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On the Inconsistence between the Long-period Method and the Assumption of Given Quantities

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Abstract
According to Sraffian economists, both the aggregate and the general equilibrium versions of the neoclassical theory suffer from a logical inconsistence that prevents them from identifying a long-period position. The aim of this paper is to show that also Sraffa's approach, based on the assumption of given sectoral outputs, brings about an inconsistence between his theory and the long-period method. The main upshot of our argument is that sectoral outputs can legitimately be left to a separate stage of the theory only insofar as the long-period method is dropped and the classical-type theory is reconstructed within the temporary equilibrium method.

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I. Introduction

According to Sraffian economists, the determination of prices and distribution by taking sectoral outputs as given provides a logically coherent alternative to the neoclassical-type simultaneous determination of equilibrium prices and quantities. It is also maintained that both the aggregate and the general equilibrium versions of the neoclassical theory suffer from a logical inconsistence that prevents them from identifying a long-period position for the economy. Sraffa's would therefore be the only consistent long-period theory.

The aim of this paper is to show that also Sraffa's assumption of given sectoral outputs brings about an inconsistence between his theory and the long-period method. The main upshot of our argument is that sectoral outputs can legitimately be left to a separate stage of the theory only insofar as the long-period method is dropped and the classical-type theory is reconstructed within the temporary equilibrium method.

II. The problem of persistence of long-period positions in neoclassical and classical-type theories

II.1 The endowment of capital goods is part of the *data* on the basis of which Walrasian theory determines equilibrium prices and quantities of both the consumption and the capital goods as well as of the productive services. However, nothing guarantees that, in equilibrium, the conditions of equality between demand and supply prices and of a uniform rate of return on the supply price of newly produced capital goods are both met. Similarly to what has been done for the Walrasian model without

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accumulation, this problem can be avoided by replacing the equality constraint between the supply price and the demand price with the inequality constraint according to which the former cannot fall below the latter and by adding the assumption that only those capital goods will be produced for which the equality holds.[1] The drawback of this solution is that a different endowment of capital goods will generally appear among the *data* of the following period, so that the equilibrium position will not possess the requisite of persistence. Whether or not Walras was trying to identify a long-period equilibrium[2], neoclassical authors do not deny that, as it now stands, a Walrasian model with capital accumulation defines a temporary equilibrium.

The awareness that an endowment of capital goods *pris au hasard* will generally not correspond to a long-period (*i.e*. stationary) solution, has prompted general equilibrium theorists to try to identify the conditions for an appropriate endowment to be persistent through time.[3] However the identification, among all possible Walrasian equilibria, of the long-period one requires that the appropriate endowment of capital goods is determined together with the endogenous variables, and is not included among the data.

II.2 Contemporary Sraffian theorists, with few exceptions,[4] consider the study and comparison of long-period positions as the only consistent method for analyzing economic reality. The supremacy of the long-period method follows from the belief that, in a freely competitive system, the migration of productive capacity toward the most profitable sectors drives the produced quantities to coincide with the quantities of effectual demand[5] so that profit rates will ultimately tend to be uniform throughout the system and *market* (i.e. actual) prices to coincide with long-period or natural prices. Due to the presence of random disturbances, market prices and the other actual realizations of the markets do not actually match but only 'gravitate' around their long-period counterparts.[6] Nevertheless, if the determinants of the long-period position are

[1] See e.g. Morishima 1964. Tosato 1969, along the lines of Morishima 1960, has shown that when the ratios among the capital goods included in the initial endowment fall within a given range all capital goods will be reproduced.

[2] According to Garegnani 1990a, the proposed solution implies a change in the notion of equilibrium underlying a Walrasian-type model whereas, according to Tosato (ibidem), the state of rest within the Walrasian approach is, by definition, limited to the period under consideration: within the ideal competitive context chosen by Walras as reference point for his analysis, equilibrium is instantaneously reached and subsequent periods are out of the theory's concern.

[3] See *e.g*. Mas-Colell A. (1989).

[4] See for instance Roncaglia 1978 and 1995.

[5] Effectual demand can be defined as "the quantity ... of each commodity which would be demanded at its natural price, when the prices and outputs of all commodities are at their normal [natural] levels" (Garegnani 1990b, p. 332; see also Mongiovi 1991, p.719 note 3). Coherently, the long period position is defined as the situation in which the quantities of effectual demand are produced in all sectors of the economy and market prices coincide with natural prices: "When the quantity brought to market is just sufficient to supply the effectual demand and no more, the market price naturally comes to be either exactly, or as nearly as can be judged of, the same with the natural price" (Smith 1937, p. 56).

[6] "The natural price, therefore, is, as it were, the central price, to which the prices of all

persistent over time and activities repeat sufficiently, "the deviations of the actual values from their theoretical counterparts will tend to compensate each other" (Garegnani 1990a, p. 47) and average market values over time will match theoretically determined long-period values, ensuring the correspondence between theory and reality.[7]

In view of the above, it is not surprising that Sraffians attach great importance to the concept of 'persistence' (Garegnani 1990a, p. 48). Strictly speaking, the consistence of the Sraffian long-period method requires two different kinds of persistence: *chronological persistence* and *theoretical persistence*.

The likelihood of *chronological* persistence depends upon reality, i.e. the characteristics of the economic system. Chronological persistence is essential for the long-period method: average market (actual) realizations over time will match model predictions only if the exogenous forces that determine the long-period position persist long enough for market magnitudes (and in particular market prices) to converge towards and gravitate around their long-period values.[8] Otherwise the center of gravity will change "*before* a sufficient repetition of activities has allowed the deviations of the actual magnitudes from their equilibrium levels to be corrected (compensated)" (Garegnani 1990a, p. 49), and the theoretically determined long-period position will not correspond to reality. To guarantee the correspondence between theory and reality Sraffians generally assume the chronological persistence of the forces determining the equilibrium (see, on this point, Garegnani 1976, p. 28).

To be consistent, Sraffian theory also requires a second kind of persistence, namely *theoretical* persistence. The likelihood that this can be achieved depends on the theory itself, i.e. on the characteristics of the economic model the theory uses to study reality: the theoretically determined values of the endogenous variables should be such not to induce any change in the values of the *data* used to determine them. Otherwise new (different) *data* would lead to new (different) values for the endogenous variables.

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commodities are continually gravitating. Different accidents may sometimes keep them suspended a good deal above it, and sometimes force them down even somewhat below it. But whatever may be the obstacles which hinder them from settling in this center of repose and continuance, they are constantly tending towards it" (Smith 1937, p. 58).

[7] "This concept of the theoretical level of the variable being the one which the actual level of the variable tends towards and gravitates about, is basic for relating theory to observable phenomena. […] The theoretical level can then emerge as a sufficiently accurate guide to some average of the actual levels" (Garegnani 1990a, pp. 47-48).

[8] Market prices 'gravitate' *around* natural prices if the sectoral distribution of productive capacity corresponds to the equilibrium distribution, i.e. if it is normally capable of producing the quantities demanded at natural prices. In these conditions, market prices for any given period will differ from natural prices, due to random disturbances in supply and demand, but since average prices correspond to natural prices, no persistent difference in the sectoral rates of profits exists and hence there is no intersectoral shift in productive capacity. 'Convergence' *towards* natural prices occurs when the sectoral distribution of productive capacity is *not* the equilibrium distribution, i.e. if current productive capacity cannot produce the quantities demanded at natural prices. In these circumstances, rates of profits differ systematically and persistently, producing a shift of productive capacity from less to more profitable sectors. Convergence is the prerequisite for gravitation.

As a consequence the model would not provide a theoretically stationary solution, but only a temporary equilibrium solution. Such an equilibrium changes through 'theoretical time' and would itself be inconsistent with the assumption that the economic reality that it should represent gravitates around an equilibrium position that is persistent through 'chronological time'. According to Sraffians, the Walrasian model fails to fulfill this requirement for theoretical persistence.

II.3 It is our contention that also Sraffian theory lacks theoretical persistence and is therefore unable to determine a long-period position even if reality were characterized by chronological persistence.

Taking for granted that Sraffa actually intended to identify a long-period position, the produced quantities which he assumes as exogenously given must be the quantities of effectual demand.[9] In fact, if the given sectoral outputs are *not* the quantities of effectual demand, the sale of these quantities at Sraffa prices would not clear the markets and would fail to equalize the realized rates of profits in different sectors. The consequences of this circumstance are particularly significant under non-constant returns. In this case, technical coefficients vary with outputs; hence the failure to equalize the realized rates of profits in different sectors leads to changes in the quantities produced and thus to changes in technology and prices:[10] the model lacks theoretical persistence. To meet the requirement for theoretical persistence Sraffian theory should, first of all, let the 'right' quantities, i.e. the values of effectual demand, become an object of theoretical investigation and hence accept that, within the long-period method, quantities are endogenous variables. Second, it should develop analytical tools to calculate their values. Until this is achieved, the classical-type theory, like the Walrasian one, fails to meet the requirement for theoretical persistence and is incapable to determine a long-period position.

One should also consider that the main reason for assuming sectoral outputs as given when determining relative prices and distribution lies in William Petty's idea, expressed in the Preface to *Political Arithmetik*, that all things that depend 'upon the mutable Minds, Opinions, Appetites and Passions of particular Men' should be removed from the realm of economic analysis. A further contradiction seems here to arise, given that the coincidence between sectoral outputs and effectual demands can be brought about only by a process of adaptation of the sectoral productive capacities to a sufficiently stable demand pattern of all actors involved. But if demand depends on

[9] That Sraffa's given quantities are those corresponding to the normal position of the system is not a generally agreed upon statement. According to Roncaglia (e.g. 1978, 1995) the Classical-type theory of prices and distribution is characterized by a theoretical separation of outputs and prices but not by the idea that a long-period position, defined as a situation in which natural prices and effectual demands 'meet each other', plays the role of center of gravity for actual market prices. Leaving aside the question whether Roncaglia's interpretation represents an accurate historical reconstruction of the classical theory, it should be noticed that his denial that the classical economists were concerned with the study of the long period positions is more coherent than Garegnani's position with the idea that the peculiarity of the classical school lies in the logical separation between the determination of prices and the determination of quantities.

[10] What we are discussing here is theoretical persistence. In this setting it is not the actual values that change over time but the theoretically determined values.

'mutable minds, opinions, appetites and passions', then it cannot have the requisite of persistence and the sectoral productive capacities can hardly have time to adapt to it. To close the price system by assuming a uniform rate of profit, as the long-period method requires, seems therefore to be at odds with the rejection of an investigation of volatile demand conditions. Either demand is subject to stable determinants (and is hence susceptible of scientific investigation) so that competition ensures that sectoral outputs adapt to it, or profit rates discrepancies should be considered normal.

In any case, within the Sraffian research program the analysis has been limited to the study of the characteristics and of the formal properties of the long-period position, considering as self-evident that competitive market economies tend to converge toward it.[11] This belief has allowed to bypass the problem of quantities determination since, if convergence is somehow assured, the 'right' quantities - or in any case the elements upon which these quantities depend (see Garegnani 1984, p. 296, footnote 12) - can legitimately be taken at an average of their actual realizations. In other words, quantities could be taken from reality. The weakness of such a solution has become evident when late twentieth century analyses of the stability of long-period positions showed that a theoretical proof of stability was hard to achieve even with strong 'ad hoc' assumptions.[12] This negative result on the stability of even very simple dynamic models casts serious doubts about the convergence of actual (complex) economic systems towards long-period equilibria. And if it cannot be taken for granted that actual economic systems gravitate around a long-period position, the quantities of effectual demand cannot be legitimately taken from reality, and the inconsistence between the long-period method and the assumption of given quantities is still there.

Our opinion is that there exist just two ways out to avoid this inconsistence: either accepting to include the determination of the long-period sectoral outputs within the analysis or dropping the long-period method. In the following section we discuss the first approach by examining three different alternatives: Garegnani's iterative procedure, a classical-type simultaneous determination of prices and quantities, and Caravale's attempt to model the disequilibrium dynamics possibly leading to a long-period solution for both prices and quantities.

III. Determining long-period sectoral outputs within classical-type theory

III.1 The need to include outputs determination within the theory starts to be recognized even by Sraffian theorists. Garegnani has for instance developed an iterative procedure which has the scope of identifying the new long-period position when, in the presence of non-constant returns to scale, an exogenous shock has destroyed the old one[13]. Actually, we don't see any theoretical reason for confining Garegnani's procedure to the particular case of a sudden change in one or more of the elements

[11] Hereafter the term "convergence" is referred to actual magnitudes whereas "stability" is referred to theoretical magnitudes.

[12] See on this point D'Orlando 1997 and, among the most important contributions, Egidi 1975, Medio 1978, Steedman 1984, Nikaido 1985, Boggio 1990, Arena, Froeschle and Torre 1990, Dumènil and Lévy 1990, Garegnani 1990b and 1997, Caravale 1994b, Bellino 1997 and 1999.

[13] See Garegnani 1990c, p.130 ff. and 1983, p. 310 ff.; see also Mongiovi 1991. For a critique of Garegnani's procedure, see D'Orlando 1996 and 2005.

determining the long-period position; it should rather be considered as a more general proposal for the identification of a theoretically persistent long-period position. As Garegnani himself admits, "[t]he 'convergence' of such an analysis seems the same question of that of the existence of a normal position of the economy" (Garegnani 1990c, p. 140, note 51). In any case, Garegnani's solution aims at identifying the long-period position as the fix point of a dynamic process. Within this dynamic process the interdependence between prices and quantities is not dealt with by means of a neoclassical demand-supply simultaneous determination of the two groups of variables.

The procedure suggested by Garegnani is based on a theoretical scheme made of two separate logical stages: a first stage in which Sraffa prices are determined on the basis of given quantities; and a second, separate stage devoted to the determination of these quantities. On these bases the model works as follows. The dynamics starts from a fully adjusted long-period position. At this point, an exogenous modification of the quantities demanded at natural prices forces the system to produce these 'new' quantities.[14] If returns to scale are variable, production of the new quantities will require a change in technological coefficients. Solving Sraffa's system for these new coefficients will produce a price vector and a rate of profits that, in general, will differ from the 'old' price vector and the 'old' rate of profits. In this situation, the new quantities produced – i.e. the quantities demanded after the shock, at the old price vector – will, in general, be different from the quantities demanded at the new prices resulting from the new techniques. The system will therefore produce these latter quantities (i.e. the quantities demanded at the new prices). Under variable returns to scale, the technology will then vary again, determining another change in the Sraffa price vector, and so on. This iteration will continue until the quantities demanded at Sraffa prices are equal to the quantities produced with the techniques that generate these prices, i.e. until theoretical persistence is achieved and Sraffa prices become long-period prices.

The possibility for Garegnani's procedure to identify the long-period position rests upon the possibility to specify the dynamics of both prices and quantities. But Garegnani denies the possibility of defining "relations of sufficiently definite form" (Garegnani1990c, p. 123-124) on the basis of which determining demanded quantities as a function of prices, production and income. Garegnani reassesses instead the validity of an approach based on separate logical stages, where the determination of quantities does not show those regularities which can be found, on the contrary, for the determination of prices (when quantities are given), and must for this reason be left to a separate logical stage (the second stage in our description). Hence, according to Garegnani, the first stage can be modeled, the second cannot. But, as a consequence, nothing can be said on the dynamic behavior, and on the (possible) convergence, of the iteration.

Garegnani seems to be aware of this problem, and hence of the need to propose an alternative method for determining quantities in that he maintains that, given Sraffa prices in each phase of the iterative procedure, the quantities demanded at those prices (and thus the quantities produced in the following phase) cannot be identified *a priori* but can be "analysed in accordance with the circumstances of the case under

[14] In Garegnani's example, the change is in the (exogenously given) wage rate. He nonetheless explicitly admits that the same procedure could be applied if the change was in effectual demand. See Garegnani 1990c, p. 130.

consideration" (Garegnani1984, p. 299) since they are influenced by "social and political factors, independent monetary factors, or independent technical changes" (Garegnani 1990c, p. 125). What the phrase «in accordance with the circumstances of the case» means is not crystal clear. It could be interpreted as if demanded quantities are observable magnitudes and hence could be taken from reality. Given, however, that the iterative procedure is clearly a theoretical construction and not a description of the actual functioning of markets, one cannot take demanded quantities at each phase of the iteration from reality and claim that they represent demand at Sraffa prices since in general those actual quantities correspond to (are generated by) actual prices which are different from Sraffa prices. But, if quantities cannot be taken from reality, an investigation into the dynamics of the iteration would require 'a priori' knowledge of the demand vector corresponding to any possible price vector. In short it requires a precise relationship between prices and quantities, in the absence of which the theoretical study of the process would end at the very first step of the iteration. And, again, nothing can be said about the (possible) stability of the process and its capability to single out a long-period position.

One should conclude that Garegnani's procedure, in order to consistently identify a long-period position, needs a theory of demand the refusal of which constitutes the same *raison d'être* of the whole procedure. Garegnani's proposal cannot therefore represent a solution to the inconsistence between the long-period method and the assumption of given quantities.

III.2 Our opinion is that a reasonable formalization of demand cannot be left to a separate stage of the theory, this separate stage being in fact a prerequisite for any long-period theory of prices and distribution. Taking as given something (sectoral outputs/effectual demand) which is, on the one hand, clearly *determined by* some endogenous variables (relative prices) and, on the other hand, fundamental for the determination of other exogenous *data* (technological coefficients) appears to be admissible exclusively outside the long-period method. Given that it is typical of the Classical-type theory to treat the interdependence among the productive conditions of the various sectors by means of a system of simultaneous equations, we do not see why the same cannot be done, within the long-period method, for the interdependence between prices and quantities. This can easily be done without resorting to the purely subjective neoclassical construction of the demand schedules. Rather one could draw inspiration from Ricardo's idea that each social class follows a specific demand pattern. On this basis we hereafter propose a very simple two sectors model in which two commodities, corn and gold, are produced by means of labour inputs alone. The assumption is made that the three social classes - workers, capitalists and rentiers - exhibit class-specific 'propensities to luxury' expressed in terms of a given percentage of their income that they spend in buying gold, and that corn is produced under variable (decreasing) returns to scale, while the amount of money capital (wages only) is given. Long-period relative prices depend on sectoral outputs which, in turn, depend on how incomes generated by the productive process are spent by social classes. The verification of the consistence between the productive conditions and the demand patterns should therefore be considered an essential ingredient of the classical-type long-period theory. In this perspective, within this simplified Ricardian-type economy, sectoral outputs, relative prices and distribution can be determined by solving the following system of simultaneous equations:

(1) $\bar{k} = N \cdot w$

(2) $N_c + N_g = N$

(3) $w = p_c \cdot \bar{x}$

(4) $N_g = \overline{n_g} \cdot A_g$

(5) $N_c = N_c(A_c),\ N_c'(A_c) > 0,\ N_c''(A_c) > 0$

(6) $p_g \cdot A_g = N_g \cdot w \cdot (1+r)$

(7) $p_c \cdot A_c = N_c \cdot w \cdot (1+r) + R \cdot p_c$

(8) $R = R(A_c),\ R'(A_c) > 0$

(9) $p_g \cdot D_g = w \cdot (N_g + N_c) \cdot (\bar{y}_w + r \cdot \bar{y}_p) + R \cdot p_c \cdot \bar{y}_r$

(10) $p_c \cdot D_c = w \cdot (N_g + N_c) \cdot \left[(1-\bar{y}_w) + r \cdot (1-\bar{y}_p)\right] + R \cdot p_c \cdot (1-\bar{y}_r)$

(11) $A_g = D_g$

(12) $p_g = 1$

Given the amount of money capital ($\bar{k}$) that capitalists have decided to invest, equation (1) determines the wage bill accruing to a certain amount of labour units (N) that, according to equation (2), can be employed either in the corn or in the gold sector. Equation (3) equals the money wage to the value of a given quantity of corn. [15] Equations (4) and (5) identify the production conditions, i.e. the relationship between the amount of employment in the two sectors (N_c, N_g) and the respective output (A_c, A_g), where the labor coefficient in the gold sector $\left(\overline{n_g}\right)$ is independent of output while the labor coefficient in the corn sector is increasing with output . Equation (6) equals the output in the gold sector valued at the long-period price (p_g) to the wages invested at the beginning of the period plus profits at the uniform rate (r). According to equation (7), the value of output in the corn sector includes also the value of rents that, according to equation (8), increases with output. Equation (9) expresses effectual demand for gold in terms of the product between incomes accruing to the three classes (workers, capitalists, *rentiers*) and their respective propensities to buy luxuries ($\bar{y}_w, \bar{y}_p, \bar{y}_r$). Equation (10) identifies effective demand for corn, while equation (11) suffices to ensure that effectual demand equals output in both sectors. Finally, equation (12) sets the *numeraire.*

[15] A logical difficulty should here be noticed. In line with Ricardo's theory, we are taking as exogenously given the *real* wage rate and this choice generally rests upon the well known 'subsistence' argument. However, we are assuming that the money wage that workers receive will not necessarily be devoted to buying corn alone. We are, in other words, assuming that workers receive a certain amount of money (the price, in terms of the *numéraire,* of a given quantity of corn) which they can, in principle, spend also in luxury goods. This ambiguity in the meaning to be attributed to the exogenously given wage rate had been noticed by Sraffa, who considered the choice to treat the wage "as 'given' in terms of a more or less abstract standard" as devoid of "a definite meaning" (Sraffa1960, p. 33).

It should be emphasized that equations 1-12 identify a stationary solution for the long-period corn price (p_c) and hence the relative price p_c / p_g, the total amount of rents (R), the rate of profits (r), the number of workers employed (N), the money wage rate (w), output and employment in the gold (A_g, N_g) and in the corn sector (A_c, N_c) together with sectoral effectual demands (D_g, D_c) insofar as the money capital invested by capitalist is constant through time ($k = \bar{k}$). Were not this the case, the solution of the model would identify only a temporary position that would however exhibit long-period features in the sense that at the natural relative price p_c / p_g the quantities produced in each sector match the effectual demands and a uniform rate of profits prevails throughout the economy.[16] This type of solution is not different from a simultaneous determination of prices and quantities characterizing neoclassical value theory and shows that, in the case of non constant returns to scale, the long-period position can in principle be represented by Sraffa's equation, provided that consumption behavior of social classes is specified and *treated as an essential part of the theory*. An assumption on demand patterns of social classes is a necessary ingredient of the theory when it aims at identifying long-period relative prices, even within a simple Ricardian-type model wherein wages constitute the whole capital advanced by capitalists and relative prices are governed by the labor theory of value.

It is important to recall that despite the possible adoption of a simultaneous solution, the main differences between classical and neoclassical theories would still be there, the most important of which being the choice to treat one of the distributive variables as exogenously given. Furthermore, the possible inclusion within the classical-type theory of 'consumption functions' conceived as the outcome of social classes' demand patterns would be strikingly inconsistent with the neoclassical notion of demand schedule resulting from the utility maximizing behavior of isolated individuals.

III.3 Caravale's 1994 model (Caravale 1994b) can be referred to as an example of an approach that aims to identify the conditions required for a sequence of classical-type temporary positions to converge to a final outcome represented by Sraffa's equations.[17] The main advantage of this approach is that, once the long-period equilibrium is identified as the fix point of a sequence of classical-type temporary positions, it will be stable. Moreover, since this approach identifies also the long-period quantities, together with the appropriate technological coefficients, as the fix point of the dynamics, it can also solve the problem of theoretical persistence.

Caravale's proposal contains many of the elements required for a classically-inspired model of short-period dynamics. First, he suggests an innovative procedure ("Smithian-type *tâtonnement*") for the determination of short-period prices during each phase of the dynamics. Second, he models the influence of demand over prices, using functional relationships that differ profoundly from the neoclassical functions in that they do not depend on utility maximization. Third, he assumes variable returns to scale, although "the assumption is made that quantity adjustment on the part of producers do not imply violent changes in the technical coefficients" (Caravale 1994b, p. 55).

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[16] In the specific context of Ricardo's theory, the sequence of these centers of gravity converges to the stationary state (on this point see Caravale 1994a, p.241-3).

[17] See also Arena, Froeschle and Torre (1990).

Caravale's dynamics consists of a sequence of phases, each of which comprises a number of sub-phases. First, producers use their past experience and current expectations to decide the quantity of commodities they will bring to the market. They then 'announce' their selling price, which they determine on the basis of production costs, past rates of profits and their current expected rate. This price determines the volume of demand and hence the quantity of goods actually exchanged. If the quantity of goods brought to the market exceeds the quantity demanded, the goods are initially exchanged at the 'announced price'. This initial exchange is then followed by a series of sub-phases during which entrepreneurs adjust (lower) their price so as to clear the market. This is the essence of Caravale's "Smithian-type *tâtonnement*". Each sub-phase allows the sale of a proportion of goods at a "temporary market price". The process comes to an end when the market is cleared and a new productive period (and then another phase) begins. The model allows the goods involved in the process to be exchanged at 'false' prices (Caravale 1994b, pp. 58-59), and the 'actual market clearing price' for a commodity within a phase is the average of the ('temporary market') prices for a sequence of exchanges (sub-phases) leading to the clearing of the market. In Caravale's model it is only in this weaker sense that 'market prices' are capable of clearing markets and, significantly, the way the model relates prices and quantities "is *not* based on neoclassical-type demand functions", but on a "downward sloping, irregularly shaped oscillation 'band' expressing the essence of Adam Smith's ideas – totally shared by Ricardo – as to the relation between the quantities brought out for sale and the market price" (Caravale 1994b, pp. 54-55). [18]

III.4 A striking difference emerges among the three approaches examined above. Contrary to the two formalized models illustrated in sections III.2 and III.3, Garegnani's iterative procedure sidesteps a formal treatment of the sequence characterizing the iteration. On the other hand, both the simultaneous solution and Caravale's formal description of a sequence of classical-type temporary positions share with the neoclassical general equilibrium models the drawback that till now no general proof of stability has been provided. But, while the former does not need a proof of stability to get theoretical persistence (if a solution exists it will be theoretically persistent although not necessarily stable), the latter needs a proof of stability (if the system is unstable it cannot identify the relevant equilibrium magnitudes as the fixed point of a dynamic process). In other words, proving stability is essential for those models that aim at identifying Sraffa's given quantities as the fixed point of a dynamic process, and hence for ensuring in this way theoretical persistence of the Sraffian long-period approach.

It is worth clarifying the meaning we are here attributing to the notions of *convergence* and *stability*. We refer to stability as a property of theoretical (in particular, dynamic) models and to convergence as a property of reality.[19] Insofar as stability is proved by means of *ad hoc* dynamic models, it is neither a sufficient nor a

[18] Actually, Caravale's model provides no clear microfoundation for the non neoclassical mechanism driving demand decisions, and its inquiry into the dynamic stabilty of the system is incomplete. On this latter ground, Caravale limits himself to saying that: "The preliminary analysis of the convergence problem carried out in this context is supplying encouraging results" (Caravale 1994b, p.59).

[19] For a more detailed analysis of the difference between "convergence" and "stability" in a classical type framework, see D'Orlando 2007, pp. 20-21.

necessary condition for the long-period method to be well founded. On the contrary, convergence is both a necessary and a sufficient condition. If reality has no tendency to realize any long-period equilibrium, theoretically determined magnitudes would not coincide with average actual values and the long-period method itself (not only in its Sraffian version) should be dropped. It follows that an empirical proof of convergence is a prerequisite for the consistency of *any* long-period model.

IV. Extending the classical-type theory outside the long-period method

IV.1 In the absence of empirical evidence of convergence, the shift of neoclassical theory from the long-period method to Hicks-type temporary equilibria should not be interpreted, as Garegnani (1976) does, as a retreat of neoclassical theory; on the contrary, the decision to drop the long-period method might be understood as an attempt to better understand the functioning of actual economic systems. It should also be noticed - in sharp contrast with Garegnani's evaluation of Hicks's method[20] - that 'Hicks's week' can accommodate an essential aspect of Garegnani's interpretation of the Classical-type theory, namely the distinction between a 'core' of general theoretical propositions and other, less general, not-to-be-formalized propositions that Garegnani relegates to a second stage of the theory (Garegnani 1984). Garegnani's distinction is in fact perfectly in line with Hicks's *sequence* of temporary equilibria since all the 'less general' theoretical propositions, such as those depicting the possible retroactions of the endogenous variables on the set of data, can be placed within the transition period among the various sequential weeks.

The essence of the temporary equilibrium method lies in the recognition that both production and exchange take time and that the flow of historical time makes it hard for market mechanisms to realize the matching between demand and supply intended as *ex ante* magnitudes. In Hicks's words:

> "In determining the system of prices established on the first Monday, we shall also have determined with it the system of plans which will govern the distribution of resources during the following week. If we suppose these plans to be carried out, then they determine the quantity of resources which will be left over at the end of the week, to serve as the basis for the decisions which have to be taken on the second Monday. On that second Monday a new system of prices has to be set up, which may differ more or less from the system of prices which was established on the first" ...
>
> ... it is the divergence between expected and realized prices which is of central importance theoretically. Whenever such a divergence occurs, it means (retrospectively) that there has been malinvestment and consequent waste. Resources have been used in a way in which they would not have been used, if the future had been foreseen more accurately; wants, which could have been met if they had been foreseen, will not be satisfied or will be satisfied imperfectly. Thus disequilibrium is a mark of waste, and imperfect efficiency of production (Hicks 1946, pp.131-3).

[20] Garegnani (*ibidem*) interprets Hicks's 'retreat' as the consequence of the problems posed by the capital controversy.

In what follows we try to argue that the essence of Hicks's method can be retained while substituting a classical-type explanation of relative prices and distribution for Hicks's price theory. In particular, we examine two approaches that aim at describing how sectoral outputs and relative prices tend to change through time when the initial production decisions taken by firms do not correspond to sectoral effectual demands. The first approach (D'Orlando 2005) retains the traditional flex-price cross-dual dynamics, while the second (Nisticò 2002, 2007) relies on a cost-plus pricing approach in which the burden of adjustment falls on sectoral degrees of capital utilization.

Given that in actual economic systems the various sectors exhibit marked differences in the degree of competition among firms, the two approaches should be considered complementary rather than alternative explanations of the forces that drive relative prices and distribution in contemporary capitalism.

IV.2 When purged by its aim to identify a long-period position, Caravale's model described in section III.3 provides useful suggestions for modeling short-term classical-type equilibria.

As it is argued in D'Orlando (2005), one of the most interesting features of Caravale's model is the determination of short term relative prices in probabilistic terms.[21] In fact, Caravale's model can be considered as a first attempt to formalize the interdependence between prices and quantities, outside the long-period method but within a classical-type framework, using formally-specified demand and supply functions that do not depend on maximizing behavior. Therefore such an approach has the potential to avoid the main drawback of the Sraffian theory, namely the rejection of any analytical tool capable to handle the interdependence between prices and quantities., while providing a useful alternative to neoclassical theorists' ambition to handle the interdependence by means of demand and supply functions based on utility/profit maximization by individuals.[22]

The probabilistic determination of short term relative prices derives from the interaction between the price announced by firms (on the basis of past experience and expectations about the future) and a downward sloping 'demand band' as opposed to the traditional notion of demand function. The line of research indicated in D'Orlando (2005) is to derive (microfound) the actual position and width of this band from the theoretical as well as empirical analyses inspired by the models of bounded rationality that represent the core of the so-called *behavioral economics* and that overlap to some extent with the classical economists' concept of demand behavior. The similarity is particularly evident in the areas of social rationality, social interaction, imitation, social learning and the behavior of social groups (Laland 2001, Mellers et al. 2001 and Boyd and Richerson 2001). In both approaches the demand for commodities does not depend on explicit utility maximization but on a broad range of social and historical factors determining the behavior of social classes/groups (see e.g. Fishbein and Ajzen 1975 and

[21] D'Orlando (2005) argues that the probabilistic foundations of Caravale's model allow it to overcome the critique, addressed to short-period models by Sraffians, according to which only the long-period method can guarantee the correspondence between theory and reality.

[22] There is a huge, and growing, body of evidence that individuals do not maximize (or act 'as if' they were maximizing) their utility/profit functions (for a survey, see Conlisk 1996 and Devetag 1999).

Olshavsky and Granbois 1979).[23] In this perspective one can argue that one of the main differences between the classical-type approach and neoclassical theory ultimately rests on the different concept of rationality that informs the behavior of the basic economic entities: classes' (socially-driven) procedural behavior *versus* single subjects' (price-driven) maximizing behavior.

IV.3 The temporary equilibrium method can also be employed to define a classical-type model founded on the assumption that firms set prices following the cost-plus formula and in particular taking as given both the normal profit rate of the whole economy and their degree of monopoly within the sector (Nisticò 2002). Firms take their pricing decisions for a whole time horizon, or "accounting period", made up of various production periods. With a given money wage, the real wage resulting at the end of an accounting period is endogenously determined together with the money prices of those commodities entering a predefined wage basket. The classical notion of subsistence wage sets the limit to the mark up in the sector that, directly and indirectly produces the wage goods. The expected rates of profits in all other sectors are exclusively dependent on the degree of monopoly perceived by each firm. When faced by a discrepancy between expected and actual sales at the cost-plus price, firms do not modify their cost-plus price. Rather, they react either by adjusting the degree of capital utilization with respect to the normal one or by increasing advertising expenses. In both cases, at the end of the accounting period the actual average total cost and hence the actual profit rate will diverge from the expected ones.

Although sharing Hicks method, the model departs from Hicks theory on three important aspects., namely:

- On Monday morning, firms have to solve the productive capacity/expected sales dilemma by resorting to the *animal spirits* (expected sales), in that nobody can secure them with an actual flow of sales equal to the normal output per week at the normal cost-plus price corresponding to the installed capacity;
- once the irreversible investment decisions have been taken, at the given expected profit rates and money wages firms price their output on the basis of imputed costs;
- during the week, each firm will adjust its output price as actual input prices diverge from imputed input prices, and actual prices as well as the residual distributive variable (the real wage) will tend to converge towards a Sraffa-type configuration;[24].

In accordance with the temporary equilibrium method adopted, the model does not incorporate profit rates uniformity. Losers and winners among firms will be known on Saturday evening when the actual degrees of capacity utilization, determined by actual as opposed to expected sale, and hence the actual profit rates, will be revealed. Consumers as well will discover the amount of commodities that they have been able to

[23] Models of bounded rationality can be found within very different theoretical schemes. In this article we consider as *behavioral economists* only the authors that refer to bounded rational models as alternative and not complementary to neoclassical maximizing models. The book by Gigerenzer and Selten (2001) is an example of this attitude.

[24] For the proof of convergence see Nisticò 2002, note 14, p. 92. This Sraffa-type configuration is to be reinterpreted as the set of exchange ratios that ensures on the one hand the compatibility between all capitalists' expectations and, on the other hand, that the real wage does not fall below subsistence level.

afford with their given money wage and the outcome of their consumption choices in terms of pleasures enjoyed.

On Sunday, the newly negotiated money wages, the new state of firms' expectations and any possible innovative behaviors on the part of both firms and consumers will set the stage for the forthcoming week.[25]

V. Conclusions

Economic theories aim at describing real world phenomena in which the presence of complex dynamic processes makes it difficult to single out the key determinants of economic variables. The classical-type theory of prices and distribution adopts the long-period method by assuming that the dynamic process ends when the vector of effectual demands coincides with the vector of sectoral outputs and profit rates uniformity obtains in all industries. Therefore it abstracts from dynamics and concentrates on the properties of fully adjusted economic systems, i.e. on the properties of the long-period positions.

We have tried to argue that the long-period method encounters two major difficulties. The first is that actual market economies do not necessarily exhibit convergence towards fully adjusted positions; the second is that for profit rates uniformity to obtain, within a theoretical model, the vector of sectoral outputs should be endogenously determined together with relative prices. Our conclusion is that the Classical-type theory should accept one of the following:

- to concentrate on temporary positions, a choice that would allow to 'save' the assumption that sectoral outputs do not need to be determined simultaneously with relative prices;
- to include the vector of sectoral outputs among the endogenous variables, a choice that would allow to 'save' the long-period method;

While we think that exploring the first could enhance the explanatory power of the theory, especially in the absence of convergence, we have tried to argue that also exploring the second could turn out to be theoretically fruitful. In both cases, it is important to recognize that one cannot save both, the long-period method and the assumption of given quantities.

[25] For a description of a possible 'sequence of weeks' that points towards the use of Sraffa's theory for the explanation of prices and distribution within imperfectly competitive markets, see Nisticò (2007).

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