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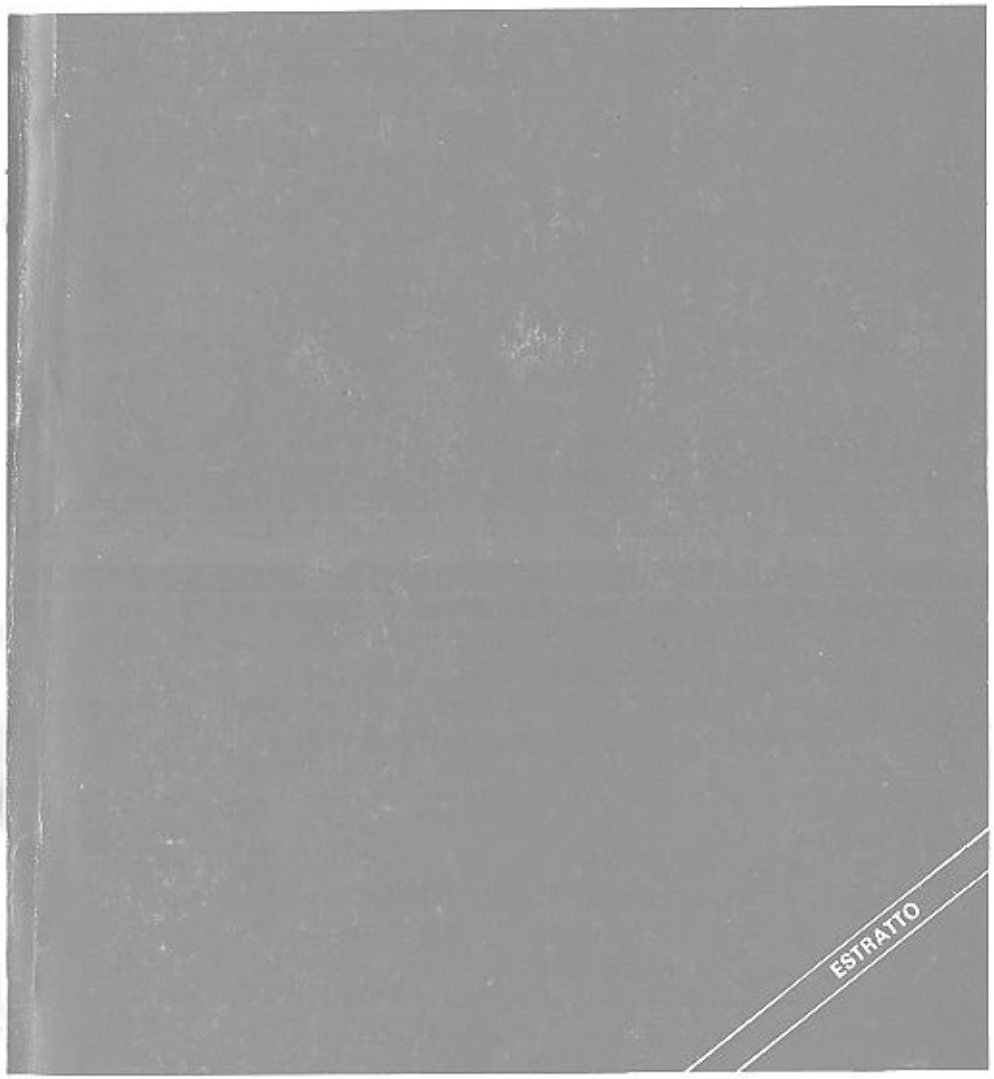

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KALDOR VS. SCHUMPETER ON ECONOMIC GROWTH AND STRUCTURAL CHANGE

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Introduction

The role of structural change in economic growth and employment has recently become of major interest. However, it still remains a highly complex issue, since both demand factors at macro-level and supply factors at micro-level are deeply involved.

A comparison between two competing views on the issue could be an enlightening starting point for further research[1]. The argument of the present paper is that these views can be identified in N. Kaldor's and in J. A. Schumpeter's works (Sections 1. and 2.). The comparison tempts one the search for a synthesis of the two views in order to provide a more complete explanation. However, inconsistencies impede it, though very important insights of the two authors can be maintained for building a new theoretical framework for such an explanation (Section 3.). A tentative proposal in this direction is finally outlined on the basis of Hirschman's and Rosenberg's contributions (Section 4.).

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[1] The demand-pull/technology-push controversy usually relates to technical progress (as reported by Gold, 1981; and by Dosi, 1984) and sometimes to inventive activity (Schmookler, 1966; Rosenberg, 1976, ch.15). It is curious that the controversy has not explicitly shifted to economic growth and development. See Pugno and Santarelli (1986).

1. Kaldor's Macro-Demand-Pull Approach

In a number of papers Kaldor (henceforth K.) seeks an explanation for the trend of economic growth in capitalist economies. More precisely, he seems to pursue two distinct lines of research: the first focuses on the conditions and mechanisms for maintaining a trend of full employment equilibrium (i.e., the Harrodian exogenously given "natural" growth rate); the second studies how the trend of "full employment" is achieved and shaped in highly dynamic economies (i.e. how a desired-actual rate of growth incurs and relaxes bottlenecks in approaching the "natural" path, which is thereby affected)[2].

Since the structural changes that emerge as changes in the composition of output and divergence in productivity growth rates among sectors are only dealt with by the second line of research, the present paper will consequently narrow its focus.

K.'s famous 1966 Inaugural Lecture marks the cornerstone of his research into growth and structural changes. The general question he addresses, in fact, concerns the causes of long term economic growth in capitalist economies.

K.'s starting-point of analysis is an empirical one, i.e. it consists of the following stylized facts:

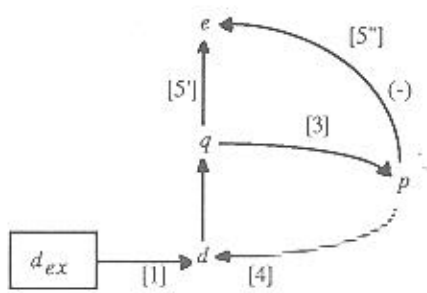
(*i*) the manufacturing growth rate is positively related with the GDP growth rate (K., 1966, p.4)[3] ;

(*ii*) the manufacturing productivity growth rate is positively related to the manufacturing output growth rate (this is a version of the Verdoorn Law) [4];

(*iii*) the manufacturing growth rate is positively related to labour absorption from other sectors (*ibid.*, pp.16-17).

Highly significant statistical associations for Western industrialized countries during the late 1950s/early 1960s are cited in support of such statements (K., 1966; 1967; 1968; 1975a). A consistent theory that fits these facts and explains the rate of growth as a whole thus has to be looked for, and K. pursues it along "classical" lines.

K.'s approach views economic development as the result of interaction among economic sectors, where manufacturing is the "engine", and demand coming from the "primary" sector and from abroad is the stimulus. K.'s specific argument can be schematised in the following chart:



[2] The first line of research is the world of steady-state models which describe a one-sector, closed economy with all variables but the labour force constant and equal in the growth rates. The main question in such an analysis is the stability of the full employment path. This K. solved by making particular assumptions on income distribution. Deviations are regarded as only being of theoretical interest (K., 1957a; 1961; K. and Mirrlees, 1962). By contrast, the second line of research deals with the way in which economic growth interacts with fluctuations (see below) (K., 1954a; 1954b; 1957b; 1966; 1967; 1971; 1974).

K.'s preference for one of the two has recently been made explicit: "in order to make [my theory of distribution] work, some time ago I made that foolish assumption of full employment. This depended also on the aggregate models fashioned at that time" (K., 1985a, p.110, our translation).

[3] More precisely: "the faster the overall rate of growth, the major is the *excess* of the rate of growth of manufacturing production over the rate of growth of the economy as a whole" (*ibid.*).

[4] The Verdoorn Law was originally based on positive associations between productivity growth and output growth both for industry as a whole and for industrial sectors in various advanced countries before World War I and in the interwar period. It was thought as of a "rule of thumb" for planning purposes (Verdoorn, 1949).

where:
D_{ex} = exogenous demand components,
D = global nominal demand,
Q = real output,
P = labour productivity,
E = labour demand.

Lower case letters stand for rates of changes; arrows [1]-[5] stand for *positive* channels of causation, except for [5"] which leads to inverse effects (-). The intermittent arrow stands for less stable causation.

Manufacturing is regarded as an open system. At country level, it is stimulated by demand from agriculture during the first phases of industrialization, and from abroad during the following phases (K., 1967). Analogously, at world level, the growth of manufacturing is governed by development in the "primary" sector (K., 1974). Labour supply is not the constraining factor; on the contrary, "for industry it is potentially *unlimited*" (*ibid.*), when disguised unemployment in other sectors, both at home and abroad is considered (*ibid.*)[5]. Therefore, exports from the manufacturing sector (d_{ex}) stimulate a wider range of demand (d) through the accelerator-multiplicator mechanism (channel [1]), while the lack of labour constraint allows output (q) to adjust (channel [2])[6].

According to K., increasing returns of output growth (Verdoorn Law) is a typical phenomenon only of manufacturing (K., 1966, pp.16-18)[7], where there occur both static and dynamic economies of scale (learning by doing, specialization) and technological diffusion through embodiment in new capital vintages. The phenomenon, therefore, is "macroeconomic" in nature (Young, 1928) because it develops through

[5] Since K.(1968), labour has not been regarded as constraining in "mature" economies either.

[6] "The rate of growth of industrialization fundamentally depends on the exogenous components of demand" (K., 1968, p.386; see also 1975a, p.895). In fact, neither labour nor capital is regarded as "a serious limitation on economic growth" (K., 1968, p.390).

[7] More precisely, K. does not regard the Verdoorn Law as appropriate either for the other sectors or for individual manufacturing industries.

interactions among industries.

According to K., labour productivity growth in manufacturing (p) could thus be explained simply, by output growth (channel [3])[8].

Feedback from productivity to output through prices (channel [4]) is recognized as effective by K., thus enabling "circular and cumulative causation" *á la* Myrdal to occur (K., 1971 and 1974). Nevertheless, this channel is also regarded as being "far less regular and systematic" than channel [3] (K., 1975a, p.895n), because price flexibility with respect to productivity and price elasticity of demand may not be sufficiently high and systematic (K., 1966, p.14)[9].

The net effect of output growth (channel [5']) and of productivity growth (channel [5"]) on labour demand must be positive if K.'s above-mentioned[10] third empirical law (*iii*) is to be fulfilled.

The driving impulse towards growth, therefore, is provided by the exogenous demand components. These are responsible not only for the pace of macroeconomic growth (see Thirlwall, 1979), but also for structural changes among sectors (manufacturing/non-manufacturing) and among industries (within manufacturing). The "engine" role of manufacturing, in fact, consists of potentiating and transforming demand stimuli into macroeconomic growth through intersectoral and interindustrial development. This emerges as a passive process of productivity growth and employment expansion. Lacks of exogenous demand stimuli, on the other hand, appear to be responsible for

[8] K. maintains that the Verdoorn relationship is not necessary in his model (i.e., the elasticity of productivity with respect to output in manufacturing could be very low) insofar as manufacturing absorbs labour from sectors that display diminishing returns. But if the alternative case to a strong Verdoorn relationship is a weak relationship - i.e. a case where the correlation coefficient is low - then labour absorption can no longer be predicted with a high confidence level, and the whole model becomes unstable.

[9] K. maintains that price elasticity of demand should be greater than one if both stylised facts (*ii*)-(*iii*) are to be explained (*ibid.*). Such a restriction, however, must refer to demand in real terms (our q). In fact, a rise in p could increase q and e through reductions in price, although *nominal* demand is also reduced.

[10] When per-capita income is the same in all sectors, manufacturing is no longer able to absorb extra labour, to expand output and to raise productivity. In this way, it approaches the stage of "maturity" (*ibid.*, p.3).

unemployment[11]. In conclusion, the Kaldorian process of manufacturing growth is characterised by positive and close correlations between the growth rates of demand, output, productivity, investment and employment at macro-level. Since phenomena at micro-level do not receive an autonomous explanation, this approach can be labelled as a "macro-demand-pull".

Two further qualifications characterise this approach. Firstly, population growth, in the long run, is endogenous to the extent that the subsistence level improves (Malthusian regulation) and migration is induced (K., 1954a). The performance of agricultural productivity is brought to attention here, because it governs economic possibilities of the population and new demand for industrial products. In this respect, a substantial rise in agricultural productivity ("the agricultural revolution") is the necessary condition for industry to be stimulated effectively ("the industrial revolution") (K., 1954b; 1967). However, it is not the sufficient condition in explanation of the extent to which industry is stimulated, i.e. the actual industrial rate of growth. In fact "the most plausible explanation for a rate of growth [...] in output as a whole is *expectation of a growth in demand on behalf of entrepreneurs* " (1951, p.842, emphasis added). Therefore the dynamics of exogenous demand components explains overall economic growth only in a first approximation (as in K., 1971), since the ultimate determinant lies in entrepreneurs' expectations of that dynamics (K., 1954a; 1954b; 1957a).

The second qualification concerns the endogeneity of technical innovation, claimed by K. to be dependent on investment[12]. More specifically, K. theorises the "technical progress function", which relates productivity growth to capital intensity growth (K., 1957a). Therefore the elasticity of productivity with respect to output varies according to both the "height" and the shape of this function, these being due to the "`technical dynamism' of the economy, [...] meaning by this both inventiveness and readiness to change or to experiment" (1961, pp.208-209).

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11 It could be labelled as "Keynesian" as far as the role of demand is concerned, but the possible lack of plant productive capacity is ignored.

12 "Improved knowledge is, largely, if not entirely, infused into the economy through the introduction of new equipment" (K., 1961, p.207).

The complete endogeneity of technical innovation (K., 1954a; 1954b) therefore depends on the *stability* of the "technical progress function". This is confirmed by K.'s empirical findings, where productivity growth is largely explained by output growth and, to a small but statistically significant extent, by capital intensity growth (K., 1967, p.82).

K.'s approach to capitalist economic growth therefore predicts[13] a growth path where manufacturing entrepreneurship works as the active force, while decreasing returns in "technical dynamism" and in population response to economic growth provide the constraints (K., 1954a;1954b). The interdependence of the former with the latter gives the specific long term rate of growth[14].

2. Schumpeter's Micro-Technical-Push Approach

The questions Schumpeter (henceforth S.) poses at the center of his analysis of capitalist economic development concern growth fluctuations and structural changes.

His analytical starting-point is a theoretical one: the Walrasian general equilibrium, reformulated in the theory of static circular flow (Schumpeter, 1934, ch.1; 1939, pp.35-38). His research, in fact, comprises a consistent matching between that theory and a new one designed to explain the dynamic features of the economic system[15].

Historical and statistical records for the entire pre-war capitalist

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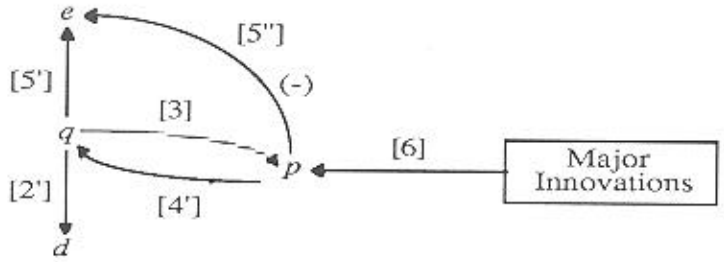
13 For an example of predictive purposes, see how K. explains the puzzling U.S. productivity slowdown by means of the lack of demand (K., 1985b).

14 "[T]he actual rate of development is the outcome of the strength of entrepreneurial pressures on the one side, and the elasticity of responses of population growth, technical progress and capital accumulation on the other side" (K., 1954b, p.237). "[T]he more the `warranted rate' tends to exceed the `natural rate', the more it will *bend* the `natural rate' in its own direction" (1954a, p.69).

15 "[H]istorical facts [...] induce the theoretical work and determine its pattern" (S., 1939, p.32). For a distinction between an "orthodox " and an "innovator" S., see Graziani (1977) and Donzelli (1983). Donzelli (1983), in particular, calls into question S.'s reference to Walrasian type of equilibrium, among different neoclassical types, as the most proper for his own approach.

development of the UK, the US and Germany provide the empirical evidence for his attempt (S., 1939, chs.VI-XV).

In order to render K.'s previous schematization comparable with S.'s, the following chart is proposed:



Innovation appears to be the stimulus for economic development, i.e. the shock pushing the system out of the Walrasian equilibrium characterising the circular flow[16].

This is defined by S. as a "new combination of factors of production"[17] or, more rigorously, "as the setting up of a new production function" (S., 1939, p.87). The relevant innovation, however, is only the major innovation as a *uno actu* or indivisible phenomenon (S., 1934, p.81n, p.231; 1939, pp.93-94 and p.101).

The prospect of profit motivates the leading entrepreneur to

16 "Innovation [...] is at the center of practically all the phenomena, difficulties and problems of economic life in capitalist society" (*ibid* ., p.87). "It is a *distinct* factor because it is not implied in, nor a mere consequence of, any other" (*ibid* ., p.86, original italics).

17 In S.(1934) it includes: "(*i*) the introduction of a new good [...] (*ii*) the introduction of a new method of production [...] (*iii*) the opening of a new market [...] (*iv*) the conquest of a new source of supply of raw materials [...] (*v*) the carrying out of the new organisation of any industry" (p.66).

introduce innovation into a new line of production[18]. This means that a new investment is added as a claim on factors of production, which, however, are assumed by S. as already being fully employed (S., 1934, pp.67-68; 1939, pp.131-133). Thus a change in the composition of output, rather than an increase in it, occurs through increased prices. When the new capacity eventually comes into operation, a higher quantity and/or a better quality of consumption goods emerges, thus increasing labour productivity (channel [6])[19] and output (channel [4']) (and possibly reducing prices). These emerge as the macroeconomic results of underlying adjustment processes of transmission of microstimuli through firms and industries by means of the conventional price/quantity mechanisms.

Demand, therefore, is assumed to be perfectly flexible with respect to price, quality and novelty of output (channel [2'])[20]. Possible "technological unemployment" can thus be rapidly absorbed and does not emerge as a significant phenomenon (channel [5"]).

S. calls this round of effects "Primary Wave". It is reinforced by a "Secondary Wave", insofar as the initial burst of prices ignites profit expectations and the setting up of new businesses throughout the economy (S., 1939, pp.145-161). This enables minor innovations flowing from the major ones to diffuse through firms and industries (1934, p.81n), thereby effecting a further overall productivity increase (channel [3]) (1934, p.245n). It is important to note that the conventional adjustment mechanisms are applied to a process of proliferation of technological opportunities, i.e. to the very Schumpeterian concept of "swarming".

Eventually, overproduction and speculative heating is approached

18 This "does not [...] presuppose either an actual nor an expected rise in prices and expenditure" (*ibid* ., p.130).

The second actor in S.'s play is the banker, who finances innovation by creating banking money (*ibid* ., pp.109-123).

19 When output changes in quality, the definition of productivity becomes ambiguous. However, no satisfactory solution seems to exist (S.'s attempt is in 1934, pp.141-145).

20 Consumers' tastes are moulded by supply when product innovations are introduced (S., 1934, p.65; 1939, pp.73-74); but their traditional sovereignty reappears in the adjustment processes to price changes.

until crash and recession put an end to the wave (1934, pp.236-241; 1939, pp.148-150). Unemployment may thus emerge as being due to the abnormal consequences of the Secondary Wave - as "cyclical" in character rather than properly "technological" (channel [5'] with falling q, rather than channel [5"])[21]. Again, the traditional mechanisms will eventually adjust the system towards equilibrium[22]. Equilibrium is not necessarily characterised by the absence of unemployed resources, insofar as S. relaxes the hypothesis of perfect competition (1939, pp.160-161). In such a case, the expansionary effectiveness of major innovations can more rapidly take place (from channel [6] to [4'] and to [5']).

Major innovations, therefore, appear as *exogenous* with respect to the dynamics of economic activity. However, a further basic point in S.'s analysis concerns the *endogeneity* of major innovations with respect to the capitalist system (1939, p.86)[23]. In fact, the increased uncertainty of introducing major innovations when the system is already under shock as a result of the preceding ones seems to be the basic reason for discouraging their introduction (1939, pp.135-136). Hence, innovations will not appear regularly, but rather in bunches (1934, pp.223 and 228-229; 1939, pp.100-101).

In conclusion, according to S., economic fluctuations are explained by pulsations of microeconomic stimuli of a technical kind generated in swarms, and reactions of the economic system in output and employment through chains of conventional price/quantity mechanisms. Development is thus characterised by the strict and positive accordance of the system (dynamics of output, productivity, investment and employment) with the stimulus, though it predicts a cyclical growth path. "Micro-technical-push" could thus be used as a label for such an approach insofar as macroeconomic performance does not receive an autonomous explanation.

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21 "Technological unemployment is thus shown to be a component part of cyclical unemployment, and should not be contrasted with it as if it had nothing to do with the cycle" (1934, p.250).

22 "[T]he theory of equilibrium is *a description of an apparatus of response* " (S., 1939, p.68).

23 In other words, the determinants of major innovations are *economic* factors, apart from those included in the loop.

3. Analogies, Differences and Shortcomings of the Two Approaches

Both K.'s and S.'s approaches are attempts to explain economic growth and structural change in capitalist economies. They conceive of development as being a cumulative process of causation between demand, output and productivity, ignited by an exogenous stimulus. However, both stimulus and causations are different in the two approaches. K. considers demand for manufacturing exports from other sectors as the exogenous stimulus, and output and productivity as adjusting, since labour, capital and new inventive ideas, in general, do not significantly constrain. S., on the other hand, considers major innovations as the exogenous stimulus, and demand as automatically adjusting (channel [2'] is the reverse of K.'s [2]) because prices and consumers' tastes are assumed to be perfectly flexible with respect to the new production (channel [4'] directly points to q instead of to d). Feedback for a loop is provided by a certain degree of price flexibility in K., and by minor innovations in S. (intermittent arrows in the charts). Whereas no general prediction is possible for the stability of K.'s loop (Dixit and Thirlwall, 1975), S.'s loop is of the convergent type. This leads K. to predict - for highly dynamic economies - an exponential growth path recurrently damped because it incurs exceptional supply constraints (e.g., 1957b), and S. to predict a cyclical growth path according to a shock-and-adjustment pattern. Investment is endogenised in both cases, as adjusting to output and profits. Finally, they maintain that the net effects of output- and of productivity-growth on employment are positive: K. on an empirical basis, S. on a theoretical basis.

Economic growth therefore emerges in each of the two authors as a process where stimulus, growth rates of demand, output, productivity, investment and employment are positively and strictly correlated. This, however, hides two different views on structural change: according to K., it is a passive phenomenon contained in the "black box" of macroeconomic productivity growth; according to S., it evidences microeconomic stimuli[24].

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24 It is tempting to claim that, whereas K.'s approach deals with the *theory of*

It is interesting to note that, although K. and S. come from two very different theoretical backgrounds, they converge in regarding the entrepreneur as the active force in the capitalist development that links investment to innovation. However, whereas the necessary feature for the Kaldorian entrepreneur is to invest and the possible feature is to innovate, for S. it is exactly the reverse. Secondly, in K. the action of the entrepreneurs is macroeconomically effective when they behave as a class (quantitative significance), whereas in S. this is the case when their individual experiments (qualitative significance) are able to ignite large-scale response. Finally, although success for the Schumpeterian "innovating" entrepreneur is more difficult to predict, it is more far-reaching than the Kaldorian "investing" one.

Each of the two competing views appears, in turn, to make an analytical contribution where the other seems inadequate.

Firstly, K. derives the leading role of effective demand from Keynes' lesson, where, in an unconstrained economy, the autonomy of investment is emphasised and underemployment equilibrium is argued for. But this lesson is neglected by S.[25], who follows the neoclassical theory of adjustment, so that, in particular, there is always demand for new production out of innovations, and bunches of innovations automatically lead to waves in economic activity. On the other hand, K. does not recognise that effective demand for a new product cannot be "well-perceived" by firms (Nelson, 1972, p.46)[26], thus hindering a systematic supply adjustment, whilst quality innovations play a central role in S.'s approach.

Secondly, the leading role of technical progress in S. is derived from the autonomy of the entrepreneur's "act of insight" (*á la* Usher,

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growth, insofar as structural changes within manufacturing depend on aggregate growth of demand and can thus be ignored, S.'s approach deals with the *theory of development*, since structural changes emerge as the necessary condition for growth, and they have to be explained.

25 A personal testimony by Goodwin reports that S., his teacher, refused to incorporate Keynes' contribution in his theory of cycles (Goodwin, 1984).

26 This explicitly emerges where he notes that "in the case of income, the changing character and composition of the constituents could be ignored in the first approximation" (K., 1957b, p.598n).

1955) as distinct from managers' "acts of routine" (S., 1934, p.83). The profit opportunity arising from a "new combination of factors" shapes the direction of technical progress and can explain productivity growth independently of demand dynamics. Also minor innovations are independent of demand dynamics, since they arise in "swarms"[27]. This conflicts with K.'s view, which regards not only technical progress and productivity growth but also technological change as adjusting with respect to demand growth both in rate and in direction (K., 1954a, p.66). It is true that such an adjustment is not regarded as being complete, insofar as he explains residuals of the Verdoorn type regressions by means of capital intensity growth (K., 1967, p.81), i.e. by using his theory of "technical progress function". However, if some autonomy of the evolution of technological change and of technical progress is assumed, then movements along, and shifts of, "technical progress function" are linked together, thus threatening the meaning of the function itself. In other words, K. can no longer assume the stability of the function first[28] and theorize the stability of capital intensity growth afterwards. This raises further issues: first, the irrelevance of such "Schumpeterian" fluctuations in the function with respect to the trend of growth - as K. seems to suggest; second, the time span of reference: whether this is a question of more than a century of industrial development or of the 1950s and 1960s, i.e. an upswing phase only of the long wave.

K.'s endogeneity of productivity dynamics therefore appears unsatisfactory, since it is largely viewed as a "black box", where a number of explanations do not find a specific role[29].

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27 This is explained by S. in the following way. Taken for granted that "only few people have [...] qualities of leadership", i.e. the ability to move beyond the bounds of routine, "the progressive lightening of the task" thus follows (S., 1934, pp.288-289), because those "pioneers remove the obstacles for the others first appear, but, owing to the nature of these obstacles, *ipso facto* in other branches too" (-ibid-., p.229).

28 "[I]mportant new discoveries (such as the invention of the internal combustion engine or atomic energy) are likely to raise the position of the curve considerably for *some time* " (K., 1957a, pp.596, our emphasis).

29 E.g. Young's specialization of industries, Arrow's learning by doing, Salter's embodied technical progress.

On the other hand, S.'s contribution does not ground on a very solid base either. His entrepreneurial-shocking-the-system pattern is severely criticised - in particular by Rosenberg (1976 and 1982): (*i*) introducing innovations is not a pick-up-from-the-shelf activity, rather it is the activity of making inventions marketable, where technological constraints and economic opportunity interact; (*ii*) in the same productive process, `major' innovations often have lesser effects on productivity than the `minor' ones that follow (learning by doing, learning by using); (*iii*) new techniques often induce higher productivity in old techniques, maintaining their profitability; (*iv*) a high rate of technological change could induce a lower rate of technical progress because of higher uncertainty in expectations. These considerations significantly obscure the role of the Schumpeterian entrepreneur, because it becomes difficult to recognise indivisibility and skilfulness. Waves in innovations are diluted and they lose correlation with productivity dynamics.

This, however, does not mean that K.'s view is supported by Rosenberg's analysis. On the contrary, Rosenberg stresses the autonomy of the evolution of technological change, in particular when he observes that (*v*) the innovation sequence is marked by technical bottlenecks and opportunities, as if it follows a kind of "technological imperative". Finally, Rosenberg claims that (*vi*) inventive/innovative activity shows significant failures in responding to demand signals.

Rosenberg's observations, therefore, suggests the unpacking of the productivity "black box" by research at the disaggregated level, but assign minor role to both demand (unlike K.) and prices (unlike S.).

Insofar as K.'s macro-demand-pull approach and S.'s micro-technical-push approach display complementary aspects, a synthesis between the two is tempting. Demand-, output- and productivity-growth would close a self-reinforcing loop with two sources of partial exogenous stimuli. Questions on each step of the loop would seem to have an only essentially empirical content, such as the evaluation of:

1) the demand elasticity with respect to novelties in consumption goods (correlation between p and d);

2) the macroeconomic impact of an innovation on producers' expectations, and then on investment (correlation between p and d);

3) the sensitivity and direction of technical change with respect to constraints in output (correlations between d and q , and between q and p);

4) the autonomous component and the demand-induced component of productivity advance (correlations between q and p).

However, research into these kinds of questions entails rejecting two theoretical simplifications that first K., but not S., and then S., but not K., have adopted. First, the Walrasian automatic mechanism of adjustment toward full employment is to be regarded as inadequate in explanation, in particular, of the macroeconomic performance of output and employment, something that S.'s approach assumes.

Second, aggregative analysis is also to be regarded as inadequate in explanation, in particular, of the endogenisation of microeconomic phenomena such as technological change in K.'s approach.

Therefore, in order to explain economic growth and structural change, the synthesis of K.'s and S.'s approaches seems no longer possible, because these theoretical simplifications are essential features, in turn, of each approach. Thus, it also follows that analysis of the correlations between q , p and e - where both approaches seem to converge - loses economic meaning and remains trapped in the problem of simultaneity[30].

A new theoretical framework, one that avoids these simplifications and overcomes the simultaneity problem, is therefore required. This can be obtained by linking the macroeconomic role of demand dynamics to the microeconomic role of changing production processes in a consistent way. Such a framework, where both K. and S. contribute with insights but not as approaches, is still to be built. However, a suggestion for it is outlined in the next Section.

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[30] The problem of simultaneity between p and q in K.'s case gave rise to the well-known controversy on what from Verdoorn Law becomes "Kaldor's Law" (see, e.g., Rowthorn, 1975; Parikh, 1978). In S.'s case the problem is hidden by the assumption of complete flexibility of demand, so that coincidence between waves in innovations and waves in output is not discussed (see e.g. Kuznets, 1940).

It is curious, in particular, how the positive correlation between q and p is treated by the two authors: for K. it is an "empirical law", in that any theoretical static cost curve is of scant relevance (K., 1957a); for S. it is obtained as shifts (that cannot give place to a "law") of the cost curve governed by the traditional "law of diminishing returns" (S., 1939, pp.87-90).

4. An Outline of the "Linkage Framework"

A.O.Hirschman has put forward a proposal for the linking together of economic growth and structural change.

He argues that successful growth in a developing economy may occur as, and be pursued as, following an unbalanced pattern. His argument is that growth can be seen as a sequence where some sectors, industries and firms move ahead more than the others, and "each move in the sequence is induced by a previous disequilibrium and in turn creates a new disequilibrium that requires a further move" (Hirschman, 1958).

Hirschman calls each step of the sequence a "*linkage* ", one that occurs "whenever an ongoing activity gives rise to economic or other pressures that lead to the taking up of a new activity" (Hirschman, 1981, p.76). Since he mainly deals with developing economies, linkage consequently refers to the adding of new activities to existing ones, i.e. the building of new blocks into the matrix of techniques. This does not seem the usual case with developed economies. However: firstly, at a very disaggregate level this is in fact the general case insofar as output changes quality over time; secondly, linkage could be seen as referring rather to change in running activities, i.e. change in the coefficients of the matrix of techniques. Further, such changes do seem to have been particularly the case in most recent years for developed economies as well[31].

Therefore, I will attempt to translate Hirschman's concept of linkage into a very general framework where the relationships between d, q, p and e, as originally considered by K. and S., are disaggregated and analysed in causations[32].

In essence, such a translation can be justified if we keep Hirschman's attempt at researching limited patterns within a perspective

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31 This is revealed, on one hand, by the weakening of the Kaldorian approach because of the instability in the Verdoorn Law (Cripps and Tarling, 1973; Boyer and Petit, 1980; Rayment, 1981; Michl, 1985), and, on the other hand, by the strengthening of the Schumpeterian approach, as the recent debate on "Long Waves" shows (Van Duijn, 1983).

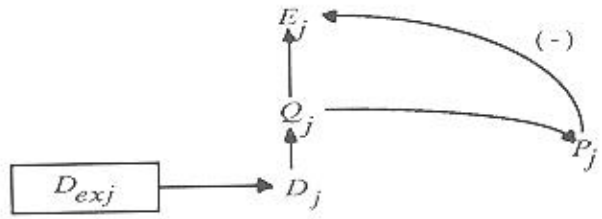
32 The very rich study by Dahmén on Swedish industrialisation (Dahmén, 1950) can be regarded as a pioneering research of this framework.

of growth as a sequential process of qualitative changes[33].

The framework can be organised into different kinds of linkages:

(*a*) A "*backwardlinkage* " occurs when a rise in demand for a product induces a productivity advance through output growth in the final stages and then in the whole vertically integrated sector (Pasinetti, 1973) of that product.

This pattern can be charted in our familiar way, but it should be noted that the variables refer to the vertically integrated sector (or firm) j, that D_{exj} is referred to the demand for its final production, and D_j to the demand for its total production Q_j .



This productivity advance should be singled out as the only one due to the increasing scale of production. This occurs when scale-dependent technological opportunities become exploitable, or when learning by doing and by using, specialization and mechanization (see, e.g., Stigler's "vertical disintegration", 1951) are accelerated.

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33 This attempt has been largely influenced by the recent growing literature on technological change, which is extensively based on case studies, often of a historical kind. The rationale for this lies in research to aimed at identifying some specific links of causation that are both limited, insofar as experiences of technological change do not replicate themselves, and object to be patterned, insofar as they help to restrict the range of uncertainty when prediction of effects of a new technological change is concerned.

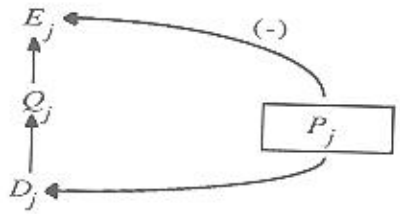
Our attempt, as it should be clear, departs sharply from the standard "synchronic approach" to "linkages" based on input-output relationships of production flows (e.g., Yotopoulos and Nugent, 1973; Meller and Marfan, 1981; Cella, 1984).

This case assumes demand as *effective* and depends on the *potentialities* underlying productivity advance.

Ambiguous net effects are expected on employment of the whole integrated sector.

The Kaldorian flavour is evident, but this disaggregated view enables inspection of microeconomic factors in productivity response and evaluation of the different effects on employment;

(*b*) A "*forwardlinkage* " occurs when a productivity advance (inclusive of the quality dimension) of an industry or firm is able either to induce new demand for its production through lower prices, better quality or new products, or to reduce employment while production remains stable.



A number of cases are possible. If the industry produces consumption goods, then it faces consumers'needs and insight is required in order to evaluate their price sensitivity and/or performance sensitivity towards its production. If the industry produces investment goods (or intermediate goods), then producers'needs are involved, and - because they respond to different stimuli (Lundvall, 1984) - they are perceived and can be investigated in a very different fashion from consumers'needs.

Both cases assume productivity advance as *effective* and depend on *potentialities* of demand absorption.

But the standard linkage involves both these industries when a new type of investment good allows consumption industries to obtain substantial productivity advances (Abernathy and Utterback,1978). A particular but relevant case is that of *rationalisation* , where a quantitative productive advance is obtained with low investment

(Lamfalussy, 1961).

The Schumpeterian flavour is thus only partial. This is because a negative direct effect on employment is also considered to be a possible outcome of productivity advance.

The introduction of an innovation is not only to be regarded as successful when demand is stimulated, but also when costs are reduced and labour displaced;

(*c*) "*Side linkages* " may be used as a term to include those phenomena which, on one hand, Rosenberg calls "technological convergence" (1976, ch.1), and which, on the other, Hirschman calls "complementarity" in investment and consumption (1958, pp.40-44). In the first case a technological innovation originally developed in one industry induces technical advance in other industries[34]. In the second case, "the increased *use* of [the good] A leads to greater demand for [the good] B", as a phenomenon of "entrained wants" (*ibid* ., p.68).

These kinds of linkages allow the lateral transmission between industries and firms of vertical linkages - through *p'* s in the first case and through *d'* s in the second.

These three types of linkages are complemented by other important related effects. A first group concerns the *timing* of linkages. An example - particularly relevant to the development of backward linkages, is provided by the possible perverse effect of technological innovations. These, in fact, could temporarily damp productivity advance both in the using industry, because of the overmanning required by experimentation of new technologies (Rosenberg, 1976), and in the producing industry, because of the gestation of new capital goods. Another particularly relevant example to forward linkages is provided by the dependence of the rate of innovation diffusion on the degree of competition (Kamien and Schwarz, 1982) and on expectations over future demand. Further, the availability of natural resources can also heavily affect the timing of linkages.

A second group of related effects of linkages concerns *leakages* , which act as counterparts. A standard example for backward linkages is import. Another example relating to side linkages is the

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34 At firm level this can be called "innovation diffusion".

substitutability between goods.

This specification of linkages and related effects could outline a useful, though partial, framework[35]. In fact, it can help in overcoming the inadequacies both in one-sided approaches, such as K.'s or S.'s, and correlation analysis of q , p and e . This is made possible by dropping K.'s simplification of aggregative analysis and S.'s simplification allowed by the adjustment of the neoclassical kind.

On the one hand, demand effectiveness on output-productivity- and employment-growth could be decomposed into linkages and studied according to their importance, chaining and related effects. Shifts in, or the loss of, the Verdoorn-Kaldor relationship (change in the parameters or lowering in the correlation) could thus find an explanation.

On the other hand, innovation effectiveness on output-, productivity- and employment-growth could be similarly inspected and its ambiguity evaluated. An explanation for the appearance of persistent unemployment might thus be found and some justification for its "technological" component be provided.

However, a framework such as that outlined here requires a reduction in the "degrees of freedom" through specific research studies aimed at identifying significant patterns of linkages and related effects, and study of how their occurrence has been selected[36].

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35 The other very important component in an explanation of economic growth and structural change - which is not analysed in this paper - is that of distribution of income and formation of endogenous demand. For a theoretical as well as empirical attempt to explore this component, see Pugno (1987a). For the integration of the two components in a "natural economy", see Pasinetti (1981).

36 Recent examples in the literature are research studies of: inter-industry technology flows (Rosenberg, 1982; Scherer, 1982), a taxonomy of firm patterns of technical change (Pavitt, 1984), "technological natural trajectories" (defined by Nelson and Winter (1977) as cumulative and self-generating directions of technical development), machine-/labour-specialisation in technical progress (Ames and Rosenberg, 1964), entrepreneurs' active/passive pattern of inducement to innovate (Carter and Williams, 1958), demand/capacity interaction in diffusion (Metcalfe, 1981), customer-vs.-manufacturer paradigm of product innovation (Von Hippel, 1979; Teubal, 1979), life-cycle patterns for products in terms of productivity, rather than in terms of sales (Abernathy and Utterback, 1978; Shapiro, 1984). An exploratory research into patterns of growth in industries that are defined as leading by the "linkages" performed is attempted in Pugno (1987b).

ABSTRACT

This paper investigates economic growth and structural change as an interaction between demand at macro-level and supply at micro-level. It centers its analysis on a comparison between N.Kaldor and J.A.Schumpeter as competing theorists. In fact, on the one hand, it is argued that Kaldor regards macroeconomic growth as demand-pulled, with manufacturing production and technical progress as adjusting in a cumulative structural-changing response (section 1). On the other, Schumpeter regards development as technical-pushed from innovating sectors to the economy, where demand dynamics automatically adjusts to structural changes (section 2). The correlation between output and productivity (and employment) emerges in both authors as high and positive. Therefore it does not discriminate between the two competing theories. However, since each approach seems to provide an explanation where the other appears inadequate, a synthesis of the two seems to be possible, but theoretical inconsistencies impede it.

Therefore comparison between Kaldor and Schumpeter can provide only a starting point, though extremely useful one, for building a comprehensive framework and for further research (section 3). A tentative proposal following Hirschman's and Rosenberg's analysis is outlined in section 4.

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