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contents

Sraffa's Circular Process and the Concept of Vertical Integration *

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1. FOREWORD

Piero Sraffa's *Production of Commodities by Means of Commodities*[1] is not the only work at the root of the recent revival of interest in classical economics, but, from an analytical point of view, is probably the most solid one. After 25 years since its publication, it insistently reveals itself for what the author claimed: a necessary *prelude* to further work; and in two directions: as a critique of current economic theory, and as a reconstruction of economics along the lines of "the old classical economists".

Production of Commodities thus emerges as one crucial piece in what still at present is regarded by many as the great puzzle of an approach to economic reality, which, by going back to the basic foundations of classical economics, can reasonably claim to be alternative to the one that has become prevalent among economists since the end of the XIX century.

Sraffa's *Production of Commodities* is centered on theories connected with the price system (mainly theories of value and income distribution). It does not deal with the economics of physical quantities, which are taken as given. This is its major aspect of differentiation from the theories which, from Keynes to the post-Keynesians, have (quite independently from Sraf-

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[1] P. SRAFFA, *Production of Commodities by Means of Commodities. Prelude to a Critique of Economic Theory*, Cambridge, CUP, 1960; from now on *cit.* as *Production of Commodities*. All section references in this paper are to this book.

fa) shared the same critical attitude to prevailing theory and have pursued the same aim of reconstructing economic theory along the lines of the old classical economists. Keynes and the post-Keynesians, in striking contrast with Sraffa, have concentrated on movements of macro-economic magnitudes through time, while neglecting the relations at the inter-industry stage and normally taking the price structure as given.

This situation seems to cry out for a clarification, on the one side, of what has (improperly) been referred to as the micro-foundation of Keynesian analysis and, on the other side, of what is the macro- and dynamic implication of the type of analysis that Sraffa has revived.

Modern economic analysis has revealed to us that, even on purely analytical ground, any elaboration concerning the theory of prices has a (dual) counterpart in an elaboration concerning the theory of physical quantities, and vice-versa. Hence, although in an initial stage it may be legitimate to concentrate on only one of the two sides, it sooner or later becomes inevitable to consider also the other (dual) side.

In the present paper, I am going to adopt an approach to economic reality which is the same as Sraffa's, but I am aiming at considering an economy which is moving through time. I shall therefore put myself *beyond* Sraffa's assumption of given physical quantities and thus reach out for a link, and a harmonization along classical lines, with the economic theory that has stemmed from Keynesian and post-Keynesian analysis.

2. A SHARP BREAK WITH THE "MARGINAL" METHOD

A striking feature of *Production of Commodities*, emerging from the very first passages of the *Preface*, is the author's deliberate intention of setting himself in opposition to "modern theory", which is explicitly identified with the "marginal method"; and of going back to the "standpoint which is that of the old classical economists"[2].

This attitude is further elaborated in the "References to the Literature", given at the end *Production of Commodities*. In a section entitled "Production as a circular process in the Physiocrats and Ricardo"[3], Sraffa specifies the sense of "The connection of this work with the theories of the old classical economists". He reminds us that "It is of course in Quesnay's *Tableau Economique* that is found the original picture of the system of

[2] *Ibid.*, p. V.

[3] The title of the section does not appear explicitly in the text (on p. 93), but (as for all sections of *Production of Commodities*) can be found in full in the *Table of Contents* (on p. XII).

production and consumption as a circular process", and he goes on to point out the similarity of this approach to the "method devised by Ricardo... of singling out corn as the one product which is required both for its own production and for the production of every other commodity"[4]. This method — he adds — "stands in striking contrast to the view presented by modern theory of a one-way avenue that leads from 'Factors of production' to 'Consumption goods'"[5]. But this assertion cannot be taken lightly; it must be investigated very carefully.

3. CIRCULARITY OF THE PRODUCTION PROCESS

The title of Sraffa's mentioned section is "*Production* as a circular process in the Physiocrats and Ricardo". But already in his reference to Quesnay (and *a fortiori* to Ricardo), Sraffa adds something else — he talks of a "picture of the system of production *and* consumption as a circular process"[6].

There seems to be a certain ambiguity here that must be cleared up, and it may be useful to distinguish two stages.

The circularity of the production process emerges in its purest form in chapter I of *Production of Commodities*, which deals with "production for subsistence". All commodities are, directly or indirectly, necessary to the production of all other commodities, and all of them return, at the end of each year, to the production process, either as necessary technical requirements or as necessary means of subsistence for the labourers. (In this context, there really is no difference between the two).

The same circularity may be looked at from the price system point of view. There is a unique set of rates of exchange among commodities that is determined by technology alone and that must be adopted in order to keep the system in a self-replacing state. Sraffa points out that these rates of exchange might indifferently be called "natural prices", or "prices of production", or "values" (he prefers the latter term for brevity), but he objects to the term "cost of production", because of the circularity. He explains that it would be inappropriate to call them "costs of production", because what appears on the left-hand side of each equation (the "price") depends on what appears on its right-hand side (the "cost"), no less than the other way round.

At this stage, both from a physical system point of view and from a price system point of view, there is perfect circularity.

[4] *Ibid.*, p. 93.

[5] *Ibid.*, p. 93.

[6] *Ibid.*, p. 93, italics added.

4. PRODUCTION WITH A SURPLUS

Chapter II of *Production of Commodities* is devoted to "Production with a Surplus", and a complication immediately arises. Sraffa warns,

"One effect of the emergence of a surplus must be noticed. Previously, all commodities ranked equally, each of them being found both among the products and among the means of production... But now there is room for a new class of 'luxury' products, which are not used..." [7].

At least as far as these "luxury" products are concerned, the circularity is broken. There also immediately appears one degree of freedom as to the distribution of these "luxury" consumption goods. No longer must they go necessarily to the labourers (since they emerge *above* subsistence). They might be divided, in a proportion to be determined from outside the production relations, between profits and "surplus" wages.

But let us return to the main point. When there is a surplus — all made up of luxury goods — a very clear distinction can be made, in physical terms, between the production process and the surplus, more specifically, between the commodities making up the means of production (all basic commodities, in Sraffa's terminology) and the commodities making up the surplus (all non-basic commodities, *ex-hypothesi*, in our case). The former are produced within a perfectly circular production process; the latter emerge from this production process without re-entering it.

A parallel, equally clear, distinction can be made between the natural prices of the means of production and the natural prices of the consumption luxury goods. The former are still characterized by complete circularity, while the latter are no longer so characterized. The "prices" of the consumption goods, in this case, are clearly and unambiguously distinguishable from their "costs". Sraffa does not bring out this distinction explicitly; on the contrary, he seems to minimize it. Perhaps he is afraid that the reader might be confused with what he had earlier called the "one-way avenue [of traditional economics] from 'Factors of production' to 'Consumption goods'".

But the distinction deserves attention.

Clearly, one can see very distinctly the circularity of the production process concerning the means of production. But equally distinctly one can see, on each side of it, the emerging of a surplus of consumption goods at one end and the inflow of a physical quantity of labour at the other end.

A relation between the two seems to suggest itself in a natural way. It may be useful to notice that such a relation is *not* of the type traditional

[7] *Ibid.*, p. 7.

theory has suggested. First of all, there certainly is no direct, or broad, "avenue" between the two. In between labour on the one side and consumption goods on the other, there is a very complex circular process concerning all the commodities making up the means of production — a very intricate and complicated process indeed — which represents, in fact, the main object of Sraffa's investigation. Secondly, the relation does not go (even in a very complicated way) from labour (or for that matter from the means of production) to consumption goods, but, if at all, it goes the other way round. For any given (or externally determined) physical set of final consumption goods, the inter-industry coefficients determine the set of physical commodities required as means of production and the required amount of labour.

In a precisely parallel way, in the price system, the relation does not go — as marginal traditional analysis would have it — from final consumers' preferences to "imputed" costs, but it goes the other way round. As classical analysis has always claimed, it goes from costs of production (which are unambiguous in the case we are considering) to "natural" prices. At least in the case of a surplus made up of consumption (luxury) goods, Sraffa's scheme does therefore imply an over-turning of the causal links that were traditionally considered, both in the physical quantity system and in the price system.

But what about the case of a surplus made up of basic commodities? In this case, the whole question becomes more complicated.

If one looks at the economic system in physical terms, one can still see and distinguish very clearly, as in the previous case, the consumption goods that make up the surplus, on the one side of the circular process (concerning the means of production), and the labour inflow on the other side of it. The price system, however, does not show the distinction equally clearly. The natural prices of the (basic) consumption goods depend on the natural prices of their means of production, no less than the other way round. We are back to circularity.

There is however an analytical device that allows us to separate in an unambiguous way what pertains to the surplus from what pertains to the circular process. I am referring to what Sraffa, by looking at the economic system from an inter-industry point of view, has called the method of the "sub-systems"; and I myself, by looking at it from a final demand point of view, have called the method of the "vertically integrated sectors".

5. SUB-SYSTEMS

The method of the sub-systems is presented by Sraffa, in a three-quarter page appendix, simply as a device to "show at a glance" the amount of labour which directly and indirectly goes into producing each

commodity. It is interesting to notice that Sraffa, after objecting to the term "cost of production" when he presents the price system (§ 7), brings such a term back precisely when he faces the problem of the direct and indirect quantities of labour that go into producing each commodity. He talks, in this respect, of a "cost of production aspect" of prices (§ 45). And in order to analyse this aspect he uses two alternative analytical devices: the device of the "reduction to dated quantities of labour" (in Chapter VI) and the device of the sub-systems (Appendix A, recalled in § 14). But the former is subject to severe limitations — it can only be adopted in the case of single production. The latter, on the other hand, can be used in general, both for single and for joint production as well.

By taking advantage of an analysis already carried out elsewhere[8] and by using the same symbols, an economic system in which m commodities are produced may be represented, in a particular period of time (a "year"), as follows:

$$(B-A)\,X=Y, \qquad [5.1]$$

$$a_n X=L, \qquad [5.2]$$

$$AX=S, \qquad [5.3]$$

where B and A are the output and the input inter-industry matrices respectively, a_n is the input direct labour coefficient (row) vector, X is the (column) physical quantity vector, Y is the (column) net product vector, S is the (column) means of production vector, and L is the (scalar) quantity of labour. All matrices are m-order square matrices and all vectors have m components[9]. Equation system [5.3] might in fact appear redundant, as is already implied in [5.1], and simply gives a definition of that part, S, of physical production, X, that will have to go back to the production process to replace the used-up means of production. Sraffa does not pay particular attention to this system of equations and does not consider it explicitly. But [5.3] will be seen in a moment to play a crucial role.

The price system, on its part, may be represented as:

$$pB=a_n w+pA+pA\pi, \qquad [5.4]$$

$$w=1, \qquad [5.5]$$

[8] Cf. L. L. PASINETTI, "The Notion of Vertical Integration in Economic Analysis", *Metroeconomica*, XXV, pp. 1-29, reprinted in *Essays on the Theory of Joint Production*, ed. by L. L. Pasinetti, London, Macmillan, 1980, pp. 16-43.

[9] The easiest way to look at the equation system [5.1], [5.2], [5.3] is to consider it as an open Leontief model. The m final physical quantities in vector Y are considered as given. Then the $2m+1$ equations [5.1], [5.2], [5.3] determine the $2m$ physical quantities, X and S (two m-component vectors) and the (scalar) physical quantity of (required) labour L.

where p is the (m-component, row) price vector, w and π are scalars for the wage rate and the rate of profit respectively, and w is expressed in terms of "labour commanded" ($w=1$)[10]. For simplicity, I shall suppose that physical units have been chosen in such a way as to make the main diagonal of B a list of ones. I shall also suppose that technical coefficients are given and constant (constant returns to scale), within the period concerned. Moreover, to avoid complications, I shall suppose that technical coefficients are such as to be economically meaningful at all levels of π between zero and its maximum.

This economic system may now be partitioned into m sub-systems defined as follows:

$$(B-A)\,X^{(i)}=Y^{(i)}, \qquad i=1, 2, ..., m, \qquad [5.6]$$

where $Y^{(i)}$ is a (column) vector the components of which are all zeros except the i^{th} one, Y_i, which is the i^{th} component of vector Y, and $X^{(i)}$ is the (column) vector of the physical quantities corresponding to it. By "solving" each particular sub-system i with respect to its $Y^{(i)}$, we obtain:

$$X^{(i)}=(B-A)^{-1}\,Y^{(i)}, \qquad [5.7]$$

and by substituting into [5.2], [5.3], we have:

$$L_i=a_n\,(B-A)^{-1}\,Y^{(i)}, \qquad [5.8]$$

$$S^{(i)}=A\,(B-A)^{-1}\,Y^{(i)}, \qquad [5.9]$$

$$i=1, 2, ..., m,$$

where $X^{(i)}$, L_i, $S^{(i)}$, represent those particular magnitudes, defined by systems [5.1]-[5.3], that would correspond to a particular net national product made up of the single physical (scalar) quantity Y_i. Linearity of course ensures that:

$$\Sigma\,Y^{(i)}=Y; \quad \Sigma\,X^{(i)}=X; \quad \Sigma\,S^{(i)}=S; \quad \Sigma\,L_i=L; \qquad [5.10]$$

i.e., all sub-systems exactly add up to the original economic system.

As may be observed, equation [5.7] represents the familiar Leontief solution of a hypothetical economic system that produces as final product only the single physical quantity Y_i. Equation [5.8] takes us one step further by giving us the amount of labour that is directly and indirectly required in the whole economic system to produce the single final good Y_i. This amount of labour now appears "at a glance", as Sraffa says.

[10] We may follow Sraffa and leave the price system open (i.e., indeterminate) as to the distribution of income between wages and profits. All prices can be determined relative to any particular level of the rate of profit, to be fixed from outside the equation systems [5.4] and [5.5].

Finally, equation system [5.9] takes us one step still further, by giving us the set of physical quantities of commodities 1, 2, ..., m, that are directly and indirectly required in the whole economic system to replace the means of production used up for obtaining the single final good Y_i. It should become clear at this point that it is for this purpose that equation system [5.3] was formulated to begin with.

Thus, each sub-system i is essentially an analytical construct that represents a self-contained economic system which produces physical quantity Y_i, as net product, and absorbs physical quantity L_i of labour as net input, while at the same time reproducing all the means of production (no less and no more) necessary for this purpose, through a self-replacing circular process.

If we turn to the price system, it can be seen immediately that, when $\pi = 0$, p_i, the price of commodity i, is simply equal to L_i/Y_i. In other terms we can see that $p_i Y_i$, i.e., the value of Y_i, is L_i[11], which indeed represents the physical quantity of labour of sub-system i, or physical quantity of labour which has directly and indirectly gone into the production of Y_i.

For each sub-system, therefore, the relation of labour to final goods emerges immediately. The partitioning of the economic system into m sub-systems allocates a particular quantity of labour to each final good. The final goods produced by the m sub-systems exhaust all the produced final goods and the quantities of labour allocated to the m sub-systems exhaust all the available labour.

Each physical quantity of final good (independently of whether it is a non-basic or a basic commodity!) is unambiguously related to a physical quantity of labour; and the two have, in between them, a physically defined self-replacing circular process of means of production, which simply reproduces, at the end of the "year", exactly those means of production (no more and no less) that were inherited at the beginning.

6. VERTICALLY INTEGRATED SECTORS

On purely analytical ground, the elaborations reviewed in the previous section open up entirely new horizons. The singling out of a relation between each physical final good and a physical quantity of labour offers us another point of view from which to look at, and consider, the whole economic system.

To be more specific, the very same economic system may be considered from two different points of view.

[11] From [5.4] and [5.5], when $\pi = 0$, we have:

$$p = a_n (B - A)^{-1},$$

i.e., from [5.8],

$$p_i = L_i/Y_i.$$

One point of view is that of the circularity of the production process, which has been analysed in the previous pages. From this point of view, one can investigate the interconnections among the various production processes, the numerous complications that they entail, both in physical terms (fixed capital, joint production, natural resources, etc.) and in terms of prices (relations of value and distribution, ways of making them simple through devices such as the standard commodity, changes in income distribution and changes in relative prices, and switching, or reswitching, of techniques, etc.). Inevitably, when adopting this point of view, the need to concentrate the analysis on those aspects which pertain to circularity leads one to minimize all the other aspects. This is the point of view chosen by Sraffa. The labour/consumption relation is kept in the background. Final demand is taken as given, or assumed to be unchanged, so as to cause a minimum of complications. The technique of production itself is taken as given or is supposed to be unchanged. The analysis must be carried out either as referring to one single period of time, considered in isolation, or as referring to a (stationary) economic system that exactly reproduces itself without any change from one period of time to another.

But there is another point of view from which to look at the whole economic system. This is the point of view of final demand. From this point of view, in any economic system, one can investigate the final product and immediately relate it to its direct and indirect requirements, quite independently of whatever is going on inside these requirements. The purpose is normally that of setting the stage for a dynamic analysis concerning the movements of the final product through time. From this stand-point, the circular process, however complicated it may be, appears to be of secondary importance, as it simply reproduces those means of production that existed already at the beginning of each period. It can therefore be taken for granted and kept in the background.

When I first came to adopt this approach, I thought of so minimizing the complications of the circular process of production as to explicitly reduce it *ex-hypothesi* to a single quantity of intermediate labour. The analysis was then carried out — no longer in terms of "industries", or production processes, as they may immediately be observed when one looks at them as operating in the real world — but in terms of "vertically integrated sectors", i.e., of "sectors" that take all the intermediate processes for granted, however complicated they may be, while bringing into relief precisely the final goods, on the one side of the process, and their ultimate requirements (labour quantities), on the other [12].

[12] L. L. PASINETTI, "A New Theoretical Approach to the Problems of Economic Growth", *Pontificiae Academiae Scientiarum Scripta Varia*, n. 28, Proceedings of a Study Week on "The Econometric Approach to Development Planning", Vatican City, reprinted by North Holland Publishing Co., Amsterdam, 1965, pp. 572-696.

In terms of the analysis carried out in the previous pages, a vertically integrated sector i may be represented simply by one physical unit of final good i, one physical unit of vertically integrated productive capacity for final good i, and one physical quantity of labour for final good i ($i = 1, 2, ..., m$). In simple terms we may represent each vertically integrated sector i, when operating at unit activity, by the elementary vector:

$$[1, 1, v_i] \qquad i = 1, 2, ..., m, \qquad [6.1]$$

where the first component refers to the physical final good i, the second component to the physical vertically integrated productive capacity for final good i, and the third component to the physical quantity of (vertically integrated) labour for final good i. As may be observed from [6.1], the remarkable feature of the concept of a vertically integrated sector is that, complex though (behind the scene, so to speak) it may be in its composition, it is simply reduced to two ones and to a further single number representing a physical quantity of labour.

The prices relating to each vertically integrated sector i may correspondingly be represented by the vector:

$$[p_i, p_{k_i}, w, \pi], \qquad i = 1, 2, ..., m, \qquad [6.2]$$

where w and π are the scalars already defined, p_i is the price of one physical unit of final good i, and p_{k_i} is the price of one physical unit of vertically integrated productive capacity for good i. The latter synthesises in one single number the whole complicated circular process.

Within each period of time, for the same economic system, the relation between its expression in terms of the m vertically integrated sectors [6.1] and [6.2] and its expression in terms of the usual inter-industry formulation [5.1]-[5.5] is given by the m sub-systems [5.6]-[5.10] considered in the previous section. As may be realized, each unit of final commodity i is the same both in the inter-industry formulation [5.1]-[5.3] and in the vertically integrated formulation [6.1]. Each unit of vertically integrated productive capacity, on the other hand, extremely simple as it is in [6.1], appears very complicated in formulation [5.1]-[5.3]; for, it is constituted by a composite commodity corresponding to each column h_i ($i = 1, 2, ..., m$) of a matrix H, defined as:

$$H = A\,(B - A)^{-1}. \qquad [6.3]$$

And each physical quantity of vertically integrated labour appears in [6.1] as the compact component v_i ($i = 1, 2, ..., m$) of a vector v defined as

$$v = a_n\,(B - A)^{-1}. \qquad [6.4]$$

Each v_i synthesises in itself all physical quantities of labour directly and indirectly required in the whole economic system for the production of one unit commodity i.

Similarly, p_i, w and π are the same both in formulation [5.4] and in formulation [6.2]. But the price of each unit of vertically integrated production capacity p_{k_i} ($i = 1, 2, \ldots, m$) emerges from a linear combination of all the prices of the means of production. Setting all p_{k_i}'s together in one single vector p_k, whose components are the m prices of the vertically integrated units of productive capacity, their relation to the price vector of equation system [5.4] is defined by the expression:

$$p_k = pA\,(B-A)^{-1} = pH. \qquad [6.5]$$

There exists therefore, at each particular time, a one-to-one correspondence between expressing an economic system in terms of "industries" and expressing it in terms of vertically integrated sectors, both with reference to physical quantities and with reference to prices. And this one-to-one correspondence is evinced by the two linear operators $H = A\,(B-A)^{-1}$ and $v = a_n\,(B-A)^{-1}$, referring to productive capacities, i.e., to the means of production, and to labour, respectively.

But precisely these analytical expressions very clearly evince also the exact nature of this one-to-one correspondence. As will be realized, the one-to-one correspondence refers to given matrices A, B, a_n, i.e., is relative to a given technique. But techniques change as time goes on! Therefore, from an analytical point of view, one might say that the one-to-one correspondence breaks down as time goes on. Or rather, it may be more appropriate to say that there is a particular one-to-one correspondence specific to each particular period of time. As time (t) goes on, each particular period of time will be characterized by a particular set $A(t)$, $B(t)$, $a_n(t)$, and thus by a particular set $H(t)$, $v(t)$. This means that, from the point of view of inter-industry analysis — i.e., of the circularity approach — all relations are upset and have to be recomposed from one period of time to the following one, when technical change takes place.

Yet this makes no complication from the point of view of the vertically integrated sectors. The first and the second components of vector [6.1] are unit, *quite independently* of technical change! This is obvious for the definition of one unit of final good i. But a remarkable property of vertically integrated sectoral analysis is that it is also true of a unit of vertically integrated productive capacity for good i. The concept of a unit of vertically integrated productive capacity is entirely independent of its composition. In other words, the composition may well change, even dramatically (i.e., the corresponding sub-system may well break down and be recomposed in an entirely different way), and yet, conceptually, a unit of vertically integrated productive capacity remains a unit of vertically integrated

productive capacity, quite independently of its changed composition. This is precisely what gives relevance to the concept of vertically integrated sectors.

It should be noticed for example that, when there is technical change, it would be quite impossible — outside the framework of vertically integrated sectoral analysis — to say anything about what the circular process should reproduce. It is the concept of vertically integrated productive capacity that gives us the precise specification (through its new technical relation to the various physical commodities expressed by a new subsystem) of the physical means of production (quite different from those that have been used up) which have to re-enter the production process, in order to ensure self-replacement.

The vertically integrated concepts thus emerge as becoming essential precisely at the point of going over to dynamic analysis, i.e., precisely at the point where inter-industry analysis would otherwise become useless, and hopeless. There is therefore complementarity (not incompatibility!) between vertically integrated sectoral analysis and inter-industry analysis. The foregoing arguments seem to me to indicate (in fact quite clearly) that it is the appropriate combination of the two approaches, or more specifically the finding of an appropriate way of, alternatively, going back and forth, from one approach to the other, that can pave the way to a truly modern version of classical economic analysis — an economic analysis that may encompass, at the same time, the circular process of production and the evolution of the economic system through time.

7. SRAFFA AND KEYNES - A MEETING POINT

The conclusions reached at the end of the previous section — through a chain of arguments starting from Sraffa — can also be reached by starting from the other end (i.e., from a Keynesian analysis).

If we go back for a moment to the statements made at the beginning, it is not difficult to realize that what has allowed Keynesian and post-Keynesian analysis to deal with technical change (in striking contrast with inter-industry analysis) is precisely the fact that, by being conceived in macro-economic terms, it had necessarily to leave out all intermediate relations, which means that it had necessarily to be conceived in vertically integrated terms.

By the same token and in the opposite direction, it is not difficult to realize that what has made it impossible for inter-industry analysis to absorb technical change is precisely its requirement of sticking to the same technical coefficients. Very wisely, Sraffa stopped his analysis short of allowing changes in physical quantities. But the two other well-known authors who attempted a "dynamization" of the inter-industry scheme —

Leontief[13] and von Neumann[14] — were compelled to develop models of a hypothetical economy that expands only in size (due to population growth), with no development. By keeping technical coefficients absolutely constant, the steady dynamic path, to which their models lead, implies that all per-capita magnitudes remain absolutely constant, thus yielding a perfectly proportional growth with no change in structure. Such models — I have argued elsewhere[15] — can only be considered as intermediate analytical steps. If taken at face value, they would represent the negation of what is called progress. It is also doubtful whether they should be called "dynamic" at all. More appropriately, they have in fact sometimes been called "quasi-stationary".

Unfortunately Keynesian analysis, though capable in principle of overcoming the limitations of given technical coefficients, when extended to the long run, has not been carried beyond the stage of macro-economic analysis. It is therefore paradoxical that, while being able to absorb technical change, it has come to share the defects of Leontief/von Neumann models, owing to the fact that — by being macro-economic — it had to be interpreted as referring to a structure (of prices and quantities) that remains constant through time. The consequences for long-run analysis have been even worse than those following from the proportional dynamics of Leontief/von Neumann models; for, it is contradictory (as I have argued elsewhere)[16] to assume a constant structure through time when per-capita incomes are increasing.

But there is no need for Keynesian dynamic analysis to be carried out only in macro-economic terms. The singling out of the concept of vertically integrated sectors allows the possibility of its complete disaggregation into as many sectors as there are final goods. And this allows the possibility of breaking it down to a complete scheme of structural dynamics.

Here therefore is the clear way to analytical development. It has become common place by now that Keynesian analysis must be developed beyond its macro-economic original conception. But the usual attempts have been made to merge it with Walrasian economics. The arguments carried out above indicate that the way forward is in an entirely different direction, namely in its being broken down into as many vertically integrated sectors as there are final commodities. The analytical device of the

[13] Cf. W. W. LEONTIEF, "Static and Dynamic Theory", Part I of *Studies in the Structure of the American Economy*, ed. by W. W. Leontief, New York, Oxford University Press, 1953.

[14] Cf. J. VON NEUMANN, "A Model of General Equilibrium", *The Review of Economic Studies*, XIII, 1945-46, pp. 1-9.

[15] Cf. L. L. PASINETTI, *Structural Change and Economic Growth - A Theoretical Essay on the Dynamics of the Wealth of Nations*, Cambridge, CUP, 1981.

[16] Cf. *ibid.*

sub-systems can then complete the so much sought-after relations and links with the field of investigation concerning the circular process of production.

We thereby arrive — from another route — at the same conclusions reached by the end of the previous section. Starting from Keynesian macrodynamic analysis, one can see the way to a disaggregation into vertically integrated sectors. Then one can see the analytical links with the subsystem, i.e., with Sraffa's circular process analysis. From another point of view, this appears as a quite clear and logical way to accomplish an integration of the two types of economic analysis, associated with the names of Sraffa and Keynes, which have originally stemmed from the same preoccupations (inadequacy of traditional marginal economics) and have built on the same common ground (classical economics), but have not so far been merged into a unified research programme.

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