ACCUMULATION OF CAPITAL

di Pierangelo Garegnani

e Antonella Palumbo

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** Professore Ordinario di Economia Politica - Facoltà di Economia “Federico Caffé” Università degli studi di Roma Tre.
*** Ricercatore di Economia Politica - Dipartimento di Economia, Università degli studi di Roma Tre.
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INTRODUCTION

Two different answers are given by today’s economists to the question of what determines the growth of an economy. The first is the traditional one, according to which the community’s decisions to save in conditions of full utilization of resources (defined so as to allow for a normal succession of booms and slumps) will determine the trend of capital accumulation. This, taken together with the growth of population and the development of technical knowledge, would then determine the trend of aggregate output\(^1\). The second answer is based instead on what has been called the ‘Keynesian Hypothesis’ (Kaldor, 1955-6, p.195). According to that hypothesis it is the level of investment that generates the corresponding amount of savings, not only in the short period analyzed by Keynes, but also in the long period in which productive capacity changes\(^2\). This entails that in some broad sense aggregate demand, rather than propensities to save and other supply factors, is what ultimately determines the speed of growth of the economy.

As is well known, the validity of the traditional answer depends on whether or not the rate of interest can adjust the decisions to invest to savings out of the income of normal (desired) utilization of productive capacity (‘capacity savings’, for short). In our present analytical discussion we shall however not be concerned with the arguments for which such a role of the interest rate can be refuted together with the validity of the marginal theories of distribution of which it is an expression\(^3\). Our interest will instead be focused on two alternative versions of the Keynesian Hypothesis. The long-

\(^{1}\) In the recent ‘endogenous growth’ versions of the theory, savings are seen to also take the form of investment in human capital and in technical knowledge.

\(^{2}\) By ‘productive capacity’ of the economy we shall mean, as is generally meant, the productive equipment in existence measured by the output which can be obtained from it when used at its normal (desired) level, and with the appropriate employment of labour. For the notion of a ‘normal’ (desired) level of utilization of capacity cf. par.2 below.

\(^{3}\) For an argument towards this conclusion cf. e.g. Garegnani (1978-9). See also there, p. 80, for the difficulties of an alternative, supposedly empirical, foundation of the idea of an interest-elastic demand schedule for investment.
run generation of savings by means of investment can in fact conceivably occur along two entirely different routes. The first is by lowering the real wage (raising money prices relative to money wages), thereby raising the normal rate of profits\(^4\) and hence, generally, the proportion of profits in national income. Since the propensity to save out of profits can be safely assumed to be higher than that out of wages, the rise in the proportion of savings to consumption would follow. The second route is instead by raising the level of aggregate output together with the corresponding productive capacity, without any need to change the real wage and the normal rate of profits. For brevity we shall refer here to the theoretical positions characterized by those two routes as, respectively, the Distribution-based, and the Output-based Long-period Keynesian Approaches.

The Distribution-based Approach is that which has attracted more attention, leaving the Output-based Approach in the shadow. However, once some misunderstandings are cleared up, it may become apparent that the latter is that which better represents the route a market economy is likely to take in adjusting savings to the incentive to invest.

\(^4\) For the notion of the ‘normal rate of profits’, corresponding to a ‘normal’ use of capacity, cf. below par. 2.
1. THE LONG-PERIOD ELASTICITY OF OUTPUT

The fact that a large underutilization of productive capacity cannot be observed over sufficiently long periods of time seems to have engendered the kind of optical illusion we find in Joan Robinson when she writes:

In long-run competitive equilibrium the relation of total income to the stock of capital is determined within certain limits by technical conditions. The distribution of income however is influenced by the amount of investment (Robinson, 1962, p. 11).5

Similarly, and more explicity, S. Marglin:

in the short run ... the rate of capacity utilisation changes in accordance with aggregate demand ... But in the long run ... there is no excess capacity to accommodate demand. Distribution must bear the brunt of adjusting aggregate demand to supply (Marglin, 1984, pp. 474-5).

Now, the premise concerning the temporary nature of any large excess capacity may well be correct, but the conclusion that the real wage has therefore to fall in order to ‘accomodate’ a rise in investment (or to rise to accomodate a fall) does not follow. The level of productive capacity may conceivably adjust to output, just as output to capacity. And when the former possibility is analyzed, it becomes clear that the ‘excess capacity’ which could have accomodated additional aggregate demand cannot be seen (hence the ‘optical illusion’ we referred to above) only because the demand to be accomodated has not been there. That capacity would however have come into (or remained in) existence had the additional aggregate demand done the same. In other words, in the long period ‘the capacity to accomodate demand’

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5 The import of the passage is made clearer by what immediately follows: whatever the ratio of net investment to the value of the stock of capital may be, the level of prices must be such as to make the distribution of income such that net savings per unit of value of capital is equal to it. Thus, given the propensity to save from each type of income (the thriftiness conditions) the rate of profit is determined by the rate of accumulation of capital (Robinson, 1962, pp.11-12; our italics).
is available, but cannot be generally *observed* in the form of *excess capacity*. Then, as we shall presently see, savings can be generated by the additional investment, without any fall of the real wage. It will indeed be seen that in the long period in which productive capacity can change, the margins for expanding output in response to aggregate demand become wider rather than narrower - contrary to what is asserted in the above passages by Robinson and Marglin.

We shall assume a competitive, closed economy, where labour is indefinitely available and natural resources are not scarce. The real wage rate \( w^* \) and the technical conditions of production are assumed given, so that the corresponding normal rate of profits \( r^* \) and the prices (expressed in the same composite commodity as \( w^* \)) are also given.

We shall indicate by \( y \) the ratio which output bears to capital, reckoned at the given prices, when capacity is utilized at its normal or ‘desired’ level. For simplicity we shall assume that \( y \) remains constant together with the marginal net propensity to save \( s \) as outputs change\(^6\). Except for that regarding labour availability, the above assumptions could be removed without essentially altering our conclusions.

Let us now assume an additional utilization of capacity in year 0 providing for an additional output of a value of 10, so that if the propensity to save \( s \) is 0.2, the potential increment of output would have to include additional investment of the value of 2. Given a ratio \( y=0.5 \) of output to capital, that investment would establish a unit of additional productive capacity \( \Delta C_1=1 \) measured by the value of the net yearly output (at the given prices) it would allow for, when used at its normal (desired) level. If

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\(^6\) Clearly \( y \) would normally depend on the physical composition of the output, and on the age distribution of fixed capital. However, such changes of \( y \) are irrelevant for the general point we wish to make here. We may instead note that, contrary to what one may at first think, the \( y \) ratio for capacity from new fixed investment need not be lower than for pre-existing fixed capital, despite the fact that new investment will *initially* have the form of new machines, more expensive than those (of, say, uniform age distribution) we may find in existing capital: on this point cf. Garegnani (1992), p.57 n.10.
aggregate demand were sufficient, that additional unit net yearly output of year 1 would entail an additional net investment of \( s=0.2 \) in year 1 and therefore a further additional productive capacity \( ys=0.1 \) from year 2 onwards. This will bring to a total of

\[
\Delta C_2 = (1 + ys) = 1 + 0.1 = 1.1
\]

the additional capacity which would have come about by year 2, had there been a sufficient incentive to invest in years 0 and 1. Then, in year 2 the potential additional investment could be

\[
s (1+ys) = 0.2 \times 1.1 = 0.22
\]

with a potential additional capacity of

\[
ys (1+ys) = 0.5 \times 0.22 = 0.11
\]

bringing the total potential additional capacity engendered by year 3 to

\[
\Delta C_3 = ys (1+ys) + (1+ys) = (1+ys)^2 = (1 + 0.10)^2 = 1.21
\]

and so on and so forth with a total additional capacity available from any year \( t \) of

\[
\Delta C_t = (1+ys)^{t-1}
\]

This potential always-enlarging, never-ending process of creation of saving and productive capacity, which can generally be activated in response to additional aggregate demand, is in fact strictly analogous to that of a sum of money increasing at a compound rate of interest. The growing sum is here the productive capacity initially brought into existence by an additional
utilization of *existing* capacity, and the compound rate is $y_s$, the ratio of saving to capital when capacity is utilized at the normal (desired) level, or 'ratio of capacity savings' as we shall henceforth call it for short. Thus, e.g., in our example, a 10% underutilization of capacity for a single year would forego a potential doubling in 50 years of the capacity (and consumption) of that initial year\(^7\). And if we proceed from the above example of an underutilization of capacity lasting a single year to that of an underutilization of $x\%$ lasting $t$ years, the capacity which has failed to materialize after $t$ years because of insufficient effective demand would be numerically given by the sum of $t$ annuities of $x$, accumulated over the $t$ years at the compound rate $y_s$; that is

$$\Delta C_t = \frac{sx ((1 + y_s)^t - 1)}{ys} = x ((1 + y_s)^t - 1)$$

so that if aggregate demand had been enough to ensure a 10% additional use of the initial productive capacity over the $t$ years, and also a normal use of the potential additional capacities thus brought about, a doubling of that capacity could have been achieved in 25 years, and a trebling in 32 years, while a smaller 5% additional use could have achieved the same in 32 and 39 years, and a mere 1% additional use, in 49 and 56 years, respectively.

Naturally these calculations can provide little more than rough indications. They ignore *e.g.* the destruction of capital because of bankruptcies, duplication of capacities by competing firms, etc., which are inevitably associated with any process of capitalistic accumulation. They also depend on the availability of labour. They seem however to give the possible order of magnitude of the phenomenon.

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\(^7\) Choosing for a moment as unit of capacity the initial aggregate capacity, we have $0.10y_s(1+y_s)^{49} = 0.01(1+0.1)^{49} \approx 1$. 
2. THE LONG-PERIOD ELASTICITY OF OUTPUT AND DISTRIBUTION BETWEEN WAGES AND PROFITS

A first important consequence of the above argument concerns pure theory. It is that the Keynesian Hypotesis need not provide us with a theory of distribution as asserted in the Distribution-based Keynesian Approach. The elasticity that a capitalist economy has in reacting to incentives for a more rapid growth by bringing about additional productive capacity and output, or, symmetrically, by eliminating it in the opposite case, makes clear that no necessity exists for a change in the real wage, and in the associated normal rate of profits (which we have in fact kept constant in our reasoning), in order to generate or eliminate the savings corresponding to any increased or decreased demand for investment. In particular, an explanation of the distribution between wages and profits by economic and social factors along the lines envisaged by the old classical economists (cf., e.g., Garegnani, 1987) appears to be quite compatible with admitting the relevance of aggregate demand for the analysis of the process of accumulation.

The above result may however seem to fly in the face of the so-called “Cambridge equation” which - when we assume that only capitalists save, and save with a given propensity \( s_c \) - yields the following relation:

\[
s_c \cdot r = g. \tag{1}
\]

Since \( s_c \) is given, equation (1) may seem to imply that the incentive to invest, governing the yearly rate of accumulation over capital \( g \), determines the normal rate of profits \( r \), with the corresponding real wage \( w \). This interpretation of the Cambridge equation, into which some authors seem to have slipped at times\(^8\), appears however to confuse two radically different meanings of the equation.

\(^8\) Cf. n.5 above. See also:

"In my model the rate of accumulation and the propensity to save out of profits are the independent elements that determine the rate of profits on capital while the rate of profit together with the technical conditions, determine the real wage" (Robinson, 1963, p.409). Similarly Richard Kahn (1959) states that the Cambridge ‘identity’ leaves open only two possibilities: either ‘a system of ideas under which the rate of growth of capital is derived from the rate of profits’, or ‘a system under which the rate of profits is derived from the rate of growth’ (p.149). Kahn can then conclude that under what we have called the ‘Keynesian Hypothesis’, the second possibility is the only acceptable one. In fact the ‘Cambridge identity’ does leave open a third possibility: that the rate of growth and the normal rate of profits are independent of each other.
The first meaning occurs when the distribution referred to is understood to consist of the real wage $w^*$ and, therefore, of what is traditionally referred to in economic theory as the normal rate of profits $r^*$ - namely the rate of profits on capital under the assumption of the normal (desired) level of utilization of capacity. This particular rate of profit is that for which the methods of production introduced in the price equations (in the production functions) are defined. The rationale of such a definition is that the profit rate is a notion relevant essentially for the investor (whose capital has not yet been sunk into a definite physical form): and the investor will refer to the normal (desired) level of capacity utilization since, in effecting his investment, he will be able to give it the size he wishes relatively to the demand he expects for his products (on this question cf. e.g. Garegnani, 1992)\(^9\).

Now, under that first meaning of the profit rate, the rate of accumulation over capital appearing on the right-hand side of equation (1), which we may then rewrite in the form

$$r^* s_c = g^*,$$

will be the potential rate of accumulation $g^*$ which we would have had under the assumption of the same normal (desired) degree of capacity utilization for which the normal rate of profits $r^*$ is calculated. It would thus be equal to the 'ratio of capacity savings' defined above, and would need have little to do with the actual rate of accumulation. Clearly, the Keynesian Hypothesis by itself will in no way entail that such $g^*$ can be treated as an independent variable in equation (1): on the contrary, $g^*$ is a dependent variable, determined by the propensity to save $s_c$ and by the normal rates of profit and profit rate.

output/capital ratio $y$. Correspondingly, equation (2) cannot be seen to entail $g^*$ determining $r^*$, any more than it entails $r^*$ determining $g^*$ (as would be the case in traditional theory).

The second meaning of the Cambridge equation (1) occurs instead when $g$ is taken to refer to the actual rate of accumulation ($\hat{g}$), which can indeed be taken as an independent variable in the Cambridge equation, rewritten in the form

\[ \hat{r} s_c = \hat{g}. \]  

(3)

Then, however, the ‘rate of profits’ $\hat{r}$ will be, so to speak, an ‘ex-post profit rate’ just as ‘ex-post’ as the level of capacity utilization which $\hat{g}$ has in fact entailed. This rate $\hat{r}$ needs therefore have nothing to do with the normal rate of profits $r^*$ and the real wage $w^*$. In particular, $\hat{r}$ can change together with $\hat{g}$ without in the least affecting $w^*$. And then it will again be illegitimate to interpret the Cambridge equation as entailing that the rate of accumulation determines the normal rate of profits $r^*$ (that expected by the investor) and the real wage rate $w^*$. That interpretation could only arise from inconsistently reading the equation (1) above as if it had $\hat{g}$ on the right-hand side, and $r^*$ on the left-hand side.

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10 Significantly enough, even a definition of this second notion sufficiently exact for theoretical purposes appears to meet serious difficulties. The difficulties are those of estimating the capital goods in existence, many of which will not belong to the dominant techniques - difficulties that already underlay the concept of a 'rate of accumulation' referred to in equation (3). In Garegnani (1992, p. 60-61) it was noted that in order to make such an 'ex-post' rate coincide with the normal rate of profits when productive capacity is utilized at its normal level, one would have to refer to a value of capital that would have little to do with the actual value of capital in the economy; and would instead have to estimate at 'normal' prices the physical capital stock as it would have been, if all output had been produced with the dominant techniques. This value should also be put in the denominator of our rate of accumulation $\hat{g}$ if (3) is to be satisfied.
3. THE LONG-PERIOD ELASTICITY OF OUTPUT AND THE SUPPOSED ALTERNATIVE BETWEEN CONSUMPTION AND GROWTH

Our argument clearly entails that in the long period, no less than in the Keynesian short period, an increase in investment can generate the corresponding amount of savings through changes in output without any need of falls in consumption (see the examples in par.2)\textsuperscript{11}. Indeed, it seems possible to argue that the margins of unutilized capacity which are normal in a capitalist system make it plausible to think that that will be the normal way in which savings will adjust to investment, so that an increase in investment will be generally accompanied by a rise in consumption (and \textit{vice-versa}) similar to that characteristic of the short-period multiplier.

Some considerations may in fact strengthen that provisional conclusion. A first such consideration is that an increase in the incentive to invest will generally be gradual: it will \textit{e.g.} manifest itself at first in shorter slumps and longer booms rather than in drastic changes in peak demand. This, taken together with the added elasticity provided by international trade, will make it easier to produce the additional investment goods by utilizing at first the existing capacity, and making use, then, of the increased capacity generated by that initial additional investment.

Moreover even if, despite all that, the increased investment were to cause a fall in real wages and consumption, such a fall would seem unlikely to last. The shortage of productive capacity causing that fall would not probably last for long, whereas the bargaining position which was reflected in the initial level of the real wage would, if anything, be likely to be strengthened by the increase in labour employment. A rise rather than a fall

\textsuperscript{11} A similar conclusion is reached in Vianello (1985) who points out the role which the assumption of steady growth may have had in leading some authors into the Distribution-based Keynesian Approach.
of the real wage might therefore be expected to accompany an increased incentive to invest and a faster growth. (It should in fact be stressed, in this connection, that our argument must not be taken to deny the possibility - or, indeed, the likelihood - of interactions between the real wage on the one hand, and the speed of capital accumulation on the other. What is here disputed is only the single effect postulated in the Distribution-based Keynesian Approach which, as just seen, might rather be the opposite of the actual effect)¹².

It seems therefore that the Keynesian Hypothesis may allow rejecting the widespread idea we find in both the marginalist and the Distribution-based Keynesian Approach that, initially at least, increased investment and faster growth require sacrificing consumption, and that they accordingly impose lower real wages.

¹² We are not concerned, on the other hand, with the non-technical limits which the distributive conflict may set to the potential growth of capacity through monetary inflation.
4. ON THE POINT OF VIEW OF ECONOMIC HISTORIANS

It is possible to say that some of the observations that economic historians have offered about the real experiences of growth of capitalist economies tend to confirm our analytical conclusions. Unlike economic theorists, economic historians have in fact often recognized the importance of demand in driving the process of growth\(^{13}\). This has been done, \textit{e.g.}, by stressing the role of the expansion of foreign markets in enlarging production and productive investment in 18th and 19th century Britain (Deane, 1967, esp. ch. 4; Rostow, 1973; Davis, 1962; Kindleberger, 1961); or by observing the fact that the slower development of both domestic and external markets was the main cause of the delayed start of industrialization in other European countries such as France and Germany (Habakkuk, 1955); or by noting the strict correlation between the historical series of British growth rates in exports and in national product (with changes in the latter following changes in the former) during the course of the 19th century (Kaldor, 1978, p. 165); or by recognizing the fundamental role of exports and public investments in the initial phase of German industrial development, when domestic demand grew only very slowly due to low incomes (Borchardt, 1972, pp. 16-19; see also Tilly, 1981); etc.

This does not mean, of course, that other economic historians have not reached different conclusions, more in accordance with traditional economic theory. Some have described the observed experiences of growth in terms of changes in supply factors: this is the case with influential authors such as, \textit{e.g.}, T.S.Ashton in his account of the British Industrial Revolution (Ashton, 1948); or W.W.Rostow in his attempt to describe and rationalize the stages of economic growth (Rostow, 1960)\(^{14}\). What is remarkable, however, is the fact

\(^{13}\) For a more detailed analysis of this question see Palumbo (1994).

\(^{14}\) Ashton finds the causes of the Industrial Revolution in a concomitant rise in all factors of production during the second half of XVIIIth century. Rostow explains the process of sustained growth that characterizes the passage from backward to modern economies (the so-called \textquoteleft\textquoteleft take-off\textquoteright\textquoteright) in terms of an autonomous increase in the propensity to save.
that even some of these authors happen to offer observations on the fundamental role of demand, contradicting their very theoretical premises (Matthews and Rostow provide two examples, both stressing the role of the demand for exports in different phases of British growth)\(^\text{15}\). This seems to imply that observed facts have not appeared, to these historians, to agree with the conclusions of traditional economic theory, and may be significant also for realizing the difficulties of the approach, that in recent years has gained wide acceptance, known as ‘new economic history’, founded on the attempt to re-write the economic history of capitalist economies by strictly applying the tools and conclusions of traditional theory\(^\text{16}\).

If historical observation seems thus in general to validate the Keynesian Hypothesis, it may be worthwhile trying to go further and ask whether it offers any evidence in favour of one or the other of the above-mentioned two Keynesian Approaches. A way in which it seems possible to address the question is by considering the behaviour of the share of savings in national output during periods of fast growth (see Palumbo, 1996).

Ignoring here the complications due to the international transactions and to the role of Government (which however would not affect the substance of our argument)\(^\text{17}\), the inelasticity of long-run output in response to changes in the incentive to invest, claimed by the Distribution-based Keynesian Approach, would in fact entail, at least initially, a rise in the share of investment and savings, when the amount of investment rises. The elasticity of long-run output contended in the Output-based Keynesian

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\(^{15}\) Cf. Matthews \textit{et al.} (1982, especially pp.500-50); Rostow (1973, p.557 and \textit{passim}).

\(^{16}\) For some representative instances of new economic history see Fogel (1964), Fogel and Engerman (1971), Mokyr (1985); and for a more detailed critical discussion Palumbo (1994).

\(^{17}\) If the simplifying assumption of a closed economy without state intervention is removed, one should consider the variations in the investment and saving shares which are brought about both by the variations in the net export share (which affect the investment share), and by public policies (which may influence the private propensity to save). These changes, however, are autonomously determined and need not occur in a particular direction during periods of fast growth.
Approach may instead be conceived to leave that share nearly unaffected to the extent in which output and capacity rise together with investment.\textsuperscript{18}

Now, a near constancy of the share of gross savings seems in fact to be what is observable in various historical instances in initial periods of faster growth, and what has puzzled several historians influenced by traditional theory. A rise in the saving share in national output seems to come only after a period of faster growth of some length. This appears to have emerged in the debate on capital formation during the Industrial Revolution (Deane, 1972; Crouzet, 1972; Feinstein, 1978; Crafts, 1983), where the main empirical result seems to be that an increase in the saving share occurred \textit{only decades} after the process of sustained growth had begun (the saving share nearly doubled in comparison with pre-industrial Britain only after the 1830’s, the conventional date for the beginning of Industrial Revolution being between 1760 and 1780)\textsuperscript{19}.

Moreover, Habakkuk (1955, p.161-2) notes that there was no rise in the saving share at the beginning of the growth process in the European countries that imitated British industrialization. Similarly, according to Cairncross (1963, p. 249), the Swedish economy witnessed a tendency to rise in the gross saving share only during the 20th century, although “industrialization was already in full swing and production rising rapidly long before 1900”, while also for Norway the rise in the saving ratio followed rather than preceded the take-off. The same kind of evidence is observable in those Asian

\textsuperscript{18} This of course assumes, as it is generally assumed, that an increase in the growth rate of output requires an enhanced amount of investment. To the extent in which growth were merely due to \textit{technical progress} affecting labour productivity, it could conceivably occur without any increased amount of investment, so that the constancy in the saving share could be reconciled with the Distribution-based Keynesian Approach. However, it is generally held that in the historical processes of growth under examination \textit{extensive growth} of the modern industrial sector of the economy has been decisive and also that a considerable part of the overall increased labour productivity has there been due to shifts of labour towards those sectors and therefore to that extension.

\textsuperscript{19} This historical trend of the saving share has been firstly registered by Deane and Cole (1962, p.263-4); and seem generally to be confirmed in the subsequent literature (see e.g. Crafts 1983, who has proposed major revisions of many of the Deane and Cole’s data on Industrial Revolution).
countries which have lately experienced a process of fast industrialization and growth: the gross saving share was initially roughly constant (and very low by international standards), whereas it remarkably increased only one or two decades after the sustained increase in the growth rate of output had firstly occurred\textsuperscript{20}.

That comparative constancy of the share of savings in the initial stages of episodes of fast growth seems thus to indicate a long-period elasticity of output and hence no need to change distribution to provide for savings. The later rise of the gross saving share might then perhaps be referred to a different kind of phenomenon, like the heavier dependence of a more developed economy on fixed capital and its replacement (Palumbo, 1996).

\footnote{See for instance IMF (1995); ch.5, esp. pp 70 and 73; Carrol and Weil (1994), p. 149-150.}
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