

Άρθρα - Articles

“Production of Commodities by Means of Commodities” Forty years later – An appraisal

by
*Theodore Mariolis**

I. Sraffa’s Contribution and its Repercussions

It is said that important books entail more remarkable ideas than those contained within their pages and are, consequently, open to different, separate, directions. On the basis of this criterion (and not only), “Production of Commodities by Means of Commodities. Prelude to a Critique of Economic Theory” by Piero Sraffa, “économiste italien à Cambridge”¹, is particularly important. Although the entire set of propositions in the book was designed –as noted by Sraffa in the *Preface*– to be used as the basis for a critique of the marginalist theory of value and the distribution of income, in the forty years since its publication it has inspired pioneering theoretical and empirical works, which overturned traditional ‘answers’ and produced new results, in virtually all the main fields of economic science: microeconomic and macroeconomic analysis, international trade, monetary theory, growth and technological change, input-output analysis. At the same time, by highlighting the inherent contradictions of orthodox theory, it showed the need for a return to the principles of classical economists and of Marx. Thus, it made a decisive contribution (in combination also with the work of others, such as N. Okishio, M. Morishima and L. Johansen) to the rekindling of interest in classical and Marxian theory, as well as to the activation of a process of control, correction, further elaboration and/or refutation of

* Panteion University, Dept. of Public Administration, Athens, Greece.

1. Subtitle of a biography of P. Sraffa written by L. Pasinetti, which was published in Arena and Ravix (eds.), 1990, pp. 3-18.

certain –fundamental or particular– aspects of the said theories². Lastly, one, should also not underestimate the fact that it serves, on the one hand, to prove that all –without exception– empirical works based on the neoclassical theory (of production, of prices, of distribution and of growth of national income) are –in reality– of no importance and, on the other, to precisely identify the apologetic/legitimising services offered by the orthodox theories to the maintenance and management of the existing order of the world.

It is true that the reading, comprehension, further elaboration and even criticism of “Production of Commodities” is no easy matter. First of all, it requires knowledge of Classical Political Economy as a whole and particularly the mathematical expression (and defence) of its principles, as set out by W. Whewell (1829, 1831) and V.K. Dmitriev (1898, 1904). It would be inconceivable without knowledge of “Capital”, Marx’s criticism of the Ricardian theory of value and the works of W. Muehlpfordt (1893, 1895), L. v. Bortkiewicz (1906-7, 1907), G. v. Charasoff (1909, 1910) and G. A. Feldman (1928), which deal with and elaborate on some of the most crucial points of the Marxian work. It cannot be completed without the theory of linear systems of production, input-output analysis and the so-called theory of ‘superposed price systems’, which were founded primarily by W. Leontief (1928, 1941), R. Remak (1929, 1933), J. v. Neumann (1937), D. Hawkins and H.A. Simon (1948, 1949), G. Debreu and I.N. Herstein (1953). Lastly, it requires knowledge of the different versions of neoclassical theory (Jevons, Walras, Böhm-Bawerk, Wicksell, Hicks), the early criticism of the aforesaid theory which was elaborated by J. Robinson (1953, 1956) and the steadily growing body of works of those economists (the names of G. Abraham-Frois, E. Berrebi, Ch. Bidard, P. Garegnani, H.D. Kurz, L. Mainwaring, S. Parrinello, L. Pasinetti, A. Roncaglia, N. Salvadori, B. Schefold and I. Steedman immediately come to mind), which are part of the tradition created by the “Production of Commodities”³.

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2. To be precise: and certain perceptions concerning the said theories. Thus, for example, the article by Steedman and Metcalfe, 1973, constitutes a correct criticism of Ricardo’s theory of foreign trade, while in Steedman, 1977, 1985, a series of incorrect perceptions (in our opinion) of Marxian theory is refuted. Refutation which may however form part of a reformulation of the core of Marxian theory (Mariolis, 1999, 1999a, 2000, 2001, 2002, 2003).
 3. By way of indication, we note that the early bibliography compiled by G. Faccarelo, within the framework of a special feature on Sraffa’s work in *Cahiers d’Economie Politique* (1975, No. 3), contained (without being complete) more than three hundred titles.

In “The Man Without Qualities”, Robert Musil wrote that there are intellectual activities, regarding which it is not voluminous books, but small treatises which make a man proud. And that if, for example, someone discovered that rocks, under certain conditions which had so far not been observed, could talk, only a few pages would be needed to describe and explain such a revolutionary phenomenon. Sraffa needed about one hundred pages, as well as forty years of work (1920-1960), in order to make known an equally revolutionary finding: The theory which had prevailed since the late 19th century was fundamentally incorrect. “It’s all in pieces, all coherence gone”, as the poet would say⁴ (John Donne, “An Anatomy of the World” (1611)).

This finding, if we wish to express ourselves in just a few words⁵, may be concluded from the following three propositions, which are proven in “Production of Commodities”:

P₁. In *single production* systems and when the real or nominal wage rate is exogenously given, the relative prices of commodities depend on the profit rate and the profit rate depends on the relative prices of commodities. Consequently, the profit rate is determined “through the same mechanism and at the same time as are the prices of commodities” (Sraffa, 1960, § 4. See also §§ 10-12).

This entails two things. *Firstly*, contrary to what Jevons and Walras argued in their notorious critiques of the Ricardian theory of value, it entails that the Ricardian method of determining prices and the distribution of

4. It is however true that the innovative nature of the book was not immediately perceived. This is illustrated by a book review by R.E. Quandt in the *Journal of Political Economy* (1961, 69, p. 500): “The author remarks in the Preface that the opening propositions in this slim volume were worked out in the 1920’s, while most of the remainder was completed in the 1930’s and 1940’s. It might be inappropriate to judge this book from the point of view of current thought on the theory of production... In the light of the voluminous modern literature on input-output analysis and activity analysis, the *raison d’être* of this book becomes tenuous. The mathematical notation is cumbersome and some of the verbal arguments are unnecessarily difficult. This reviewer has not found in the book any reference to any work on economics written after 1914. Although this is a quite remarkable work for the 1920’s, it comes thirty-five years too late”.

5. For a detailed elaboration, see Robinson, 1970, Kurz, 1985, Salvadori and Steedman, 1985, Garegnani, 1990, Kurz and Salvadori, 1995, Ch. 1 and 14, 1998, pp. 1-21 and 235-275.

income is *complete*, i.e. it does not present a degree(s) of freedom⁶ (let it also be noted that Sraffa determines, although, as we shall see later, not exhaustively, those production technique conditions which ensure that the determined prices of commodities are economically significant, i.e. strictly positive⁷: see Sraffa, 1960, §§ 14-15, § 35, n. 1, Ch. V, § 49, §§ 70-71, *Appendix B* and the correspondence between Sraffa and P. Newman, which was published in Bharadwaj, 1970, pp. 150-160). Consequently, the said determination does not presuppose the incorporation of additional “explanatory factors, that were not directly observable, such as agents’ preferences” (Kurz and Salvadori, 1998, p. 9). *Secondly*, it entails that the neoclassical attempt to determine the profit rate in terms of supply and demand with regard to the services of the “capital factor of production” is highly contentious (see also Sraffa, 1960, § 7). This is so because the said attempt presupposes (logically) that the quantity of the “capital factor of production” is a *price magnitude* which is independent of the profit rate, while, as Sraffa proved, the profit rate and the prices of commodities (and therefore *each price magnitude*) are determined “*at the same time*”.

P₂. Even if the technical conditions of production are unchanged, successive increases in the profit rate lead to fluctuations (i.e. to non-monotone

6. As is known, the refutation of this argument (“It is clear now that the English economists are completely baffled by the problem of price determination; for it is impossible for I [= the interest charges laid out by the entrepreneurs, in the course of production, to pay for the services of capital] to determine P [= the aggregate price received for the products of an enterprise] at the same time that P determines I. In the language of mathematics, one equation cannot be used to determine two unknowns”, Walras, *Eléments*, Lesson 40, § 368) formed the core of Dmitriev’s first essay, [1904] 1974.

7. In contrast with Sraffa, Dmitriev, [1904] 1974, does not come up against this problem, precisely because he uses an ‘Austrian’ model (i.e. there is no commodity that enters, directly or indirectly, into its own production and thus no commodity is *basic* à la Sraffa, 1960, § 6) in the determination of production prices.

However, not only from the fact that in the first part of his first essay he uses, in order to determine the labour values of commodities, a model with basic and non-basic commodities, but also from certain of his observations regarding the possibility of zero production prices appearing (see Dmitriev, [1904] 1974, pp. 67-9), it could, *perhaps*, be deduced that Dmitriev eventually uses an ‘Austrian’ model, because he had sensed the existence of the aforementioned problem (or had tried, unsuccessfully, to solve it). It should be noted, however, that nor does he investigate the related problem of positiveness of labour values (see “Hawkins-Simon conditions”).

changes) of the relative prices of commodities.⁸ One is dealing, *in addition*, with changes whose direction is not a priori known, i.e. predictable: “The reversals in the direction of the movement of relative prices, in the face of unchanged methods of production, cannot be reconciled with *any* notion of capital as a measurable quantity independent of distribution and prices.... [Therefore, it is impossible to find] an independent measure of the quantity of capital which could be used without arguing in a circle, for the determination of prices and of the shares in distribution” (Sraffa, 1960, § 48. See also §§ 19-20 and Sraffa, 1962, pp. 478-9).

Neoclassical theory maintains that the profit rate is determined by the “marginal product of the capital factor of production”. The *impossibility*, however, of finding a *measure* of the quantity of capital, which is independent of prices and distribution implies that determination of the “marginal product of capital” which is independent of prices and profit rate is equally impossible. Consequently, the profit rate cannot be determined by the so-called “marginal product of capital” and it is thus shown that the neoclassical theory of distribution is completely unfounded.

P₃. When the economic system has at its disposal alternative production techniques, nothing can rule out the appearance of the following situation: A technique, which is characterised by relatively low ‘capital intensity’, is the most profitable (or, equivalently, the cost-minimizing technique), both at relatively low and at relatively high values of the profit rate (Sraffa, 1960, Ch. XII – now known as the ‘reswitching phenomenon’). Put differently, nothing guarantees the existence of an inverse correlation between the profit rate and ‘capital intensity’, which neoclassical economists founded on the basis of the aggregate production function and, consequently, the changes in the proportions of the inputs used by the system cannot be correlated *unambiguously* with the changes of the ‘factor prices’.

This first of all means that in reality the aggregate production function, the main analytical tool of the neoclassical, is not only non-existent but cannot even be used for heuristic purposes⁹. It further means (see Garegnani,

8. As is known, the necessary condition for this to happen is the production of more than two commodities. But even if two commodities are produced, the price intensity of capital of the system is not necessarily inversely related to the profit rate (see, for example, Mainwaring, 1974, 1978).

9. For a number of efforts to prove the opposite and their incorrectness, see Bidard, 1991, pp. 85-93.

1970, 1978, p. 72) that the neoclassical attempt to determine the profit rate in terms of supply and demand with regard to the services of the “capital factor of production” is inherently groundless, since the “demanded quantity of capital” may constitute either a strictly increasing function of the profit rate (in which case the system is characterised by unstable equilibrium) or a non-monotone function of the profit rate (in which case the system is characterised by the existence of multiple, stable and unstable, points of equilibrium). Consequently, it is impossible for the profit rate not only to be determined quantitatively, but even to be *interpreted* in a neoclassical manner, i.e. as the “price of the service of capital”, which reflects the “scarcity” of this “factor of production”. Thus, the orthodox theory is deprived of the basis of its formation. Lastly, it means that an entire series of neoclassical propositions (concerning theory and economic policy¹⁰) has no general validity or even meaning.

Typical examples of such propositions are the following: 1. An increase in the profit rate entails an increase in the relative prices of those commodities, the production of which is “capital-intensive”, the reduction of the “capital-output ratio” and the reduction of consumption per unit of labour employed. 2. Because the reduction of the price of a “factor of production” entails the increase in the used quantity of that factor per unit of output, it follows that the increase in employment presupposes the reduction of the wage rate.¹¹ 3. The elasticity of the “wage frontier” equals the ratio of the relative shares of capital and labour. 4. The pattern of international specialisation and the effects of international trade are determined *completely* by the technological conditions of production, consumer preferences, the initial endowments of the national economies with all “factors of production” (labour, capital and land) and the distribution of property rights among individual agents. 5. In conditions of perfect competition, free international trade entails the existence of positive gains for all participants and –if the participants have the same technology and

10. For an analytical investigation of the *significance (and relationship)* of Sraffa’s book for (with) issues of economic policy, see Bharadwaj and Schefold (eds.), 1990, Part III (and particularly the article by A. Roncaglia).

11. For the refutation of this proposition within the framework of a model for the investigation of the problem of effective demand in the short period, see Kurz, 1990.

specialisation is not complete– international equalisation of “factor prices”.¹²

In addition, because, for example, the “quantity of capital” changes with the profit rate, it follows that the order between the “capital intensities” of the particular industries may change with the profit rate, *even if* the technical conditions of production are unchanged. Consequently, the notion of “capital intensity” independent of prices and distribution *has absolutely no meaning*.

As conclusively proven within the framework of the works which inspired Sraffa’s work, the final conclusion drawn from the above-mentioned proofs is the following: the fundamental propositions of neoclassical theory, with regard to both “closed” and “open” economic systems, hold only in special cases which have no economic meaning. More specifically, and leaving aside those cases which hold coincidentally (e.g. at only certain values of the exogenously given variable of income distribution), their validity presupposes that: a) there are no produced means of production, or b) produced means of production exist, but the profits on the value of those means of production are equal to zero, or c) the said profits are positive, but the system produces only one, single or composite, commodity, which is used as a means of production and consumption.¹³ So, it may be deduced that the

12. The first article on the so-called neoricardian theory of international trade was written by Parrinello, 1970 (however, see also Brahmanand, 1963, pp. 144-151). The refutation of the relevant propositions of the traditional theory and the setting out of the basic propositions of the neoricardian theory was elaborated in Steedman, 1979, 1979a.

13. The first two restrictive conditions had been partly identified, but not exhaustively analysed (regarding this, see Steedman, 1979, Ch. 1, 2 and the articles of Steedman and Metcalfe contained in Steedman, 1979a), by Samuelson, 1953-54.

The third condition, despite what was initially maintained by Samuelson, 1962, was clarified by Garegnani, 1970 (and further by Salvadori and Steedman, 1988, p. 485). Lastly, it is worth noting, as shown recently by Kurz and Salvadori, that in certain of the models of the so-called “new growth theory (NGT)” (P. Romer – R. Lucas) it is not possible to make the aforementioned criticism of neoclassical theory, *precisely because they display a logical structure similar to that of classical theory*: «... when workers get a part of the surplus, the quantity of labour employed in each industry has to be represented explicitly, and the profit rate and the prices can be determined only if an extra equation determining income distribution is introduced into the analysis. The additional equation generally used by advocates of neoclassical analysis is the equality between demand and supply of “capital”, which requires the homogeneity of this factor. But no extra equation is required in the NGT, since, as in Ricardo and in §§ 4-5 of Sraffa’s book, there is a technology producing “labour”» (Kurz and Salvadori, 1998, p. 85 – see also Salvadori, 1998).

analysis of the *capitalist economy* is impossible on the basis of neoclassical notions (see also Harris, 1975) and that a return is necessary to the consideration of classical economists and of Marx, i.e. to the consideration of the existing mode of social production as a system of production of commodities and profit by means of commodities (including the labour-power commodity, the price of which is the nominal wage rate).

II. The Extensions of “Production of Commodities”

It is not always easy for one to classify all that has been written about “Production of Commodities” (or is indirectly related to it), into that which –without questioning its logic– elaborates on certain of its points and into that which constitutes a critical analysis. As representative examples of the particular points in Sraffa’s book which have been further elaborated, one may cite the following:

1. The investigation based on the notion of the sub-system of production (à la Feldman, [1928] 1964, pp. 176-83 and Sraffa, 1960, *Appendix A* – see also Pasinetti, 1973), of both the quantitative relations between the labour values of commodities and their prices of production as well as of the so-called “price Wicksell effects” (Pasinetti, 1977, Ch. V, *Appendix*, Parys, 1982, 1986, Stamatis, 1988, pp. 85-91, 1998, Vouyiouklakis and Mariolis, 1992, pp. 175-183, pp. 23-4, Bidard, 1991, Ch. V, – see also Bidard and Steedman, 1996).

These investigations should be taken as an extensive commentary on the sixth part of the first chapter of Ricardo’s *Principles*, on chapters 9-12 of the third volume of *Capital* and on the third and sixth chapters of Sraffa’s book.

2. The algebraic determination and economic interpretation of those factors, which determine the form of the function between the nominal wage rate and the profit rate (Miyao 1977, Abraham-Frois and Berrebi, 1978, 1989, 1997, Ch. 3, 5, Baldone, 1980, Vassilakis, 1982, Stamatis and Dimakis, 1981, Stamatis 1984, Ch. IV, V, 1998, Salvadori and Steedman, 1985, Steedman, 1988, pp. 92-3, Kurz and Salvadori, 1995, Ch. 4, 1998, pp. 123-147, D’Ippolito, 1996, p. 57, Mariolis, 1998, 1999b, 2000a).

As is known, within the framework of the analysis of Sraffa, the determination of *absolute* prices of commodities requires the introduction into the model of a normalisation equation of relative prices. Through this equation, the price of an arbitrarily selected bundle of produced commodities

(: *normalisation commodity*) is exogenously set equal to an arbitrarily selected positive constant and, in this way, money is mapped onto the model, as the substance of prices and as a medium of expression of exchange values of commodities.¹⁴

The above-mentioned examples of further elaboration constitute the logical continuation of Chapters IV-V and of Appendices A, B of Sraffa's book because, *firstly*, they prove that apart from Sraffa's "Standard commodity" there are, in the general case, also other commodities (*which may also contain non-basic commodities*), which when they function as normalisation commodities entail a linear relation between the nominal wage rate and the profit rate and, thus, *secondly*, they conclusively clarify the relations which exist between the "Standard commodity" and Ricardo's search for an "invariable measure of value". Lastly, these examples of elaboration contribute to the further critical analysis of neoclassical theory, since they prove that –apart from certain trivial cases, which they identify– the slope of the "factor price frontier" is not equal to the "aggregate capital-labour ratio", but to the slope of the function of profits (per unit of labour) of the *normalisation sub-system*. That is, of the sub-system that produces the normalisation commodity as its net product.

3. The determination and identification of the dual relationships which exist between the prices of commodities and the technical conditions of production (Schefold, 1976, Bidard, 1991, Ch. V, Bidard and Salvadori, 1995, Kurz and Salvadori, 1995, Ch. 6, Mariolis, 2003).

These relationships enable the complete determination of the differences between the "Austrian" and the Sraffian consideration of the production technique structure of the economic system, considerably

14. The dimension of the said positive constant is units of *fictitious money* per unit of normalisation commodity. It should be clarified that the numéraire of Walras is a normalisation commodity, which functions at the same time also as fictitious money and which is measured both as a normalisation commodity and as fictitious money by the same measure (for an analytical investigation of the role of the normalisation equation in economic theory, see Stamatis, 1984, Ch. II, V). It should be noted, lastly, that with the introduction of the normalisation equation, also introduced to the system is a "principle of conservation": the shift from an equilibrium position, due to the autonomous change of one of the distribution variables, will cause, with respect to direction and breadth, such a change in the other variable, that the price of the normalisation commodity remains constant and equal to the above-mentioned positive constant.

facilitate the algebraic treatment of all the issues referred to in the immediately preceding points (e.g. “Wicksell effects” or conditions of existence of normalisation commodities of Miyao), as well as those which have historically been associated with the so-called “Cambridge Controversy” (e.g. determination of the “maximum number of switches” between two techniques).

4. The issue of choice of technique in systems of single and joint production, fixed capital and existence of an extensive and intensive rent (Mainwaring, 1975, Abraham-Frois and Berrebi, 1981, Steedman, 1982, 1994, Stamatis, 1984, Ch. IV, d’Autume, 1988, Schefold, 1989, Parts I and II, Bidard, 1990, 1990a, 1991, Ch. VII and Part II, 1997, Kurz and Salvadori, 1995, Ch. 5 and 7-9, 1998, pp. 259-275, Mariolis, 2000a, 2000b, 2002a).

These examples of elaboration first of all broaden the criticism of neoclassical theory (e.g. it is shown that the existence of fixed capital disproves the positive correlation between income per capita and capital per capita, even if only one commodity is produced). In addition, they investigate the *non one-to-one* (in the general case, i.e. if the existence of non-basic commodities or joint production is not ruled out) methods of determining the most profitable technique, which (methods) co-exist in Sraffian approaches to the problem and which consist in the criterion of cost-minimisation (Sraffa, 1960, §§ 92-3), on the one hand, and in the criterion of maximisation of the real wage rate, at a given value of the profit rate, on the other (Sraffa, 1960, § 94 and 96). Lastly, debate is focused on the role of the composition of demand, which is ipso facto neutral (with respect to income distribution and prices) in linear systems of single production¹⁵ and which Sraffa approaches in a manner which is extremely open to discussion in the case of joint production (Sraffa, 1960, § 50, n. 2). It is therefore shown that in joint production, an –independent of demand– determination of the most profitable technique i.e. the set of operated methods of production, the number of which *may be smaller* than the number of produced commodities), of prices and of distribution is, in the general case, impossible.

15. It is usually said that this property of single production systems is expressed with the validity of the well known “non-substitution theorem”. Relatively recently, it was pointed out (Stamatis 1993, Appendix, Kurz and Salvadori, 1994, 1998, pp. 90-99, Mariolis, 2000a, 2000b) that when there are non-basic commodities, this theorem may not hold, without, however, this implying that prices are dependent on demand.

5. The investigation of the cases in which: a) the composition of the consumption of workers and of capitalists is not uniform (hence, the equations for determining prices and physical quantities are no longer independent and, consequently, consumption per capita is not necessarily negatively related to the growth rate of the system – Hosoda, 1990), b) the returns to scale are not constant (hence, the rule of negative correlation of variables of distribution, even in systems of single production, ceases to hold, while, additionally, the issue of the choice of technique becomes considerably more complex – Mainwaring, 1979, Steedman, 1980), c) it is not assumed that capacity is fully utilised in the economy (hence, the issue of effective demand is placed at the focal point of analysis and the increase in the profit rate may presuppose the increase in the real wage rate – Dutt, 1987, Kurz, 1990a, Ch. 8-10), d) there is no uniform profit rate in the system (hence the issue is raised of whether and under what conditions this is formed – Egidi, 1975, Steedman, 1984, Flaschel and Semmler, 1986, Franke, 1987, Boggio 1992), e) because of the existence of exhaustible and renewable natural resources or the introduction of technical innovations, the system is not characterised by “stationary” prices (hence, the application of the long-period method becomes groundless – Kurz and Salvadori, 1995, Ch. 12).

III. The Intrinsic Limits of “Production of Commodities”:

Determination – Interpretation – Importance

Now in contrast, there have been numerous attempts to criticise “Production of Commodities”. We believe, however, that the majority of these attempts are based on misconceptions and/or *are not immanent* (we use the term in the sense given by Goldmann, 1959, Part I). As representative examples of critiques, in which the aforesaid two characteristics co-exist, we can cite those of Hahn, 1982 (for its refutation: Duménil and Lévy, 1985 – see also Kurz and Salvadori, 1998, pp. 235-58), Burmeister, 1984 (for its refutation: Kurz and Salvadori, 1987) and all those based on the shape of the wage rate-profit rate curves (*w-r* curves) that correspond to certain national economies: “Furthermore, it should be clear that attempts to disprove reswitching in terms of wage-profit curves constructed from input-output data for different years... are fundamentally mistaken. Leaving aside data problems and the conceptual difficulties concerning the required “translation” of empirical “facts” into the categories of analytical framework,

the finding that the w-r curves associated with the techniques of 1988 and 1993, for example, do not possess several switch points cannot be considered an empirical counter-example to reswitching, since the latter refers to the technical knowledge *at a given moment of time*" (Kurz and Salvadori, 1998, p. 247).

In our view, however, what is important is the formulation of an immanent critique of "Production of Commodities", i.e. a critique, which would identify and interpret its *intrinsic limits*. Below, therefore, we shall set out this critique along its general lines.

From what we are in a position to deduce, according to the *logic* of Sraffa (as well as of neoclassical theory), the discovery of the content/meaning of prices and of the variables of income distribution presupposes the isolation of those quantitative factors which determine their level and variations¹⁶. Consequently, it should *begin with the quantitative determination* of price magnitudes within the framework of the most *realistic* possible models and, at the same time, disregard –as being, perhaps, too metaphysical– any question pertaining to the *interpretation*, not only of prices but also of the *substance of prices*, namely, money. *However, the application of the said logic does not always yield the desired results and thus gradually produces the terms for its refutation*¹⁷:

1. Not only in the case described by Sraffa, 1960, *Appendix B* (i.e. the maximum profit rate of the basic sub-system is *greater than* the maximum profit rate of the non-basic sub-system), but in *all the cases* where there are non-basic commodities, that enter (directly or indirectly) into their own

16. From this point of view, the following ascertainment of Pasinetti, 1977, p. 189, is very illustrative: "*The meaning of production prices* [...]... all prices are shown to be eventually reducible to dated quantities of labor. At least for single-product industries, there can be no doubt whatever on this point. Production prices are physical quantities of labor, weighted with the compounded rate of profit appropriate to their conceptual dates of application".

17. In that which follows, unless the contrary is explicitly stated, the existence is supposed, in order to avoid further burdening the presentation and without prejudice to generality, of single production and we are relying on Sraffa, 1960, §35, n.1, §39, n.1, §§56, 64, Zaghini, 1967, Akyüz, 1972, 1978, Berthomieu, 1975, p. 61, Egidi, 1975, Laibman and Nell, 1977, Pertz and Teplitz, 1979, Stamatis, 1979, Ch. II, 1984, 1988, 1998, Krause, 1981, Arena and Maricic, 1982, Vassilakis, 1982, Mainwaring, 1984, pp. 123-29, Catz, 1987, 1991, Mariolis, 1998, 1999b, 2000a, 2000b, 2001, 2002.

production, there appear (without it being possible to rule them out or reject them) zero, negative, indeterminate and tending to infinity prices of produced commodities. There appear, that is, *prices of produced commodities, which are economically insignificant*.¹⁸

Precisely as a consequence of this 'paradoxical' situation, the *relative prices* of basic to non-basic commodities appear to be *dependent on the composition of the normalisation commodity* (which, as pointed out by Vouyiouklakis and Mariolis, 1993, constitutes a sui generis breach of the validity of the "non-substitution theorem"): it is possible for a ceteris paribus change in its composition to change the said *relative prices* from indeterminate to zero prices. In addition, if the maximum profit rate of the basic sub-system is *smaller* than the maximum profit rate of the non-basic sub-system, the nominal wage rate is equal to zero and the normalisation commodity includes at least one non-basic commodity, then Sraffa's system of equations gives *two solutions*: one entails positive prices for all the commodities and a profit rate equal to the maximum profit rate of the basic sub-system, while the other entails zero prices for all the basic commodities, positive prices for all the non-basic commodities and a profit rate equal to the maximum profit rate of the non-basic sub-system (In contrast, if the normalisation commodity includes only basic commodities, then the system gives only one solution and specifically the former of the two aforementioned solutions. The latter of the two solutions entails indeterminate prices for the non-basic commodities). Naturally, one could consider the latter of the two solutions to be unacceptable and, thus, keep only the first solution. However, if one examines those cases in which the maximum profit rate of the basic sub-system is *equal to or greater than* the maximum profit rate of the non-basic sub-system, one will ascertain that the solutions which one gets entail (depending on the composition of the normalisation commodity) either positive prices for the basic and indeterminate or negative prices for the non-basic commodities or zero for the basic and positive for the non-basic commodities. Thus, the solution which one had originally rejected now appears to be the only economically (quasi-) significant solution, while its rejection anew would lead, evidently, to the rejection of the existence of all

18. In systems of joint production and even if we include demand, it is possible for economically significant, but non-uniquely determined prices to appear. See Kurz and Salvadori, 1995, Ch. 8 and 10.

the production systems of non-basic commodities (with a finite maximum profit rate for the non-basic sub-system), something which is, of course, quite irrational.¹⁹

2. It entails cases in which a proposition (e.g. the uniform profit rate or the nominal wage rate of the system *is not dependent* on the technical conditions of production of the non-basic commodities) and its refutation (the uniform profit rate or the nominal wage rate of the system *is dependent* on the technical conditions of production of the non-basic commodities) appear to be equally true.

The initial proposition appears to be true, when and only when the normalisation commodity includes only basic commodities, while its refutation appears to be true when and only when the normalisation commodity includes at least one non-basic commodity.²⁰ However, because within the framework of Sraffa's model, the choice of composition of the normalisation commodity is arbitrary (and could not be otherwise – see also Sraffa, 1960, §56), it follows that the aforementioned propositions are, within the context of Sraffa's model, equally true.

3. When the maximum profit rate of the basic subsystem is *smaller than or equal to* the maximum profit rate of the non-basic sub-system, then, for a profit rate equal to the maximum profit rate of the non-basic sub-system, it is possible for the sign of the slope of the w-r curve to depend on the composition of the normalisation commodity. Specifically, when the normalisation commodity includes at least one non-basic commodity (only

19. Following what Sraffa maintained within the framework of his correspondence with P. Newman, Pasinetti, 1977, p. 109, tends to consider the case of *Appendix B* of Sraffa, 1960, to be *unrealistic*. Thus, according to this logic and what we referred to above, one should treat *all the cases* of the existence of non-basic commodities, that enter into their own production, as *unrealistic*. It is however worth noting that Pasinetti himself, 1977, Ch. 7, § 5.4, when treating the complications entailed by this case for the model of J. v. Neumann, does not refer to its unrealistic nature, but first attempts to analyse it within the limits of the model and subsequently to determine its possible repercussions for the real economic world.

20. Steedman, 1984, p. 133 and in particular Kurz and Salvadori, 1995, pp. 105-6, refer explicitly to this phenomenon, but do not interpret it.

basic commodities), then the slope of the w-r curve may be *positive*²¹ or, *respectively, equal to zero* (negative).

4. The determination of the most profitable technique by means of the criterion of cost-minimisation (Sraffa, 1960, §§ 92-3) and the determination of this by means of the criterion of maximisation of the real wage rate (Sraffa, 1960, § 94 and 96) always lead to the same result when and only when the normalisation commodity includes at least one non-basic commodity.²² Lastly, the classification of techniques (with respect to their profitability) may depend on the composition of the normalisation commodity, since a change in the said composition may yield a change in the economically quasi-significant interval of the profit rate (i.e. the interval on which the prices of commodities and the nominal wage rate are semi-positive).

How is it possible to interpret these *unexpected*²³ *results*²⁴ and what is

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21. Whether it is positive depends also on the composition of the inputs of the system in direct labour, a property which, as is known (see Bidard, 1991, Ch. IX and pp. 136-8), is considered to characterise only systems of joint production and fixed capital.
22. The following wording is equivalent: when the normalisation commodity includes (does not include) a non-basic commodity, the introduction of a cost-minimising method of production of a non-basic commodity entails a change in the distribution of income (does not entail a change in the distribution of income, but leads to the reduction of the prices of certain or all of the non-basic commodities). For the significance of this situation for the theory of international trade, see Mariolis, 2000b.
23. Kurz and Salvadori, 1998a, p. 416, quite correctly note that an objective property of the economic system under consideration “*must be totally independent of the numeraire adopted...* On the contrary, the numeraire is chosen by the observer at his or her will and is not related to an objective property of the economic system, apart from the obvious fact that the numeraire must be specified in terms of valuable things (e.g. commodities, labour) that are a part of the economy that is being studied” (emphasis added).
24. Sraffa, 1960, *Appendix B*, correctly interprets the appearance of economically insignificant prices by the assumption (postulate) of the existence of a uniform profit rate (we may add here that through this assumption, see Mariolis, 2000a, the aforementioned (in footnote 15) non-validity of the “non-substitution theorem” is interpreted). If, however, we assume that the basic and the non-basic sub-system are characterised by different profit rates, then, firstly, the profit rate of the non-basic sub-system (hence, also the prices of the non-basic commodities) will not be possible to be determined endogenously, and, secondly, the profit rate of the overall system will depend, evidently, on the technique of the non-basic sub-system (something which conflicts with the basic position of Sraffa, 1960, which is first set out in § 6), *as well as* on the composition of the system’s output. On the other hand, Sraffa does not explicitly refer to the complications, which arise from a *ceteris paribus*

their underlying importance for economic theory? Clearly, the crucial point with respect to their interpretation consists in the precise determination of the nature of the w-r curve (i.e. in the identification of this curve). The w-r curve exists, however, only after the addition of the normalisation equation to the system of the determination of the relative prices. As we have already noted, it is through the normalisation equation that money too is introduced (i.e. mapped) into the model, *as the substance of prices and as a medium of expression of exchange values of the commodities*. Laibman and Nell, 1977, p. 880, had observed that the w-r curve constitutes a *contour line*, while Parys, 1982, pp. 1210-11, had determined with clarity the importance of the normalisation sub-system for investigating the relationships between labour values and production prices (Laibman and Nell, 1977, pp. 880-1, refer to this sub-system as the “numeraire sector”, but do not insist further on this point). Indeed, the analytical examination of these issues (Stamatis, 1984, Ch. IV, 1988, Mariolis, 1998, 1999b, 2000a) shows that the w-r curve depends exclusively on the technical conditions of production of each chosen normalisation commodity (of course, in order for a w-r curve to be independent of the technical conditions of production of a sub-set of commodities, the system must also produce non-basic commodities) and, to be precise, that the w-r curve constitutes a *contour line*, which expresses, solely and exclusively, the *normalisation sub-system*.²⁵ For precisely this reason, when, for example, the

change in the composition of the normalisation commodity. However, a comparison of footnote 1 of §35 and of footnote 1 of §39 shows that he had sensed the existence of the issue. We surmise, therefore, that his unshakeable conviction regarding the so-called priority and independence of the basic sub-system (a conviction emanating from Ricardo and Bortkiewicz – see Pasinetti, 1959-60, p. 85, n. 2) prevented him from raising and dealing with it.

25. Although it had on many occasions been pointed out in the literature, no interpretation had been given as to why, even if only basic commodities are produced, the intersection points of w-r curves, which correspond to production techniques differing by more than one method (see, for example, the case of “merger production” and take into account Steedman, 1979, pp. 32-3, 150), depend on the composition of the normalisation commodity. The answer is, now, clear: they are dependent, precisely because the w-r curve constitutes a *geometric locus* which expresses the normalisation sub-system. In other words, by means of w-r curves it is normalisation sub-systems that are necessarily compared and not techniques, and consequently the aforementioned dependence is only to be expected (see also the relevant discussion between Stamatis, 1993, and Erreygers, 1994, Kurz/Gehrke, 1994, and the Stamatis’s, 1998a, counter-reply).

nominal wage rate is exogenously given and the normalisation commodity includes only basic commodities (includes also non-basic commodities), a change in the technical conditions of production of the non-basic commodities does not lead (leads) to a change in the profit rate. The profit rate, that is, does not change (changes), precisely because the technical conditions of production of the normalisation sub-system are not affected (are affected).

It follows directly from the above that the prices, profit rate and nominal wage rate which are determined within the framework of the Sraffian model: a) are the prices, profit rate and nominal wage rate of the normalisation sub-system, which –because the existence has been supposed of constant returns to scale, a uniform price for all units of a commodity, a uniform profit rate and a uniform nominal wage rate– appear (and hold) as the corresponding magnitudes of the overall production system under consideration²⁶, and b) are –always and necessarily– expressed in terms of fictitious and, above all, *non-neutral* (as a measure of the exchange values of commodities) money. Consequently, all the fundamental and derivative (e.g. capital intensity, productivity of labour and the so-called composition of capital) price magnitudes which are determined do not constitute (it is not logically permissible for one to consider that they constitute) –albeit approximate– *isomorphous mapping* of the corresponding price magnitudes which are formed within the real world. This, without refuting any point of the already existing criticism of neoclassical theory, means that Sraffa’s contribution to the analysis of relationships existing in the real world between prices,

26. It is worth noting that something analogous holds in Dmitriev and in Charasoff. As one may ascertain, Dmitriev [1904], 1974, pp. 58-62 (Charasoff, 1910, Ch. X) does not determine the profit rate of the overall technique or system, but rather the profit rate of that sub-system, which produces as net (gross) product the real wages of the system (a bundle of commodities, which has the same composition as the inputs, in means of production and wages commodities, which are necessary for its production). However, because the existence has been assumed of a uniform profit rate, the profit rate determined in the aforementioned way appears (and holds) as the profit rate of the overall system. Naturally, if the maximum profit rate of the non-basic sub-system is finite, then it is possible also for these methods of determination to lead to economically insignificant solutions for the prices of certain commodities (or to lead to the economically unreasoning rejection of certain feasible solutions). See Stamatis, 1988a, Kurz and Salvadori, 1995, pp. 387-90, Mariolis, 2001.

distribution and technology, should probably be considered to be limited and must certainly be checked and further elaborated. It also means that within the context of the positivist, logical-empirical, Sraffian analysis, the fundamental issue for economic theory, i.e. the issue of interpreting real prices and real money, can not only not be solved but can not even be raised. *And how can one possibly hope to raise, let alone solve this issue, when one insists exclusively on a system of determination in which prices –with the exception of the technical data of production– are determined by prices?* This ‘vicious circle’ was certainly known, not only to Marx, 1968, Ch. V, but also to Ricardo, 1951, Ch. I, Parts IV-VI, and it exists precisely because the system of prices is linearly homogeneous with respect to the price of the labour-power commodity or, when the real wage rate is exogenously given, the prices constitute an eigenvector (thus the prices are uniquely determined *up to a factor*) of the matrix of the inputs in means of production and wages commodities per unit of commodity produced (i.e. of the so-called augmented matrix of inputs). In other words, this ‘vicious circle’ exists precisely because within the context of the system for determining prices, the substance and the measure of prices are not *endogenously defined* (and nor is it possible, subsequently, for them to be determined).

All this, of course, cannot but serve to underline the extreme importance of the Marxian theory of value-surplus value and money, as theory which has full awareness of the seriousness of the aforementioned ‘enigmas’, but also solves them (or, at least attempts to solve them) by showing that price, money, wage and profit constitute *necessary forms of appearance of certain social contents*. Specifically, that price and money constitute, respectively, the necessary forms of appearance of value and of abstract social labour (which is the substance of value), while the wage and profit constitute, respectively, the necessary forms of appearance of paid and unpaid labour.²⁷ And it is precisely on the basis of these proofs that Marxian theory teaches that the capitalist mode of production, while *necessarily appearing* (and therefore

27. Although there is no general agreement on the content of these concepts, it is generally accepted that these concepts and their relationships form the core of Marxian theory. My positions on the issue, which differ from traditional positions (first and foremost from the approach to values of commodities as quantities of labour “embodied” and, therefore, from the traditional content of the concept of abstract social labour) are set out in Mariolis, 1999, 1999a, 2000, 2001, 2002, 2003.

being perceived) as a system of production of commodities and profit by means of commodities, *in reality* constitutes a system of production of commodities and profit *by means of human labour*.

In the history of economic science, there are cases of critical treatments, the corollaries of which are entirely different to those which were initially sought. Thus, Solow, did not solve (as he himself believed) the “instability problem” which had been manifested by Harrod’s well known growth model, but in reality showed that, under certain assumptions, all the equilibrium (by construction) growth paths of the system converge in the long run to a unique steady-state growth path (see, for example, Abraham-Frois and Berrebi, 1995, Ch.I.). In addition, Samuelson, in his attempt to prove, through a “surrogate production function”, that the corollaries of the traditional theory hold (also) in the general case, in reality (as clarified by Garegnani, 1970 and by Salvadori and Steedman, 1988) showed that the breadth of validity of the said corollaries was extremely limited. Without a doubt, “Production of Commodities” is not one of these cases. However, on the basis of what has already been noted, it should be stressed that Sraffa’s contribution is not limited to a critique *and* transcendence of neoclassical theory. He also allowed (admittedly in an imperfect manner) the insuperable limits of his own logic to emerge. This is the logic that has prevailed to date, which is expressed by self-restraint in the construction and solving of models for the determination of price magnitudes, the relations of which, however, to reality, which they supposedly describe, can only be inscrutable. Forty years later, one cannot say that Sraffa’s *three contributions* have been equally understood and further elaborated. To the extent, therefore, that the issue of interpreting and mapping prices and money remains open, the process of developing models for determination, which under no circumstances should be underestimated, remains without foundations.

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