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Will the classical-type approach survive Sraffian theory?

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Abstract: *This paper has two goals. First, it seeks to show a logical inconsistency in Sraffian theory. The theory, it is argued, is conceived as a long-period approach but is unable to identify a long-period position. Second, the paper tries to show that even if we drop some of the building blocks of Sraffian theory, it is still possible to build a coherent alternative to neoclassical theory using (some of) the ideas of the classical economists. It suggests that we put the indefensible long-period method to one side, and build short-period equilibrium models with probabilistic prices.*

Key words: *classical-type approach, long period, natural prices, short period, Sraffian theory.*

During the 1960s and 1970s, a number of authors returned to the works of the classical economists and, in particular, to those of David Ricardo, with the aim of building a coherent alternative to mainstream (i.e., neoclassical) economic theory. In what follows, I will refer to this theoretical scheme as Sraffian theory.[1] Although, for a while, Sraffian theory appeared to be effectively challenging neoclassical orthodoxy, it subsequently fell into oblivion. Nowadays, only a small minority of economists are Sraffians, and the Sraffian approach seems to be losing rather than gaining supporters. What is more, the weakness of Sraffian theory has generated a general prejudice against the possibility of building a consistent economic analysis on classically inspired foundations.

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[1] Piero Sraffa's 1960 book, *Production of Commodities by Means of Commodities,* has been a source for a number of different theoretical contributions, or "Sraffian schools" (see Roncaglia, 1991), among which the most valuable have been those from Pierangelo Garegnani's group. Although the issues raised in this paper concern the Sraffian approach in general, its main focus will be on the work of these scholars.

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Curiously, however, critiques of Sraffian theory have been less telling than they might have been. Despite the lengthy debate around its *pars destruens* (the "capital critique" of neoclassical theory), there has been no thorough investigation of the logical consistency of Sraffian theory. This is interesting, because a closer examination of the relationship between Sraffian theory and the long-period method would have shown that Sraffian theory is not as robust as it appears.

It is from here that this paper will depart. It will have two aims. The first is to show that there is a logical inconsistency in Sraffian theory: the theory is conceived as a long-period approach but fails to correspond to reality in the way that Sraffians believe long-period theories should. In other words, the theory is unable to identify long-period positions. Second, the paper seeks to show that even if we drop some of the building blocks of Sraffian theory, it is still possible to build a coherent alternative to neoclassical theory using (some of) the ideas of the classical economists. More specifically, the paper suggests that we should abandon the indefensible long-period method and build classically inspired short-period equilibrium models. In such models, the probabilistic nature of theoretically determined short-period prices ensures that theory corresponds to reality—something that Sraffians believe is not possible for a short-period analysis.

The inconsistency in the Sraffian long-period approach

The concept of persistence and the correspondence between theory and reality

According to Sraffians, the classical and the early neoclassical economists (in particular, Walras) analyzed economic reality by studying and comparing *long-period positions* (see Garegnani, 1976, pp. 25–29; 1990b, p. 47). Long-period positions are characterized by the realization of long-period equilibrium prices in all sectors of the economy. Because these prices clear markets and produce the same rate of profits in all sectors, they leave no space for endogenous dynamics. As a result, the long-period position is persistent over time.[2]

[2] The most important studies on long-period positions refer to *stationary equilibria*—that is, to equilibria that reproduce themselves identically over time. Even for the steady-state case, the study of equilibrium growth paths is much more demanding. This paper deals specifically with stationary equilibria; its conclusions are, nonetheless, valid for both cases.

Sraffians 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, there are forces that drive the system toward long-period equalization of the rates of profits, and that, as a result, *market* (i.e., actual) prices tend toward long-period or natural prices.[3] This "convergence" does not imply that market prices will coincide with natural prices. Even with convergence, the presence of random disturbances implies that the actual realizations of the markets can only "gravitate" around their long-period counterparts.[4] Nevertheless, if the determinants of the long-period position are persistent over time and markets repeat sufficiently, "the deviations of the actual values from their theoretical counterparts will tend to compensate each other" (Garegnani, 1990b, p. 47), and average market prices, over time, will coincide with natural prices. Hence, even if the predicted values for relevant variables *differ* from actual (observed) values, their average market values, over time, will match theoretically determined long-period values, ensuring the required correspondence between theory and reality.[5]

In view of the above, it is not surprising that Sraffians attach great importance to the concept of "persistence," which, indeed, is crucial for the consistency of their whole approach. Strictly speaking, the consistency 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—that is, the characteristics of the economic system. Chronological persistence is essential for the long-period method: average market

[3] This process is mainly governed by differentials between rates of profits in different sectors of the economy; such differentials encourage shifts of productive capacity from the less to more profitable sectors.

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

[5] "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, 1990b, pp. 47–48).

realizations, over time, will match model predictions only if the exogenous forces that determine the long-period position persist for a sufficient period of historical time. In particular, they have to persist long enough for market prices to converge toward, and gravitate around, their long-period values.[6] Otherwise, the center of gravity will change before deviations have had time to compensate for one another. If there is no such persistence, the theoretically determined long-period position will not correspond to reality. In these circumstances, according to Sraffians, theories based on the long-period method fail to provide an adequate generalization of reality. And the same applies to theories based on the short-period method. Again, according to Sraffians, short-period models can determine neither the actual market realizations (no theory can do this), nor theoretical values that correspond to average market realizations. By definition, in fact, the short-period equilibrium changes "*before* a sufficient repetition of activities has allowed the deviations of the actual magnitudes from their equilibrium levels to be corrected (compensated)" (ibid., p. 49). Hence, short-period models cannot correspond to reality. A symptom of the irrelevance of short-period equilibria to classical and Sraffian economic analysis is the absence, in these analyses, of a term to denote short-period equilibrium prices: market prices are *actual* prices, and cannot be determined by theory, whereas natural prices are the long-period theoretically determined prices that correspond to market (actual) prices averaged over time. As a result, Sraffians are forced to assume that the economic system guarantees the chronological persistence of the forces determining the equilibrium (see, on this point, Garegnani, 1976, p. 28); if this were not the case, neither the long-period method nor any other form of economic analysis could guarantee the correspondence between theory and reality.

[6] Market prices "gravitate" *around* natural prices if the sectoral distribution of productive capacity corresponds to the equilibrium distribution—that is, if it is potentially 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 because 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" *toward* natural prices occurs when the sectoral distribution of productive capacity is *not* the equilibrium distribution—that is, if current productive capacity does not have the capability to 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.

But, to remain consistent, Sraffian theory also requires a second kind of persistence—namely, *theoretical* persistence. The likelihood that this can be achieved depends on the theory—that is, on the characteristics of the economic model the theory uses to study reality. Assuming reality gravitates around a long-period position that does not change over time, the theoretically determined values of the endogenous variables should also not change over time. In other words, these values should be such to induce no change in the values of the *data* used to calculate them. Otherwise, new (different) *data* would lead to new (different) values for the endogenous variables, and these would not depict a long-period equilibrium. In this case, the model would be unable to identify a long-period position (i.e., an equilibrium persistent over time). Unlike cases in which there is no chronological persistence, what we have here is a short-period model. The long-period method would remain internally consistent (as long as the requirement for chronological persistence was met), but the model would be unable to guarantee the correspondence between theory and reality. According to Sraffians, the Walrasian model fails to fulfill the requirement for theoretical persistence, even if chronological persistence is assumed.[7]

To sum up, the argument that the long-period method alone can guarantee the correspondence of a theory with reality ultimately rests on the chronological persistence of the forces determining equilibrium. Chronological persistence allows the convergence-gravitation process to do its work, ensuring that actual magnitudes gravitate around their long-period theoretical counterparts—that is, around magnitudes that long-period analysis should be able to determine.[8] In other words, a long-period position, susceptible to treatment by the long-period method, can only

[7] "[In a Walrasian model with accumulation], even if all existing capital goods will be reproduced, nothing guarantees that current outputs equal replacements for all of them so that a different endowment of capital goods will generally appear among the *data* of the following period. Whether or not Walras was trying to identify a long-period equilibrium, neoclassical authors do not deny that, as it now stands, a Walrasian model with capital accumulation defines a temporary equilibrium" (D'Orlando and Nisticò, 2000, pp. 11–12).

[8] It is worth emphasizing that no proof of convergence of actual reality toward long-period positions exists. Moreover, the studies that claim to focus upon convergence actually deal with *theoretical* convergence (stability), that is, with the dynamic behavior of theoretical models, and not with *empirical* convergence—that is, with the dynamic behavior of actual reality. For a deeper investigation of these issues, see the subsection "Theoretical Persistence and Convergence Toward Long-Period Positions."

exist if the forces determining the long-period position are persistent over time. Because the persistence of these forces is hard to prove (the rapid rate of modern technical change suggests that the only proof possible would be a *disproof*), Sraffians have been forced to *assume* it. For the sake of discussion, I will maintain this (theoretically and methodologically weak) assumption until the end of the second section. However, even if we assume chronological persistence (ensuring the consistency of the long-period *method*), Sraffian models still have to face the theoretical problem of identifying an equilibrium in which the exogenously given *data* are compatible with the values of endogenously determined variables. Unlike chronological persistence, this requirement of theoretical persistence cannot be assumed. In some models, theoretical persistence is an intrinsic characteristic of the model; in others, it is not.

The problem of the determination of quantities in Sraffian theory

Although the implications of these considerations for the consistency of the Walrasian approach have been fully investigated, there has, as yet, been no adequate analysis of what they mean for the consistency of Sraffian theory. In what follows, I will show that the Sraffian theory, just like the Walrasian approach, is unable to determine a long-period position: even when chronological persistence is assumed, the model lacks theoretical persistence. In general, the Sraffian model generates values for endogenous variables (prices and the rate of profits) that are *incompatible* with the values of the *data* that determine the equilibrium and, in particular, with the exogenously given quantities. In these circumstances, different sectors of the economy will have different (realized) rates of profits, the quantities produced will tend to change,[9] and hence, the theoretically determined values of the endogenous variables will also change. These characteristics are incompatible with the requirements of a long-period equilibrium model.

To highlight the problem, I will use Piero Sraffa's (1960) production prices analysis, the starting point for the majority of classically inspired contributions.

Sraffa describes an equilibrium position characterized by a vector of relative production prices that solves the system:

$$p^* = Ap^* (1+r) + lxp^*. \tag{1}$$

[9] In the case of an equilibrium growth path, it is *relative* quantities that change.

where A is the square matrix of technical coefficients, 1 is a column vector representing labor input per unit of output, r is the rate of profits (which is equal across sectors), p^* is a column vector representing the relative prices of output commodities, and x is a row vector representing the quantities of commodities contributing to the real wage. The unknowns are the prices p^* and the rate of profits r; technical coefficients, labor input, and the real wage vector are considered as known.

In this scheme, the technical coefficients are included among the *data* of the problem, and Sraffa can consider them as known, as he considers the quantity of output as known (ibid., p. 4). Moreover, the condition that the rate of profits should be equal in all sectors implies that Sraffa prices are consistent with long-period equilibrium, because the *data* determining the equilibrium show (theoretical) persistence. In fact, if all sectors are equally profitable, quantities of output—and the endogenous variables they determine—will remain unchanged.[10] This implies that these quantities are not only known but also *given,* in the sense that the system will reproduce them identically. It is thus perfectly correct to present Sraffa prices as a possible formalization of the classical notion of natural prices (ibid., p. 9) and Sraffa's given quantities as a formalization of *effectual demand.*[11] It should be emphasized that, in this scheme, quantities cannot be chosen arbitrarily. The quantities produced have to have the "right value" (corresponding to the effectual demand). If this is not the case, 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. This problem exists when returns to scale are constant,[12] but becomes particularly significant under nonconstant returns. In this case, the production of "wrong" quantities implies a proper technology that generates a (theoretical) vector of Sraffa prices and a

[10] In the case of an equilibrium growth path, it is *relative* quantities that do not change.

[11] 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, 1990a, p. 332; see also Mongiovi, 1991, p. 719, n. 3; Smith, 1937, p. 56).

[12] In the case of constant returns, Sraffa's procedure generates the *same* vector of prices for *any* vector of quantities. Nonetheless, if quantities are "wrong," the nature of the equilibrium position (short or long period) is, to say the least, ambiguous. In this case, market prices cannot correspond (even on average) to the theoretically determined equilibrium prices; realized rates of profits differ across sectors; and quantities of output change, even when theoretically determined prices (and the theoretically determined rate of profits) do not change.

(theoretical) uniform rate of profits. But selling these quantities would generate differences between the rates of profits in different sectors. Differences between the rates of profits lead to changes in the quantities produced. And, because under variable returns, technical coefficients vary with variations in output, changes in the quantities produced generate changes in technology and thus a new vector of Sraffa prices and a new (theoretically determined) uniform rate of profits, and so on, as long as quantities are the "wrong" ones;[13] the kind of result one would not expect from a long-period model.[14] To find a long-period position, Sraffian theory would first have to find the "right" values for the exogenous *data*—that is, the "right" quantities. But these values can only be found if they first become an object of theoretical investigation. Therefore, the first thing Sraffians have to do is accept long-period quantities as endogenous variables, and develop analytical tools to calculate their values. Until this is achieved, the model fails to meet the requirement for theoretical persistence. It is, in fact, nothing more than a short-period model that fails to guarantee the correspondence between theory and reality.

Theoretical persistence and convergence toward long-period positions

The classical economists considered the determination of the quantities of effectual demand as a trivial problem, and appear to have believed that chronological persistence would guarantee theoretical persistence. If the forces determining long-period equilibrium were sufficiently persistent, they thought, competition would drive the system toward a long-

[13] What we are discussing here is theoretical persistence. In this setting, it is not the actual values that change over time (if chronological persistence and convergence are assumed, the only changes in these values are fluctuations around the long-period position) but the theoretically determined values.

[14] This problem is exactly the same as the problem of the incompatibility between the values of the exogenously given variables and the equilibrium values of the resulting endogenous variables that, according to Sraffians, invalidates Walrasian theory. In fact, "under non-constant returns . . . the same determination of long-period prices rests on the preliminary knowledge of the sectoral outputs which determine the matrix of the technique. But if one includes sectoral outputs among the *data* of the theory, these quantities could in principle be taken at whatever level. This . . . set of produced quantities would generate its own set of requirement for production, its own income distribution and its own vector of prices; and the quantities demanded at these prices would generally differ from the given produced quantities. The solution of the system would not depict a long-period position. The implication of the above argument is that the classical-type approach, like the Walrasian one, is capable of singling out a long-period position only if the exogenously given quantities are taken at their 'right' values" (D'Orlando and Nisticò, 2000, pp. 13–14).

period position. If this were true, theory could safely assume that reality was close to the long-period position and that actual market realizations gravitate around their long-period counterparts. Given that, at least on average, the quantities and other data observed in reality would correspond to their theoretical counterparts, it was legitimate to take this data directly from reality.[15] This may help to explain why Sraffians—while rejecting the neoclassical apparatus of supply and demand and the simultaneous determination of prices and quantities[16]—have never developed the "other part of the theory" (Garegnani, 1976, p. 29)—that is, an alternative mechanism to determine the "right" quantities (on this point, see Piccioni, 1998, p. 5).

In any case, it is definitely *not* legitimate to take quantities from reality. This became clear 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.[17] This result suggested that not only the stability of long-period positions (a theoretical problem affecting the dynamic behavior of theoretical models) but also the convergence of actual magnitudes toward long-period positions (an empirical problem affecting the dynamic behavior of actual reality) were not at all obvious outcomes of competitive market dynamics. And if convergence is not proved, it cannot be shown that the system gravitates around a long-period position. In these conditions, data taken from reality are worthless not only as a representation of the theoretical long-period values of variables (in the case of quantities, the effectual de-

[15] In particular, according to Garegnani's interpretation of classical theory, the long-period "*volume* of the social product depends on: (i) the stage reached by accumulation, which governs the number of 'productive' laborers employed; (ii) the technical conditions of production which regulate the physical product per laborer and depend in turn on the stage reached by accumulation. . . . The *commodity composition* of the social product, on the other hand, was studied from the angle of the needs of reproduction . . ., or else was left to be studied case by case as the need arose" (1984, p. 296, n. 12). Garegnani thus seems to believe that the system is so close to the long-period equilibrium that the values of the above magnitudes (the stage reached by accumulation, the technical conditions of production, the needs for reproduction) are exactly the ones that correspond to this equilibrium, a circumstance that, in general, cannot be assumed.

[16] Since Sraffians believe that no "necessary quantitative relations" can exist between prices and quantities, they consider it impossible to simultaneously determine these two groups of variables. On this point, see Garegnani (1984, p. 297).

[17] On this point, see D'Orlando (1997) and, among the most important contributions, Arena et al. (1990), Bellino (1997; 1999), Boggio (1990), Caravale (1994), Duménil and Lévy (1990), Egidi (1975), Garegnani (1990a), Gontijo (2000), Medio (1978), Nikaido (1985), and Steedman (1984).

mand) but even as an approximation of these values. Accordingly, the quantities of effectual demand cannot be legitimately taken from reality, and theoretical persistence is not achieved.[18]

Apart from proving convergence, another possible method to determine the "right" quantities exists, proving the stability of long-period positions. If it were possible to prove stability via a dynamic model, we could use the same model to single out the vector of the "right" quantities as the fixed point of the dynamics. In this case, the requirement for theoretical persistence would be fully satisfied (but the question whether reality converges toward a long-period position would remain unanswered). The circumstance that stability has not yet been proved (and might be disproved) does not jeopardize the robustness of this method and bears an important implication. If we base the dynamic model on a sequence of short-period equilibria, capturing observable market trends, there are only two possible outcomes: either the model converges toward a natural equilibrium position or it does not. In the first case, theoretical persistence would be attained, in the second, it would not. But in either case, if the sequence of temporary equilibria proves to be capable of capturing observable market trends, we can use this method of analysis to study reality. The interesting implication is that, in these circumstances, Sraffian long-period analysis would be effectively useless, even if it were proved to be theoretically flawless.

In any case, Sraffians do not use dynamic models to single out the "right" quantities. Thus, given the illegitimacy of taking quantities from reality, they do not possess a consistent method for achieving theoretical persistence.

Garegnani's iterative procedure

In addition to the problems discussed above, the absence of theoretical criteria, capable of identifying equilibrium quantities, forces Sraffians into an "ex post accounting" problem.[19] By assuming convergence/gravi-

[18] Actually, a proof of convergence would do more than just allow the "right" quantities to be taken from reality (and hence ensure the theoretical persistence of the equilibria in Sraffian models). It would also guarantee the consistency of the choice to analyze economic reality by studying and comparing long-period positions—that is, the consistency of the long-period method in general (and not only of its Sraffian version).

[19] "In his Preface, Sraffa writes that he assumes outputs to be given. . . . According to Professor Hahn, this reduces Sraffa's analysis to 'just a fancy way of presenting accounts ex post'" (Garegnani, 1990c, p. 129).

tation, they implicitly assume that reality itself gravitates around a long-period position, and that they can therefore take the "right" quantities from reality. But, if an exogenous shock changes the "old" equilibrium quantities, Sraffians can only identify the "new" quantities (and hence the new long-period position) once these have already revealed themselves. Compared with the other issues facing Sraffian theory, this seems a trivial problem. Nevertheless, Sraffians have tackled it, leaving the other problems to one side. An example of this strategy is Garegnani's iterative procedure,[20] which aims to determine the "new" quantities ex ante, avoiding both the simultaneous determination of prices and quantities and the building of dynamic models that could jeopardize the supremacy of the long-period method (Garegnani, 1990c, p. 130).

Garegnani's iterative procedure comprises two separate logical stages. In the first stage, the economic system is in a long-period position. At this point, an exogenous modification of the quantities demanded at natural prices forces it to produce these "new" quantities.[21] If returns to scale are variable, production of the new quantities will require a change in productive techniques. Solving Sraffa's system for these new techniques 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—that is, 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. In the second stage, the system will 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—that is, until theoretical persistence is achieved and Sraffa prices become long-period prices (see D'Orlando and Nisticò, 2000, pp. 15–16).

Discussion of Garegnani's procedure is easier if it is formalized as a system of difference equations:

[20] See Garegnani (1983; 1990c), Piccioni (1989; 1998), and Mongiovi (1991). It is important to emphasize that the models in Garegnani (1990a; the proof of stability) and Garegnani (1990c; the determination of the "new" quantities after a shock) are totally different from one another.

[21] 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).

$$q_t^D = f\left(p_t^*\right) \tag{2}$$

$$q_t^O = q_{t-1}^D \tag{3}$$

$$A_t = g\left(q_t^O\right) \tag{4}$$

$$l_t = h\left(q_t^O\right) \tag{5}$$

$$p_t^* = A_t p_t^* (1+r) + l_t x p_t^*, \tag{6}$$

where q_t^D indicates the quantities demanded at time t as a function of the prices p_t^*; q_t^O indicates the quantities produced at time t, which are equal to the quantities demanded at $t-1$; p_t^* indicates the prices at time t, as computed using the technical coefficients (A_t and l_t) necessary to produce q_t^O.

In the long-period position:

$$q_t^D\left(p_t^*\right) = q_t^O. \tag{7}$$

There are two main problems with this procedure. First, it seems extremely difficult to prove its global stability. Second, some of the specific assumptions adopted by Garegnani make it impossible to study the dynamic behavior of the iteration. Garegnani rejects the possibility of defining a formally specified functional relationship between prices and quantities.[22] But, if it is impossible to formalize the relationship between prices and quantities—that is, if there is no equation equivalent to Equation (2)—it is impossible to formalize the single steps of the iteration. In these circumstances, it is impossible even to *attempt* to prove the convergence of the dynamics toward a fixed point. And, if the iteration does not converge to a fixed point, it is useless for finding a new long-period position after a shock.

Garegnani seems to be aware of this latter problem, arguing that magnitudes that cannot be calculated theoretically with the iterative proce-

[22] According to Garegnani, "the reciprocal dependence of outputs and prices can be dealt with by means other than the demand functions . . . [and] this alternative treatment, which was that of the classical economists, seems to be the only generally possible in a classical context" (1990c, p. 130).

dure can somehow be taken from reality and, thus, there is no need for a formally specified relation similar to Equation (2).[23] This is unsatisfactory. The magnitudes that have to be taken from reality are the quantities demanded at each step of the iteration, at the correct Sraffa prices for the step. Given, however, that the iterative procedure is in no way a plausible representation of the actual functioning of markets, one cannot take demand quantities *directly* from reality and claim that they represent demand at Sraffa prices, nor can we take the *average* of quantities realized in reality. This latter approach would be correct only if it were possible to prove that actual prices gravitate around the prices calculated by the iterative procedure. But these prices cannot be attractors; even if they are realized, they cannot, by definition, clear the market and, hence, cannot guarantee a uniform rate of profits.

Given that the steps in the iterative process do not describe the actual behavior of markets and that the prices generated by each step cannot be attractors, it is illegitimate to take the quantities required by the iteration from reality, either directly or indirectly. 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 such as relation (2). In the absence of such a relationship, the theoretical study of the process stops at the first iteration, and it is impossible even to try to prove convergence.

Garegnani's failure to cope with the ex post accounting argument means that, even assuming chronological persistence and convergence, Sraffians can only identify equilibrium prices when equilibrium quantities have already been realized.

Summing up: the inconsistency in the Sraffian long-period approach and the search for new solutions

As shown in the last two subsections, the ex post accounting problem that Garegnani fails to solve is relatively minor compared to the other issues facing Sraffian theory. By far, the most important problem is that Sraffians should find a method to identify the "right" quantities. Unless

[23] Defining the relationship between prices and quantities using data from reality is very different from using real data to define the quantities of effectual demand. If it were possible to prove the convergence, the latter would be a legitimate procedure. The former would be illegitimate, even if such a proof were available.

they can do this, the requirement for theoretical persistence will not be met, and the theory will fail to ensure the correspondence between theory and reality, which Sraffians impose as a requirement on long-period models. But Sraffians have failed to develop consistent methods for identifying equilibrium quantities. They have not used dynamic models. And they have made no attempt to simultaneously determine prices and quantities. As a consequence, the Sraffian model remains inconsistent, and widespread recognition of its weakness prejudices the possibility of building a consistent economic theory upon classical-type foundations. Somehow these problems have to be addressed and solved. Proof of convergence would guarantee the consistency of the long-period method and would allow the Sraffian approach to meet the requirement for theoretical persistence. Proof of stability would allow the Sraffian approach to meet the requirement for theoretical persistence alone. Disproof of convergence would force classically inspired scholars to divert theoretical attention from the long period to the short period. However, in all these cases, we will have to put the long-period method to one side, studying the dynamic evolution of short-period actual reality and using the short-period method to study the dynamics of classically inspired models.

Therefore, if we wish to defend the validity of the classical economists' main ideas, we will inevitably have to study classical concepts' ability to handle the short period and the dynamics. In the next section, I will show that the theoretical framework created by the classical economists can make an important contribution to the study of economic reality, even in the short period—that is, in a context in which we drop the assumptions of chronological and theoretical persistence (but maintain the correspondence between theoretically determined and actual magnitudes). In view of the lack of interest in these themes often shown by classical and classically inspired theories, and of the consequent lack of rigorous classically inspired foundations for short-period analysis, I will propose that the best way to understand the dynamic process is to conduct a theoretical analysis in two phases: the first devoted to the construction of rigorous, classically inspired short-period models, the second to an investigation of the dynamics of the equilibria emerging from these models. No proof of convergence toward long-period positions is necessary in the first phase (which deals with the short period), and both the short-period and the dynamic model would remain consistent even if further studies, in the second phase, will disprove convergence toward long-period positions (hence jeopardizing the long-period method).

The bridge between long- and short-period models

Caravale's dynamic model

Within the classical-type approach, some kind of short-period analysis can be found in models designed to study the stability of long-period positions. However, in the great majority of cases, these models place too much emphasis on the assumptions necessary to produce stability and too little on the short-period foundations of the dynamics. And the short-period equilibria they determine are always governed by neoclassical rules (and often by neoclassical assumptions). As a result, they fail to propose an adequate short-period classically inspired analysis. To make things worse, many models study the stability of *given* long-period positions and limit their analysis to the special case of constant returns to scale. However, a few models have proposed a more rigorous (and less neoclassical) analysis of the short period and have tried to compute the long-period values of variables as the fixed point of a dynamic process modeled as a sequence of short-period equilibria under variable returns (see Arena et al., 1990; Caravale, 1994). These models attack the stability problem directly, making no attempt to study short-period equilibrium in its own right.[24] They can, nonetheless, provide a starting point for such an analysis. In particular, Caravale's model (Caravale, 1994), although incomplete and incapable of producing solid results on the stability problem, provides useful suggestions for modeling short-term equilibrium prices.

Caravale's proposal contains many of the elements required for a classically inspired model of short-period dynamics. First, he suggests an innovative, non-neoclassical procedure (a "Smithian-type tâtonnement") for determining short-period prices (Caravale's "actual market clearing prices") during each phase of the dynamics. Second, he models the influence of demand (and supply) over prices, using functional relationships that differ profoundly from the neoclassical functions and that do not depend on utility maximization. Third, he proposes a concept of probabilistic "actual market clearing prices" that overcomes long-period theorists' objection that short-period equilibria lack persistence

[24] This is an attractive but not particularly successful strategy. These models produce interesting insights for classically inspired short-period analysis but fail to achieve full consistency. Their conclusions on the stability problem are (to say the least) vague.

(though Caravale seems to be unaware of, or uninterested in, this implication). Finally, he uses variable returns to scale (even if "the assumption is made that quantity adjustment on the part of producers do not imply violent changes in the technical coefficients" [ibid., p. 55]). These elements are discussed in more detail below.

Caravale's "Smithian-type tâtonnement"

Caravale's dynamics consists of a sequence of phases, each of which corresponds to a short-term equilibrium position. Each phase comprises a number of subphases. Producers first 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 demand, the goods are initially exchanged at the "announced price." This initial exchange is then followed by a series of subphases during which entrepreneurs adjust their price so as to clear the market. Each subphase allows the sale of a proportion of goods at a "temporary market price" (which changes between one subphase and the next). The process comes to an end when the market is cleared. This is the essence of Caravale's "Smithian-type tâtonnement." The model allows no role for an auctioneer; in the model, a proportion of the goods involved in the process are exchanged at "false" prices (ibid., pp. 58–59).

In Caravale's model, markets clear in every "market period"—that is, in every phase. This, however, requires a sequence of subphases. During individual subphases, a proportion of output is sold at prices that, in general, fail to clear the market. In this scheme, the "actual market clearing price" for a commodity is the average of the ("temporary market") prices for a sequence of exchanges 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.

The procedure just described contrasts with the majority of classically inspired studies of stability (e.g., Steedman, 1984). In these latter models, short-period equilibria are based on (market clearing) prices that *instantaneously* equate demand and supply. Implicitly, they assume the existence of a Walrasian tâtonnement, governed by an auctioneer—until the equilibrium price is reached, there can be no transactions; there is no exchange of goods at "false" prices. This kind of assumption is hard to reconcile with a classically inspired approach. More generally, even the

neoclassical literature now recognizes the need to abandon adjustment mechanisms based on Walrasian tâtonnement. Caravale's "Smithian-type tâtonnement" thus represents a first important attempt to achieve a reasonable representation of the exchange process, within the classical-type approach.

Caravale's demand "band" and the correspondence between theory and reality

In each subphase of Caravale's dynamics, the quantities exchanged are the result of the interaction between supply and demand. But Caravale does not represent supply and demand as deterministic functions founded on agents' maximizing behavior. Rather, they are probabilistic relations (random variables) based on a set of given magnitudes perturbed by a Gaussian variable. According to Caravale, 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, 1994, pp. 54–55).

If demand and supply are probabilistic magnitudes, the quantities exchanged in each subphase will also be probabilistic. The same applies to ("temporary market") prices in each subphase, whose value will depend on the volumes of supply and demand in the previous subphase and to "market prices" in each phase. Although Caravale uses the term *actual market clearing prices,* what he is actually proposing is a theoretical method for determining short-period prices. These are precisely the same prices Sraffians refer to when they say short-period prices cannot be the object of theoretical investigation. According to Sraffians, the forces determining these prices change so fast that market values have no time to gravitate to their theoretical values. Caravale, on the other hand, succeeds in determining short-period prices by defining them in probabilistic terms. In Caravale's short-period model, as in the case of theoretically determined long-period prices, actual prices may diverge from theoretical predictions. But there is an important difference. Long-period analyses will only match reality if each theoretically determined long-period price corresponds to the average of the prices actually realized by the market. In these analyses, markets (and prices) have to repeat themselves often enough to allow for the calculation of this average. Caravale's model, on the contrary, matches reality as long as the realization of the random variable—that is, the observed market price—lies within the range of the disturbance. The model does not need the repetition of markets (and

prices). It can drop the requirement for chronological and theoretical persistence while maintaining correspondence with reality.

Caravale's model and a new classically inspired short-period analysis

Caravale does not appear to be fully aware of the implications of his proposal. The model is a rudimentary one. It provides no clear microfoundation for the non-neoclassical criteria driving demand decisions and fails to give an adequate description of its "Smithian-type tâtonnement." Its treatment of the dynamic behavior of the system is incomplete.[25] Nevertheless, 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. Such an approach has the potential to avoid the main drawbacks of both the Sraffian and the neoclassical approaches. Sraffians' rejection of the apparatus of supply and demand and of short-term dynamics has prevented them from obtaining rigorous results on the interdependency between prices and quantities. As we saw in the second section, this has seriously weakened the whole classical-type approach. For their part, neoclassical theorists' ambition to base demand and supply functions on utility/profit maximization by individuals has proved to be empirically flawed; there is a huge, and growing, body of evidence that, in reality, individuals do not maximize (or act "as if" they were maximizing) their utility/profit functions (for a survey, see Conlisk, 1996; Devetag, 1999). The critique of the neoclassical maximization narrative has led to the emergence of *behavioral economics,* a new theoretical approach that could be useful for the study of demand behavior in non-neoclassical (i.e., nonmaximizing) models, thereby making a contribution to a renewal of the classical-type approach.[26]

[25] Caravale limits himself to saying that "[t]he preliminary analysis of the convergence problem carried out in this context is supplying encouraging results" (1994, p. 59).

[26] The classical economists' concept of demand behavior overlaps, to some extent, with results from behavioral economics—in particular, in the areas of social rationality, social interaction, imitation, social learning, and the behavior of social groups (Boyd and Richerson, 2001; Laland, 2001; Mellers et al., 2001). In both approaches, the demand for commodities depends on the behavior of broad social classes/groups, depending not on explicit utility maximization but on a broad range of social and historical factors (see, e.g., Fishbein and Ajzen, 1975; Olshavsky and Granbois, 1979).

Even the limitations of Caravale's model can play a constructive role, showing a clear way out of the problems that have stymied Sraffians. Certainly, the absence, in Caravale's model, of a proof of stability jeopardizes the original aim of the construction, preventing the model from identifying long-period positions as the fixed point of the dynamics. But even if the model cannot achieve its original goal, it is still useful for another purpose—which fits well with the aims of this paper. The previous section suggests that the study of short-period equilibria (in which markets are cleared but there is no uniform rate of profits), could be an intermediate step toward proof (or disproof) of the stability of long-period positions but, moreover, could be the only analytical approach capable of coping with reality if convergence is disproved. In this setting, Caravale's specification of the short-period equilibria that constitute each single step of his dynamics is very valuable, together with the probabilistic nature of his short-period prices that ensure that theory corresponds to reality and produce results similar to Foley's short-run statistical equilibrium model (Foley, 1999, p. 3).

The ideal reference model would therefore be a dynamic model within which individual entities (classes or groups) act in a procedural way. A simplified initial study could sketch out the basic features of temporary equilibria, momentarily disregarding the complex decisions involved in dynamic processes. This way of proceeding has the advantages in that it is much easier to study the individual steps in a dynamic process than to build a complete dynamic model and that the investigation of individual steps is, in any case, a necessary first phase. In this perspective, specific characteristics of classical theory can be used as building blocks. The resulting model would have a strong classical flavor. It would share classical theorists' views on the key role of social classes and their sense for dynamics; like classical theory, it would avoid the need for maximization via the behavior of individual agents or auctioneer-driven processes of tâtonnement. It would not, of course, share the classical economists' long-period method and their labor theory of value, but not everything that was written in the past (or the present) is necessarily correct.

Conclusions

The argument developed in this paper is divided into two parts, a *pars destruens* and a *pars construens.* The *pars destruens* has shown an inconsistency in Sraffian theory. Sraffian theory lacks theoretical persistence, and as a result, it is incapable of identifying a long-period position, even if chronological persistence is assumed. Consistency can be re-

stored only if we know how to determine the long-period quantities. It follows that we should drop the traditional Sraffian assumption that long-period quantities are exogenously given and develop analytical methods to determine quantities theoretically. To do this, one can either prove that actual reality converges toward long-period positions (and hence legitimately take quantities from reality) or prove the stability of a classically inspired theoretical dynamic model (and hence determine quantities as the fixed point of the dynamics). Inevitably, however, this kind of analysis will focus on the short-period characteristics of the economic system, jeopardizing the supremacy of the long-period method. If the dynamics of short-period equilibria converges toward a long-period position, short- and long-period models will both be consistent; but even if they do not, short-period models will be consistent anyway. While this may help to explain why Sraffians have been very cautious in developing such models, it also shows that the decision to study short-period dynamics and to put the long-period method to one side is an inevitable one.

Like Sraffian theory, neoclassically inspired theory has also encountered serious problems (i.e., the empirical falsification of almost all its basic assumptions). The *pars construens* of the paper proposes an alternative, namely, a research program to construct coherent, dynamic economic models, with non-neoclassical, empirically based microfoundations, which will remain consistent regardless of whether the long-period method survives. A preliminary step in this direction would be to sketch out the basic features of a classically inspired short-period equilibrium model, which would consider social classes (driven by procedural rationality) rather than individuals (driven by maximizing behavior) as the key entities in economic systems. In such a model, the probabilistic nature of theoretically determined short-period prices would ensure that theory corresponds to reality—something that Sraffians believe cannot be achieved by short-period analysis. This focus on short-period equilibrium would be one first step in the important task of building a consistent, descriptive (non-normative) dynamic model inspired by the classical economists, yet free from the fetters of the classical texts.

REFERENCES

Arena, R.; Froeschle, C.; and Torre, D. "Gravitation Theory: Two Illustrative Models." *Political Economy,* 1990, *6* (1–2), 287–307.

Bellino, E. "Full-Cost Pricing in the Classical Competitive Process: A Model of Convergence to Long Run Equilibrium." *Journal of Economics (Historical Archive),* 1997, *65* (1), 41–54.

———. "Convergence to Long-Run Equilibrium—On Some Recent Variations of the

'Pure' Cross-Dual Model." *Structural Change and Economic Dynamics,* 1999, *10* (2), 225–237.

Boggio, L. "The Dynamic Stability of Production Prices: Synthetic Discussion of Models and Results." *Political Economy,* 1990, *6* (1–2), 47–58.

Boyd, R., and Richerson, J. "Norms and Bounded Rationality." In G. Gigerenzer and R. Selten (eds.), *Bounded Rationality: The Adaptive Toolbox.* Cambridge, MA: MIT Press, 2001, pp. 281–296.

Caravale, G. "Prices and Quantities: Walras, Sraffa and Beyond." *Studi Economici,* 1994, *49* (52), 43–64.

Conlisk, J. "Why Bounded Rationality?" *Journal of Economic Literature,* 1996, *34* (2), 669–700.

Devetag, M.G. "From Utilities to Mental Models: A Critical Survey on Decision Rules and Cognition in Consumer Choice." *Industrial and Corporate Change,* June 1999, *8* (2), 289–351.

D'Orlando, F. "Criteri di definizione e stabilità degli equilibri nella teoria economica di tipo classico" [Disequilibrium Dynamics and Equilibrium in Classical-Type Economic Theory]. *Studi Economici,* 1997, *52* (62), 49–80.

D'Orlando, F., and Nisticò, S. "Prices and Quantities: Possible Solutions Within a Post-Classical Research Program." *Economie Appliquée,* 2000, *53* (3), 9–29.

Duménil, G., and Lévy, D. "Stability in Capitalism: Are Long-Term Positions the Problem? With an Addendum." *Political Economy,* 1990, *6* (1–2), 229–264.

Egidi, M. "Stabilità ed instabilità negli schemi Sraffiani" [Stability and Instability in Sraffian Schemes]. *Economia Internazionale,* 1975, *28* (1–2), 3–41.

Fishbein, M.A., and Ajzen, I. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley, 1975.

Foley, D. "Statistical Equilibrium in Economics: Method, Interpretation and an Example." CEPA, New School, New York, 1999 (available at cepa.newschool.edu/%7Efoleyd/stateqnotes.pdf, accessed May 12, 2005).

Garegnani, P. "On a Change in the Notion of Equilibrium in Recent Work on Value and Distribution." In M. Brown, K. Sato, and P. Zarembka (eds.), *Essays in Modern Capital Theory.* Amsterdam: North-Holland, 1976, pp. 25–43.

———. "The Classical Theory of Wages and the Role of Demand Schedules in the Determination of Relative Prices." *American Economic Review Papers and Proceedings,* 1983, *73* (2), 309–313.

———. "Value and Distribution in the Classical Economists and Marx." *Oxford Economic Papers,* June 1984, *36* (2), 291–325.

———. "On a Supposed Obstacle to the Gravitation of Market Prices Towards Natural Prices." *Political Economy,* 1990a, *6* (1–2), 329–359. [Reprinted in *Equilibrium and Economic Theory.* Edited by G. Caravale. London, Routledge, 1997, pp. 139–170.]

———. "Quantity of Capital." In J. Eatwell, M. Milgate, and P. Newman (eds.), *Capital Theory.* London: Macmillan, 1990b, pp. 1–78.

———. "Sraffa: Classical Versus Marginalist Analysis." In K. Bharadwaj and B. Schefold (eds.), *Essays on Piero Sraffa—Critical Perspectives on the Revival of Classical Theory.* London: Unwin Hyman, 1990c, pp. 112–141.

Gontijo, C. "On the Criticism to the Classical Method." *Revista Brasileira de Economia,* 2000, *54* (1), 85–122.

Laland, K. "Imitation, Social Learning, and Preparedness as Mechanisms of Bounded Rationality." In G. Gigerenzer and R. Selten (eds.), *Bounded Rationality: The Adaptive Toolbox.* Cambridge, MA: MIT Press, 2001, pp. 233–247.

Medio, A. "A Mathematical Note on Equilibrium in Value and Distribution." *Economic Notes,* 1978, *7* (2–3), 97–106.

Mellers, B.A.; Erev, I.; Fessler, D.M.T.; Hemelrijk, C.K.; Hertwig, R.; Laland, K.N.; Scherer, K.R.; Seeley, T.D.; Selten, R.; and Tetlock, P.E. "Group Report: Effects of Emotions and Social Processes on Bounded Rationality." In G. Gigerenzer and R. Selten (eds.), *Bounded Rationality: The Adaptive Toolbox.* Cambridge, MA: MIT Press, 2001, pp. 263–280.

Mongiovi, G. "The Ricardo Debates: A Comment." *Canadian Journal of Economics,* 1991, *25* (2), 717–723.

Nikaido, H. "Dynamics of Growth and Capital Mobility in Marx's Scheme of Reproduction." *Journal of Economics (Historical Archive),* 1985, *45* (3), 197–218.

Olshavsky, R.W., and Granbois, D.H. "Consumer Decision Making—Fact or Fiction?" *Journal of Consumer Research,* 1979, *6* (2), 93–100.

Piccioni, M. "Distribuzione e quantità prodotte nell'impostazione classica" [Distribution and Produced Quantities in Classical-Type Approach]. *Studi Economici,* 1989, *44* (37), 179–218.

———. "Distribuzione del reddito, prezzi e quantità domandate nella Impostazione Classica. Un commento a Caravale e D'Orlando" [Distribution, Prices and Demanded Quantities in Classical-Type Approach: A Comment to Caravale and D'Orlando]. *Rivista di Politica Economica,* 1998, *88* (5), 3–24.

Roncaglia, A. "The Sraffian Schools." In J.C. Wood (ed.), *Piero Sraffa: Critical Assessments in Leading Economists Series.* London and New York: Routledge, 1991, pp. 53–84.

Smith, A. *An Inquiry into the Nature and Causes of the Wealth of Nations.* New York: Modern Library, 1937. [Originally published in 1776.]

Sraffa, P. *Production of Commodities by Means of Commodities. Prelude to a Critique of Economic Theory.* Cambridge: Cambridge University Press, 1960.

Steedman, I. "Natural Prices, Differential Rate of Profits and the Classical Competitive Process." *Manchester School of Economic and Social Studies,* 1984, *52* (2), 123–140.