

Produced quantities and returns in Sraffa's theory of normal prices: textual evidence and analytical issues

Fabio Ravagnani*

University of Rome 'La Sapienza'

In *Production of Commodities* Sraffa provides a rigorous formulation of the classical theory of value and distribution. In accordance with his earlier reconstruction of the basic features of the classical approach (1951) he takes as independent variables: (i) the outputs of the various commodities, (ii) the methods available for producing those outputs, (iii) one distributive variable, and demonstrates that with this set of "data" the exchange ratios of commodities, as well as the residual distributive variables, can be determined univocally and in an economically significant way. In this theoretical framework, no distinction is made between the price of a commodity entering the production cycle as an input and the price of the same commodity considered as an output at the end of the process. To use a concise expression we may say that the theoretical prices are assumed to be "constant" over the production period.

Let us now consider the position of the economy defined by the circumstances (i)-(iii) above, with the relative prices and values of the distributive variables resulting from the equations of production. How should this position be interpreted? A widely accepted viewpoint relies on a passage of *Production of Commodities* where the author identifies his theoretical prices with the "natural prices", or "prices of production", of the old classical economists (Sraffa, 1960, § 7). It is accordingly argued that the prices obtained from Sraffa's equations are to be interpreted in the same way as those determined by Smith, Ricardo or Marx, i.e. as the exchange ratios which would tend to prevail, in conditions of free competition, when the produced quantities of the different commodities conform to the respective "effectual demands". This in turn implies that the whole theoretical position has

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to be conceived as a *normal* position, aimed at defining a centre of gravitation for the prices and quantities of the actual economy (cf. *e.g.* Garegnani, 1990a, p. 132; Mainwaring, 1984, pp. 12-13; Caravale, 1985, p. 185, and 1988, pp. 1337-38; Mongiovi, 1991, p. 719, n. 3; Kurz and Salvadori, 1995, pp. 4-5, 416-17).

It has to be said, however, that even the scholars adhering to the above interpretation are not unanimous in the assessment of Sraffa's contribution. In particular, different opinions appear to be held as to whether the notion of normal position defined in *Production of Commodities* - characterized as it is by "constant" prices - should be confined to the situations wherein the produced quantities or the methods in use are strictly invariant in time, or constitutes instead an appropriate tool for a general analysis of value and distribution.

This paper intends to stimulate further discussion on the matter by examining Sraffa's own views and the analytical issues originated by them. Thus section I provides textual evidence showing that Sraffa considered the classical normal position to be compatible with a tendency of the produced quantities to change in time, although he did not dwell on the question of how the mentioned "constancy" of the relative prices can be reconciled with that tendency in the absence of any restriction on returns. Section II identifies two alternative attitudes one can adopt with respect to the evidence reported and the related analytical issue. On the one hand, one could take that evidence fully into account and try to clarify the foundations of Sraffa's views. On the other hand, there is the route taken by many current renditions of the classical theory of value, which in a more or less implicit form appear to question those views, and in some cases decidedly advocate a "dynamic extension" of the analysis. Both routes are discussed in the paper. It is argued that while there seems to be no obvious reason for denying the applicability of Sraffa's theory of normal prices to nonstationary economies with "variable returns" (section III), it is dubious instead that a satisfactory dynamic analysis may be developed in a classical context (section IV). Throughout the paper the argument will be referred to the simplified case of single production and overabundant resources examined in the first chapters of Sraffa's book, so that the controversial problems arising under more complex conditions will not interfere with the basic issue under consideration.

I

We may begin our discussion by examining the relevant features of the economic systems analyzed in Part 1 of *Production of Commodities*. First of all it can be noticed that the assumption on the production conditions of the economy introduced in § 11 - the

hypothesis of "self-replacing state" - is entirely compatible with the presence of strictly positive net outputs of capital goods. This fact deserves to be stressed, since, under the abovementioned interpretation asserting the coincidence of produced quantities and "effectual demands", we are forced to presume that the surpluses of means of production appearing in the theoretical position will have to be demanded by one or more industries in order to increase production in the future.

Moreover, in the footnote appended to § 3 the author qualifies the argument of the first two chapters of the book by making clear that the analysis extends to all kinds of "viable" economies. And since viability allows for the presence of *negative* net outputs of capital goods, the reader may legitimately conjecture that the theory also applies to situations in which some industries are not fully replacing their stocks of means of production, and will accordingly tend to *contract* their production levels. This conjecture is indeed confirmed by Sraffa himself in a comment to Harrod's review of *Production of Commodities* (Sraffa, 1962). We may recall here that Harrod focused on the introductory example of a subsistence economy with two industries, producing "wheat" and "iron" respectively,¹ and concluded that the exchange ratio of those commodities would be ultimately determined through a sort of reproduction principle. The repetition of the production processes on unchanged scale, he noticed, requires in fact that the quantity of wheat exceeding that necessary for rebuilding the wheat industry's stocks be exchanged for the analogous excess of iron (Harrod, 1961, p. 783). In the first part of the comment, however, Sraffa rejects this conclusion and states that in his theory the relative prices are determined by the equations of production, and not by Harrod's principle. To substantiate this assertion he imagines modifying the introductory example of *Production of Commodities* by arbitrarily altering the proportion in which wheat and iron are produced, so that the resulting system of production will necessarily display a surplus of a commodity and *a deficit* of the other. Then he points out that with the new system of production obtained in this way - which is obviously incompatible with an exact repetition of both production processes - the equations of production continue to determine the relative price (and a profit rate equal to zero) precisely as in the original case. Here Sraffa is definitely mentioning a theoretical position of the economy which cannot be associated with a stationary state.²

A careful reading of the assumptions formulated in *Production of Commodities*, and of the comment published in 1962, reveals therefore quite clearly that Sraffa did not intend to confine the classical notions of normal position and normal prices to the particular

¹ Sraffa, 1960, § 1.

² For a wider discussion of this part of Sraffa's comment cf. Ravagnani (2000).

cases wherein the physical surplus is entirely allocated to households for consumption purposes, but extended those notions to the more general situations in which net outputs (deficits) of means of production are present, and the production level accordingly tends to grow (to be contracted) in one or more sectors. Sraffa's theory of normal prices thus appears to be quite open as to the direction in which the individual sectoral outputs may tend to evolve. Furthermore, this feature of the theory cannot derive from an assumption of strict invariance of the production methods with respect to activity levels ("constant returns to scale"), as Sraffa states from the outset that his analysis never depends on that assumption.

Sraffa's views about the applicability of the classical concepts of normal position and normal prices may however give rise to the following issue. How can one refer to "given" quantities and "constant" prices, in the positions of the economy wherein the presence of surpluses (deficits) of capital goods entails a tendency of outputs to change in time and constant returns to scale are not postulated? Should it not be admitted that under those circumstances the technical coefficients would tend to change and the relative prices would vary accordingly?

In the rest of the paper we shall discuss different answers to this issue. Before moving to that, however, it is worth stressing that the question under discussion arises within the strict domain of Sraffa's price theory, and has therefore nothing to do with other relevant economic problems that are not examined in *Production of Commodities*. In particular, it has nothing to do with the study of the determinants of produced quantities (effectual demands) or with the analysis of the evolution of those quantities over time.

II

Returning now to our specific topic, two alternative attitudes can be adopted with respect to the evidence reported and the related analytical issue. The first and most natural one is that of recognizing that evidence and trying to clarify the foundations of Sraffa's views. The attitude that seems to have prevailed in the literature is however quite different, and can be illustrated here by making reference to Hicks's (1990) assessment of Sraffa's contribution. Hicks does not discuss Sraffa's views at all, but takes it for granted that the theoretical positions defined in *Production of Commodities* can only be regarded as abstract representations of *stationary* economies (p. 100). Starting from this premise, he then argues that in order to emancipate the analysis from the hypothesis of stationarity, the theorist should necessarily resort to a dynamic framework, i.e. he should consider the simultaneous evolution of the relative prices and produced quantities over a succession of

interrelated time periods. Finally, as a first step towards a general dynamic theory, he suggests that the analysis could conveniently start from the study of economies operating in conditions of constant returns and balanced growth: in this setting, Sraffa's equations would still have a useful role to play (*ibidem*).

Now, Hicks's assertions about the limitations of the classical normal position as an analytical tool may come as no surprise, given that in *Value and Capital* (1939) he had already criticized on the same grounds the traditional equilibrium notion of marginal theory.³ It has to be admitted however that a similar viewpoint is conveyed - at least implicitly - by many current renditions of Sraffa's theory, which in fact confine the analysis to economies that are either stationary or in balanced growth (cf. *e.g.* Pasinetti, 1977, ch. 5; Mainwaring, 1984; Bidard, 1991; Kurz and Salvadori, 1995). For the purpose of the present discussion it is particularly interesting to single out, from this group of contributions, the opinion of the authors who directly address the issue mentioned in the previous section. For instance, Kurz and Salvadori explain in the following way the restrictions introduced in their treatment of the classical theory of value and distribution:

"The analysis presented so far has been exclusively concerned with. . . long-period positions of the economic system characterized by 'stationary prices', with the price of a commodity obtained as an output at the end of the production period being the same as the price of that commodity used as an input at the beginning of that period. It has been indicated repeatedly, though, . . . that in order to exhibit this property, an economic system has to fulfill certain requirements. For example, . . . *in the presence of nonconstant returns to scale the system must be stationary. Otherwise, relative prices would have to change*".⁴

The authors thus seem to believe that an inconsistency would be inherent in the classical normal positions as defined by Sraffa, unless those positions relate to stationary economies or postulate constant returns to scale.⁵ They accordingly conclude that beyond those special

³ Although a close examination of the argument in *Value and Capital* indicates that a fundamental reason for the rejection of the traditional equilibrium concept can be traced back to Hicks's perception of the theoretical difficulties surrounding the notion of capital - difficulties, that is, which exclusively pertain to the marginalist approach to value and distribution (cf. Garegnani, 1976, p.).

⁴ Kurz and Salvadori (1995), p. 339, emphasis added. For a correct interpretation of the above quote, it should be noted that when the authors list the requirements the "economic system has to fulfill", they are not referring to the *actual* system, but to the idealized representation of the economy provided by the theory (Kurz and Salvadori, 1995, p. 1). Furthermore, it is clear from the context in which the passage is framed that the authors' critical remarks do apply to the simplified case of single production and non-scarce natural resources examined in this paper (cf. Ravagnani, 1998, for details).

⁵ The same objection is raised by Bidard (1990, pp. 127-28):

"Consider two consecutive periods 0 and 1 with three dates 0, 1 and 2 [and let A_t , l_t , B_t respectively denote the input matrix, the labour input vector and the output matrix for period t ($t=0,1$)]. The production conditions within period 0, as represented by (A_0, l_0, B_0) lead to the determination of the price vector p_0 solution to [Sraffa's equations] for these data. . . The price vector p_1 within period 1 is

cases a proper analysis should not be limited to a single period of time, but should consider instead "*the whole time path* of prices and produced quantities" (Kurz and Salvadori, 1995, p. 298, emphasis added).

From what has been said so far, it should clearly appear that a careful evaluation of Sraffa's views about the applicability of the classical concepts of normal position and normal prices has relevant implications for the direction in which current research in the field of classical economics should be oriented. It is therefore in a constructive spirit that we shall now submit some considerations concerning the alternative routes identified in this section. Given the complexity of the questions involved, we do not claim we will offer more than a reference framework for further discussion.

III

Let us begin by exploring the first route, i.e. let us try to reconstruct the possible foundations of Sraffa's views. To serve this purpose it will be useful to recall that, in the traditional conception of both the old classical authors and the founders of marginal theory, the abstract notion of normal position has a sufficiently definite empirical counterpart. That theoretical position is in fact conceived as a guide to the average levels of the prices and quantities of the actual economy, taken over a time interval long enough to allow the competition of capitals to manifest its effects, and furthermore to allow, through the repetition of transactions, for a compensation of the accidental factors that may influence the actual prices. This general conception has in turn some implications for the interpretation of the independent variables of the classical approach. In particular, the outputs appearing in a classical normal position will broadly correspond to the quantities of the various commodities demanded on average in the time interval which delimits the analysis. Moreover, the normal position will consider the production of those "average" quantities through the technique regarded as dominant in the same time span, and will therefore include a theoretical system of production to be taken as representative of the conditions which tend to prevail in the actual economy. Under this interpretation, the net outputs of capital goods in the "representative system of production" will basically reflect

similarly determined by the new data (A_1, l_1, B_1) . But [Sraffa's system of price equations] presumes that the price vectors at the beginning and at the end of the period are identical and, in a circular process of production, two different prices cannot be ascribed to the same good at date $t=1$, as it is considered an output in period 0 or an input in period 1. *If the physical data (A_0, l_0, B_0) and (A_1, l_1, B_1) differ, the uniqueness of the price vector at $t=1$ requires that their rows be proportional, which is a constant returns assumption*" (emphasis added).

Cf. also Bidard (1991), pp. 19-21, 30-31.

the average growth of the industries employing those commodities in the time interval under consideration. And in the same way, deficits of means of production will be a reflection of the *decline* of the sectors employing those commodities.⁶

Having so specified the nature of the relevant independent variables, we can move on to examine more closely the requirements that a theoretical position defined along Sraffa's lines must fulfill in order to qualify as a normal position (centre of gravitation). In this connection it can be argued that a consistent definition of a centre of gravitation is indeed compatible with some implicit tendency of the independent variables to change, provided this tendency can be considered sufficiently slow *relatively* to the forces that are supposed to engender the gravitation of the actual magnitudes towards their theoretical levels. Thus, in the context of classical theory, an appropriate definition of the normal position and normal prices does not require either the strict constancy of outputs or "constant returns to scale" in all industries. It only requires that the change in sectoral outputs inherent in the representative system of production be not so intense as to jeopardize, through an induced variation in the technical coefficients, the "persistence" of the independent variables in the time interval to which the theoretical position refers. Here it would seem that Sraffa tacitly *assumed* this requirement of persistence to be fulfilled also in the presence of surpluses (deficits) of capital goods.

Now, two distinct but complementary considerations can be advanced with regard to the assumption we are attributing to Sraffa.

First of all it has to be pointed out that, on purely logical grounds, the classical notion of normal position contains no feature contradicting the assumption in question - i.e., no feature forcing us to conclude that the change in sectoral outputs that may be implicit in the representative system of production, and any related tendency of the technical coefficients to vary, will be appreciable in the time interval which delimits the analysis.

⁶ Consider e.g. a hypothetical normal position including the following system of production, obtained by modifying the introductory example of *Production of Commodities* as indicated in Sraffa (1962):

$$\begin{array}{rcccl}
 224 \text{ qr. wheat} & + & 9.6 \text{ t. iron} & & 320 \text{ qr. wheat} \\
 90 \text{ qr. wheat} & + & 6 \text{ t. iron} & & 15 \text{ t. iron} \\
 \hline
 314 & & 15.6 & &
 \end{array}$$

According to the interpretation suggested in the text, this theoretical system could be taken as representative of the production conditions prevailing in the "actual" economy in a time interval characterized by a gradual decline in the social demand for wheat, accompanied by an induced contraction in the production of the other commodity required for cultivation, i.e. iron. The presence of a surplus of wheat and a deficit of iron in the representative system would then indicate that, in the interval under consideration, the produced quantity of wheat still tends to exceed that advanced throughout the economy (the excess being directed to the satisfaction of the capitalists' consumption demand) while the produced amount of iron, cycle after cycle, tends to be adjusted to the decreasing demand coming from the agricultural sector.

Note in particular that once the persistence of the outputs and methods has been assumed, the determination of the dependent variables cannot lead to results conflicting with that hypothesis. This absence of logical reasons for questioning the persistence of the "data" in the classical theory of value deserves to be emphasized, as it marks an important element of difference with respect to the version of marginal theory which has recently become most popular, that derived from Walras.⁷

Second, there is no evident reason for presuming that the assumption of persistent independent variables will prove untenable when the theory is applied to the study of real economic systems. To illustrate this point, let us return to the abovementioned correspondence between theoretical and actual magnitudes. We have seen that the surpluses (deficits) of capital goods in the representative system of production will be essentially a reflection of the growth (decline) of the different industries in the actual economy. This implies that, when the theoretical position refers to a time interval in which the growth (decline) of the various sectors remains comparatively limited, it could be legitimately assumed that the tendency of outputs to vary implicit in the representative system will itself be quite moderate. Moreover, under those conditions it could be reasonably postulated that this implicit tendency will not bring about appreciable modifications in the technical coefficients. For instance one could safely maintain that moderate increases in production levels will be insufficient to stimulate significantly the processes of division of labour that the classical authors identified as the mainspring of "increasing returns" - or, moving on to consider less pervasive phenomena, those "increasing returns to scale" due to the tridimensional nature of space which Kaldor (1972) emphasized in his critique of general equilibrium theory.

It seems therefore that in the applications of the theory the economist would be justified in assuming the persistence of the independent variables - and, more generally, in presuming that the theoretical position he has constructed qualifies as centre of gravitation - whenever that position relates to a time interval compatible with both: (1) a limited growth (decline) in the various sectors of the actual economy, and (2) a sufficient mobility of capitals and repetition of transactions. On the other hand, a determination of the normal position complying with the conditions just listed may prove viable in a wider range of situations than one could think. Indeed many would probably concede that an appropriate determination will be feasible when the investigation concerns phases of the actual

⁷ As is well-known, when Walras's equilibrium equations are modified by introducing the disequalities which ensure their consistency (cf. *e.g.* Morishima, 1964, pp.), the determination of the currently produced quantities of capital goods will typically contradict any hypothesis of persistence of the data (Garegnani, 1976, pp. 36-37; 1990b, pp. 21-22, 49-51).

economy characterized by low growth rates in the different industries, or by sectoral growth rates fluctuating around low central values. The underlying idea is that slow growth would plausibly allow for the consideration of a time interval fulfilling requirement (1) and being, at the same time, long enough to support the hypothesis of a sufficient mobility of capitals. It should be noted however that a proper determination of the normal position could in principle be feasible also in the opposite case, i.e when the investigation focusses on a phase of intense and protracted growth. The reason lies in the fact that when growth accelerates its pace, the flow of investment in *additional* capital goods will be necessarily larger, in proportion to the existing "stock", than in times of slow growth: and in so far as that larger flow will tend to be mainly directed to the most profitable branches of industry, it is conceivable that profit differentials across sectors could be corrected more quickly. A shorter time interval may accordingly suffice to justify the presumption of an adequate mobility of capitals, and by referring the theoretical position to that shorter interval it may be possible to reconcile condition (2) on capital mobility with the requirement (1) of "limited sectoral growth".

IV

In the light of the foregoing considerations, it does not seem at all obvious that Sraffa's determination of the normal prices is bound to encounter unsurmountable difficulties when applied to the case of nonstationary economies with "variable returns" - and it is therefore unwarranted that a dynamic extension of the theory be really *necessary* in order to deal with that realistic case. On the other hand, it is quite dubious that the proposed extension may be implemented without sacrificing distinctive aspects of classical analysis, and anyhow, there are reasons for doubting that it may provide an adequate tool for studying the economic systems of reality. As a matter of fact some of the problems arising in a hypothetical dynamic framework have already been identified in the literature, mainly in connection with the foundations of the theory of demand that would then be required (Garegnani, 1990a, p. 131), or with the necessity of introducing the agents' subjective expectations among the determinants of prices (Kurz and Salvadori, 1995, p. 341). In what follows we shall focus instead on two additional sources of difficulties which are less frequently discussed.

Let us first wonder on which data an intertemporal reformulation of the theory should be based. In this respect it is important to notice that the circumstances taken as "given" in the classical approach are subject to a considerable degree of mutual dependence. This feature of the approach has been recently stressed by Garegnani, who has also

suggested how that interdependence could be taken appropriately into account in the analyses of economic change founded on the traditional method of comparing normal positions (Garegnani, 1987, pp. 564-65; 1990a, p. 130). By contrast it seems dubious that a dynamic model may satisfactorily deal with the interactions among produced quantities, distribution and methods. To give a hint of the difficulties that arise we can briefly refer to the model of von Neumann, which is often regarded as a fundamental starting point for the dynamic extension of classical theory. As is well-known, this model assumes that the real wage be fixed at a subsistence level which does not change from period to period, and furthermore that the set of available production methods be invariant with respect to activity levels and over time. Now, the first assumption could be provisionally justified through an hypothesis of unlimited availability of labour force, both in the present and over the whole future, coupled with the classical conception of competition in the labour market (high and protracted unemployment does not cause an indefinite fall in wages, but tends to keep them at the minimum level compatible with workers' survival). It is plain however that as soon as the awkward hypothesis on labour availability is dropped, one will have to admit that the expansion of economic activity is bound to affect the workers' bargaining position, and the assumption of a wage fixed at a constant subsistence level will accordingly become untenable. The theorist should then introduce some principle linking the wage rate to the evolution of produced quantities, but since the classical approach provides no foundation for a quantitative specification of such a principle, there is the risk that he will have to resort to an arbitrary formalization.

The same problem arises when von Neumann's second assumption is abandoned and the evolution of production methods has to be analyzed. Consider for instance the basic intuition of the old classical authors according to which the evolution of methods is influenced by the extent of the market. Formally this influence could be incorporated into a dynamic model by assuming that the set of methods "expands" as demand and production increase, in the sense that additional, superior methods are made available. The model should accordingly include among its data a distinct specification of the available techniques for any hypothetical output vector but, again, it is difficult to see on which basis this could be plausibly done by the theorist. After all, even the engineers' evaluations about the possibility of modifying *current* methods in order to achieve higher production levels proved unreliable on many occasions, and were at times patently disconfirmed by the direct experience of entrepreneurs inclined to take risks.⁸

⁸ The Japanese steel industry during the fifties and sixties provides an instructive example. It is reported by Gold (1974, 1981) that under the pressure of a rapidly increasing demand for steel, and without any careful experimentation, the Japanese managers decided to operate blast furnaces of a dimension much bigger than

Finally it has to be said that the relevance of the proposed extension remains doubtful independently of the difficulties just mentioned, as it is not easy to imagine which correspondence may be established between the prices resulting from the analysis and those we observe day-by-day on current markets. In general terms it seems hardly disputable that the theory of value cannot account for the prices observable at any particular moment, as these may be affected by a myriad of accidental factors, but can only provide a guidance to the average levels of actual prices as emerging from a repeated activity of production and exchange. However the dynamic extension faces a problem with regard to the latter task, because the *dated* prices of an intertemporal model are not easily related to averages of actual prices taken over a sequence of activities. Consider for instance the different exchange ratios the model attributes to the same commodity seen as an input at the beginning of the production period (time t) and as an output at its end (time $t+1$): it is unclear how one could meaningfully draw, from the series of transactions associated with a repeated production cycle, a pair of distinct "average prices" providing an empirical counterpart for those theoretical ratios. On the other hand, lack of clarity about how the dating of prices might be reconciled with a repetition of activities can only prompt an alternative interpretation of the theoretical prices as exchange ratios ruling at separate *instants* in time, which in turn would prevent any significant correspondence with the observable prices. In this situation one could repeat for the intertemporal reformulation of classical analysis the same warning included in a recent, authoritative assessment of the perspectives of general equilibrium theory:

"the risk. . .seriously exists that the discipline. . .loses touch with real problems [and] develops on its own into a scholastic".⁹

that recommended by the world's leading experts, the U.S. engineers. This bet against the prevailing technical view proved indeed successful and was justified later on by the managers on the grounds that "[i]f demand is great enough, it is worth taking the risk of increasing scale" (Gold, 1974, p. 11). As a matter of fact the case reported by Gold, with the fundamental role played by the subjective attitude of entrepreneurs in the specific situation, does not only document the difficulty of assessing in quantitative terms the prospective impact of substantial demand increases on the availability of methods. It also reveals how ill-founded would be to suppose that the methods suitable for production levels much higher than current ones, though partly unknown in the present, could still be regarded as "given" in the sense that they objectively exist in Nature and will be automatically discovered when the larger production is planned.

⁹ Malinvaud (1991), p. 66.

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