (Rosenberg, 1976, pp. 201-202) and for the connected investment decisions. In the perspective in which we propose to analyse investment decisions, the complementarities assume a special interest as sources of interdependence. From the point of view of complementarities in production, closely interdependent activities, such as the production of machines destined for the production of intermediate goods intended for the production of final consumer goods, tend to establish a network of recurring relations among the firms, within which innovations take on the character of an activity shared by several firms²⁰. The production of a new consumer good, for instance, requires innovative activities on the part of the final firms, in the shape of formal and informal research for a new product and a market for it, together with the innovative activity of the firms supplying intermediate and capital goods who have to realise the innovations needed. In this case, the firms that launch a new product invest in research and marketing activities whose success partly depends on the experience and market knowledge of those firms, and partly on the innovative capacity of the firms supplying intermediate goods and machinery. On this depends the possibility that the innovation will generate an investment decision through which the productive capacity will be adjusted to the new production. If a new product is launched by one or more firms producing machines, the initial innovative capacity will require, in addition to research activities, continuous interactions between producers and users of machines which will enable the process of subsequent modifications and improvements on which a large part of the subsequent reductions in costs permitted by the new machine depends. The decision to invest connected with the general adoption of the new machine may involve further investment decisions if the reduction in costs and improvement of the quality of the goods produced with the new machines lead to an expansion of the market for consumer goods. This requires, indeed, an expansion of the productive capacity of the firms producing the consumer good itself and the firms producing the machines. The interdependence arising from the complementarities in consumption is more indirect, but no less important. If the consumption of a new product requires that it be consumed jointly with other products, this may have various consequences. It may have an expansive effect on the demand for existing products if their consumption is extended by the new product. In so far as the new demand is held to be

learning by learning is achieved in research, production and distribution activity when, in the course of time, firms learn to develop abilities that will enable faster and more efficient learning processes (Malerba, 1988).

²⁰ Andersen (1996) stresses that innovative activity and vertical relationships between firms generate innovative linkages through specialisation.

permanent, this will induce the decision to expand the existing productive capacity. In this case, a linkage is established on the basis of an interdependence among the firms on the demand side. The demand for the new products may turn out to be limited by the failure of adequate development of products or new services complementary to them. Overcoming this kind of bottleneck requires an innovative activity on the part of existing firms or new firms. In this case, the diffusion of a new product and the establishment of a demand-side linkage involves the creation of a relation among firms that did not formerly exist.

(c) *Expectations and uncertainty.* Innovations represent a break in the faith in expectations acquired on the basis of past experience regarding demand and available technological possibilities. The introduction of new products and techniques on the market, like the opening up of new markets, marks new situations, the understanding of which induces the acquisition of new information and the formulation of new expectations²¹. Hence, on the one hand, innovations compel firms to reorganise their own reference points and to reformulate the expectations that underpin their investment decisions and, on the other, they introduce a strong element of uncertainty. Uncertainty as to the new techniques and new consumer goods on the part of users creates uncertainty regarding the potential outlet market for the products of the innovation²². As Rosenberg (1996) pointed out, a peculiar aspect of uncertainty connected with technological change is that it concerns more than one dimension. Many historical examples support the view the new technologies have properties and characteristics whose usefulness cannot be immediately appreciated. Furthermore the success of an innovation depends not only on improvements of the innovation, but also on improvements that take place in complementary innovation, some of which may not yet exist. So it is very difficult *ex ante* to conceptualise a new technological system connected with major technological innovation. As a consequence of the multidimensional character of uncertainty, “there is little reason to believe ... that there will be a well-defined ‘optimal’ investment or adoption strategy” (Rosenberg, 1996, p. 340). The formulation of new expectations in a highly uncertain context must be considered, to all intents and purposes, as an integrating part of the innovative activity of the firm. It should be noted here that within a system of relations among firms characterised by a wide diffusion of information on the new techniques, new machines and new consumer goods, the uncertainty may be significantly reduced.

²¹ According to Katona, the understanding that gives rise to expectations formulated with conviction does not coincide with a full and certain knowledge. It consists in the integration of a certain amount of information within a given context, so as to fill up the 'gaps'. Understanding occurs only when it is needed, which generally happens when a subjectively new situation manifests (Katona, 1946).

²² Arthur (1988, p. 601) remarks how, since the adoption of new products is not instantaneous, it must be borne in mind that the potential adopters of a certain product may change or modify their expectations concerning the success of the diffusion of that product during the adoption process. If the decision to adopt the product depends on the expectations regarding future adopters, the possibility that the expectations will change makes forecasts especially uncertain.

(d) *Demand*. Considered from the point of view, proposed here, of its ability to activate investment decisions, the growth in demand plays an important role for at least three different reasons. First, such growth creates favourable conditions to the innovative activity of firms. Expansion of demand enables a widespread use of the new products and new techniques and establishes contacts among producers and users of goods and services. Hence it is a favouring condition for stimulating learning processes and, with them, the process of gradual improvement by means of which the spread of innovations and the expansion of the market take place. From the point of view of demand, the important aspect is that, up to the point where the standardisation of the products is achieved, this process fuels itself²³. The second reason concerns the change in the composition of the demand and the resulting need of the firms to adapt to this, both by modifying or differentiating their production, and by reorienting their marketing activities. It is well known that there is a close interdependence between technical progress, and the resulting growth in productivity and *per capita* income, and the change in the structure of consumption (Pasinetti, 1981). In order to meet the new demand, firms must be able not only to make new products and/or improve the quality of existing ones, but also to reach new final consumers. This goal can be achieved as much by already existing firms as by new ones. The change in composition of demand may also involve the expansion of national or foreign markets that did not formerly exist. In this case, too, the eventual expansion of productive capacity for existing products requires the ability by the firm to reach the new markets, which, in turn, necessitates the development of commercial activities and, sometimes, the transfer of part of the production abroad. The third reason has to do with the complementarities among consumer goods. For the expansion of demand for a new product brings with it an expansion of the demand for other new products which in the absence of that market would never have been developed. This kind of linkage gives rise to investment decisions both by existing firms, that differentiate their production or specialise in the new productions, and by new firms.

On the basis of all the above elements, we may conclude that the peculiar aspect of the capacity to generate investment lies in the cumulative effects set in motion by the very decisions to invest. Two types of cumulative effects can be distinguished.

The first can be termed *self-propelling effects*, connected with the growth of entrepreneurial abilities, which are learnt by practice. These abilities involve the innovative abilities of creating of new products, processes, markets and those connected with co-ordination activities: the latter are of the utmost importance when, as in the realisation of innovations, it is a matter of maintaining contacts among the devisers of innovative projects,

²³ An emblematic example of this process is the diffusion of machine tools. See Rosenberg (1976, chap. 1) and Carlsson and Jacobsson (1995).

the realisers of these projects (both within the firm and in the relation with the supplier firms) and the final users.

A second type of cumulative effects can be defined under *propagation*. We have seen how, owing to complementarities, an investment in a certain product generates investments both in productive activities linked with it²⁴ and in the production of consumer goods (existing or new) consumed jointly. When the product in question incorporates a new technology, once this process is set in motion it enjoys increasing returns to its adoption deriving from the learning (and from the related gradual improvement of the product with the diffusion of its use), and from the existence of network externalities (connected with the diffusion of products consumed jointly with it), of economies of scale in the production (with resulting reduction in costs and prices) and of technological interdependences. The increasing returns self-fuel the adoption, and it is possible to suppose that the diffusion, by expanding the market (generating demand) for a set of linked products, will offer new investment opportunities²⁵. The effects of propagation are not confined to new products. It is well known that new products or new techniques may make it more convenient to adopt already existing products and techniques. In which case, the initial investment expands the market for existing products, opening the way to new investment opportunities whose expected profitability increases²⁶.

8. Conclusions, suggestions and prospects for research

Expected demand is an essential and necessary condition in investment decisions. The investment would, simply, not be effected without the expectation of a demand sufficient for the productive capacity created. In a certain sense, the expected demand is a condition so essential, so general in investment decisions that it cannot provide the whole explanation of investment determinants. If we would attempt to explain the actual processes that induce a decision to invest we cannot confine ourselves to saying that the investment creates the productive capacity adequate to the expected demand: obviously this is so, but it leaves out of account a whole series of essential elements for explaining investment decisions. With regard to this, two relevant considerations are here suggested.

²⁴ In referring to them, Hirschman (1958, chap. 2) defines them as "complementarity effects of investment".

²⁵ Network externalities, learning by use, existence of economies of scale and technological interdependences underpin the increasing returns to adoption through which it is possible to explain how a particular technology establishes itself even as a result of chance events (Arthur, 1988; 1989). Among these sources of increasing returns to adoption, the network externalities are held to be especially important. The by now classic example of network externalities are the products linked with VHS video-recording technology. The more widespread this technology, the more it tends to be diffused through the advantages offered by the increasing availability and variety of products that make use of it (Katz and Shapiro, 1985). With reference to this example, investment in VHS technology spreads to a series of products that use it, making its adoption more and more convenient, while the expansion of the market resulting from the diffusion of VHS products offers new investment opportunities.

²⁶ We may remark here that in this case, as in all those where important complementarities exist, the expected return on an investment is not independent of that on other investments linked with it.

The first one is that expected demand induces an investment decision as far as it is regarded as permanent and this forces an enquiry into the way in which expectations concerning the future demand are formulated.

The second relevant consideration is that the technological characteristics of the investment, the economic reasons behind it, the decisions concerning localisation and the economic and social environment within which firms reach their investment decisions — these are all elements the explanation of which cannot be neglected in analysing the long-term determinants of investment.

All these elements, and perhaps others, should be included among the supply rather than the demand factors in explaining the investment determinants. However, what is here disputed is precisely the antithesis between demand factors and supply factors in the investment determinants. We know that in neoclassical theory, where Say's law continues to hold good, demand simply does not matter in the process of accumulation, which is entirely accounted for by the supply of full employment saving in the economic system. Sraffa's work (Sraffa, 1960) has enabled the critique of the neoclassical paradigm and the return to the theory of prices and, more in general, to the view of the production process proper to the classical economists and to Marx. Abandoning, a premiss of this paper, the neoclassical paradigm (and every other form of Say's law) allows demand to take its place as an essential determinant of investment²⁷ and enables the supply side to be seen in a way wholly independent of the saving capacity of full employment of the economy. What this work proposes is not to halt the analysis of long-term investment determinants at this point, but to go beyond the antithesis between demand and supply factors in the analysis of the accumulation process. For, after rejecting the idea that investment is a purely passive element that adjusts the capital stock to the supply of full employment saving, we have tried to perfect a scheme to analyse the main elements on both the demand and the supply sides which induce one or more interconnected decisions to invest. Taking such elements into consideration may help to explain the growth itself of demand, on domestic and foreign markets, and the differences between countries and geographical areas in terms of increase in productivity and employment.

Capital accumulation viewed through the notion of capacity to generate investment appears as a path-dependent, non-uniform process, both sectorally and territorially. In this perspective we once and for all relinquish the idea of being able to analyse the process of economic growth in terms of equilibrium paths with the addition, if necessary, of a trade cycle separate from the trend. This distinction, like the one between autonomous and induced investments, simply sheds its meaning when we contemplate the way competition actually works.

²⁷ Palumbo (1994) invokes historical studies to emphasise the role of aggregate demand, and especially of exports, in economic development.

Unlike the more abstract level at which we analyse the determination of the relative prices and the distribution of income, the analysis of the accumulation process requires both a historical analysis of the relevant events and the development of the analytical instruments needed to bring out the basic structure of the relationships among the actors in this process. This is why the analytical scheme put forward forces an empirical study of the process that generates investment decisions. A special implication of the analysis here proposed is that — in the empirical investigation — the inducement mechanisms identified cannot be analysed in terms of individual actions considered in isolation. The decisional unit of investment is obviously the firm, but the latter is embedded in a network of relationships so important as to become an essential element in explaining the long-term investment determinants. Crucial in analysing the working of the inducement mechanisms that underpin the capacity to generate investment is, then, the identification of the 'relevant economic space', understood as the space of recurring economic and social relationships, within which these mechanisms operate. The hierarchic position of the firms, their economic and productive role within the system of inter-firm relationships (degree of specialisation and levels of vertical integration), the availability of natural resources and work skills created through time and experience, all become crucial elements in analysing how the strategic factors identified determine the technological and economic characteristics and the localisation of the investment.

Analysed within the interrelations among the firms in the 'relevant economic space', the capacity to generate investment appears as a social activity, even though the firm remains the unit by which the amount of the investment is projected. Performed by means of what we have termed dynamic linkages, this activity, through the technological, economic and localisation decisions of the investment, modifies the existing relations and the 'relevant economic space' itself.

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