

# On the present state of the capital controversy

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## 1. Introduction

The post-war capital controversy seems to have had two distinguishable stages. Thanks to the unambiguous phenomena of reswitching and reverse capital deepening, the first stage was conclusive in discarding from pure theory the traditional versions of neoclassical theory relying on the notion of capital as a single quantity. Subsequently, however, when the implications of those phenomena came to the centre of the controversy, together with the reformulations of the theory, which intended to do away the ‘quantity of capital’, several misunderstandings prevented, I shall contend, decisive progress in the analysis and we entered an inconclusive phase of the discussion.

Those unclarified misunderstandings, I shall also contend, have then left space for the credence that, whatever their methodological deficiencies, the reformulations of neoclassical theory that have been introduced in the theoretical mainstream—essentially by Hicks’s *Value and Capital* (1939)—and which have become dominant after the first stage of the capital controversy, are immune of the inconsistencies affecting previous theory on the conception of capital. This has in turn left space for a second, no less unwarranted, consequence: a feeling that since those reformulations, and in particular general intertemporal equilibrium, would confirm at the level of pure theory the essential validity of the neoclassical demand-and-supply apparatus, they would also provide some validation for the admittedly imperfect previous concepts—foremost that of a ‘quantity of capital’—as workable approximations in applied work.

To gain an understanding of the situation just outlined, it may be necessary to take a wide view of the problem, starting from the essential role that the notion of capital as a single magnitude played in originating neoclassical theory by extending the Malthusian theory of rent to cover also the division of the product between wages and profits, which classical economists had explained by a surplus principle. It is, in

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fact, the double essential role of providing (i) a foundation for the central neoclassical conception of general substitutability among ‘factors of production’ and (ii) a notion of equilibrium that makes a correspondence between theory and observation possible.

This double role will allow us to confirm, in the face of some conjectures recently advanced, the essential nature of Sraffa’s critique of the neoclassical notion of capital and, more generally, of his contribution in *Production of Commodities* as comprising a rejection of the neoclassical explanation of a market economy and an opening to the alternative surplus explanation provided by the English classical economists.

Returning, then, to our main line of argument, we shall recall in Section 4 the essential terms of the difficulty of capital in neoclassical theory—i.e. the impossibility to conceive that quantity independently of the distribution and prices it is brought in to determine—and we shall examine the way out of the problem, as influentially proposed in Hicks’s *Value and Capital* (1939), based on Walras’s old conception of capital as a physical vector of capital goods. That conception, which had gained little following in mainstream theory during the six decades since it was first advanced, will then be considered by us with the radical changes it renders necessary in the notion of equilibrium. They are the changes characterising the neoclassical reformulations that we earlier noted came to the centre of the post-war capital controversy in its later phase.

We shall then be able to proceed to the misunderstandings that, we shall contend, have marred that second phase of the controversy and which, we shall claim, characterise the present state of the controversy. We shall there refer to the argument developed elsewhere (Garegnani, 2000, 2003), according to which those reformulations of neoclassical theory also ultimately depend on the notion of capital as a single quantity, the same, as we just said, found indefensible at the level of pure theory in the early stage of the controversy.

## 2. The quantity of capital and its neoclassical role

A preliminary observation may be useful in order to get a grasp of the role of the conception of capital as a single quantity at the origin of neoclassical theory. The observation is that from the point of view of their owners, capital goods, however heterogeneous, are in fact perfect substitutes in proportion to their values.<sup>1</sup> As Walras had lucidly pointed out nearly 150 years ago, capital goods are demanded by savers as elements of the single commodity that he called ‘perpetual net income’.<sup>2</sup> It is indeed the single commodity whose existence we imply when we assume competitive arbitrage to tend to realise a uniform ‘effective’ rate of riskless return on the price of such goods.<sup>3</sup> The reciprocal of that rate is in fact nothing but the price of that Walrasian commodity: if the interest rate is 10%, the value of a ‘perpetual net income’ of one pound is 10 pounds. This definition

<sup>1</sup> Thus, for example, Bliss (1975, p. 8) rightly notes that capital ‘cries out to be aggregated’. He does not however seem to notice the very simple reason for that, i.e. the *homogeneity* of capital goods for a decisive category of agents: the savers.

<sup>2</sup> Walras (1954, paragraph 242, pp. 275–6). The internal logical conflict that the notion of capital poses for neoclassical theory is indeed well exemplified in Walras who, on the one hand, so clearly saw capital as the single value commodity demanded by savers and, on the other hand, realised the need for a physical measurement of capital in production.

<sup>3</sup> The *adjective* ‘effective’ is used here in order to remind the reader that this kind of uniformity of returns on capital is quite compatible with, and indeed *requires*, a ‘nominal’ difference between the commodity’s own rates of interest, once changes in relative prices over the period of the loan are considered in the equilibrium (see footnote 26 below). In that case it is in fact only the *numerical expression* of that uniform *effective* rate that will differ depending on the numeraire adopted, not unlike what happens generally with a numeraire price.

assumes constancy of prices and the rate of interest over an infinite future, but little changes in that conception if—more in keeping with contemporary intertemporal equilibrium, its finite horizon and its changing prices—we refer at any time  $t$  to the ‘income for next year’ and to the price of a (gross) unit of it, i.e.  $1/(1 + r_t)$ .<sup>4</sup>

Now, it is the notion of the quantity of this single commodity, thus rooted in the experience of the wealth owners and of the firms in which they invest, that has evidently been a key to the passage from the first to the second of the two broad approaches. These approaches, at the cost of severe simplifications, can be said to have successively dominated economic theorising since its systematic inception: the classical and then the marginalist or neoclassical approach to the theory of distribution and relative prices.

We do not need a detailed distinction between these two broad approaches.<sup>5</sup> The first approach, in order of time, is the classical one and centres on the conception of a social surplus that the community can dispose without infringing on the possibility of reproducing its outputs on a constant scale. It is the idea that—with wages linked to the subsistence of workers and therefore conceived as a necessity for social reproduction no less than the means of production are—underlies the theory of distribution and relative prices, running from the physiocrats down to Marx via Adam Smith and Ricardo. The subsequent approach is the dominant neoclassical one, which, after a half-century of transition from classical theory, did crystallise in the ‘marginalist revolution’ of the last quarter of the nineteenth century. It is founded ultimately on the conception of substitutability between ‘factors of productions’ and on the demand-and-supply functions for factors and commodities, which are taken to result from that substitutability.

What requires deeper discussion is the sense in which I consider the notion of capital as the single Walrasian commodity ‘future income’ has been a key to the passage from the classical to the neoclassical approaches.

The marginalist or neoclassical approach arose essentially, we noted, out of the Malthusian theory of rent, which, when reformulated in terms of homogeneous land, could be extended to cover the distribution of the product among any number of ‘factors of production’ and, hence, in principle, also to the determination of the division between wages and profits—thereby replacing the notion of surplus product by which that division had earlier been explained. Now, that extension of rent theory had to be founded essentially on arguing a *variability* of the proportion between ‘capital’, the single Walrasian commodity, and labour (and the other non-produced factors) in social production in general, analogous to the classical variability of the proportion between labour (plus capital) and land in agriculture. It was a variability that had to descend from the alternative methods available for producing (directly or indirectly) the *same* consumption good, as well as from the methods available for producing *alternative* consumption goods.

The problem, however, was that the alternative production processes thus involved differed, generally, more by the *kinds of capital goods* used than by the *proportion to labour in which each kind of them was employed*. Changes in the labour proportion of the same physical capital goods may in fact be possible when producing the same commodity but, as intuition suggests, these changes will generate methods of production

<sup>4</sup> It is the price of a unit of *gross* income, because an amount  $\left(\frac{1}{1 + r_{t+1}}\right)$  out of that unit will have to be

set aside at the beginning of period  $(t + 1)$  if a similar unit of gross income is to be had in  $(t + 2)$ .

<sup>5</sup> Cf., e.g., Garegnani (1960).

that will be generally dominated by other methods employing different *kinds* of capital goods: a single proportion between physically specified ‘factors’ being generally the one that can dominate the other known methods of production of the commodity in question at some level of the distributive variables. And the same variability of the *kind* rather than the *proportion* of the capital goods will be even truer between production processes for alternative consumption goods.

The variability of the ‘proportion of capital to labour’ in social production on which the neoclassical theory of the division between wages and profits is founded could therefore have been hardly conceived, had not the different kinds of capital goods required by the alternative methods of production or by the alternative consumption outputs been viewed as embodiments of quantities of the homogeneous Walrasian value commodity, which, like a fluid, underlies the demand for capital goods by savers.

The fluidity of capital necessary in order to generalise classical rent to the division between wages and profits is, however, far from being the only or, perhaps, even the main point about the role of the single savers’ commodity in originating the neoclassical theory of distribution. Even more important, from a strictly analytical point of view, was the fact that such a notion allowed the expression of capital endowment—a *datum*, basically, in neoclassical theory, just as the population and the available land were for classical rent—in a way consistent with its homogeneity for savers.

I am referring here to the already-mentioned tendency, under free competition, towards a uniform effective rate of riskless return on the capital goods’ prices. This tendency can operate over any period of time, no matter how short, simply by means of the competitive arbitrage that will adjust the returns on relatively abundant capital goods to those on scarcer ones, by lowering the (*demand*) *price* of the former below their *supply prices*, thus raising their rates of return to the level of the scarcer capitals. But clearly these will be only *temporary* adjustments that will soon be followed by further adjustments requiring time. Those capital goods whose price (or demand price) when new had to fall below the respective supply price will not be produced; a tendency will be in operation at every time point to raise that price and therefore raise the rate of return on costs for those capital goods towards the common level. The strength of this tendency will perhaps appear more evident when we realise that it is one and the same thing, with the tendency to equality between the demand prices and the supply prices (costs of production) of the (non-obsolete) capital goods, not unlike the analogous competitive tendency for the prices of any other commodity.

This means that, for the purpose of the uniformity of returns—the traditional one of the competitive uniform ‘rate of profits’—the neoclassical intended generalisation of classical rent has to assume the physical composition of the capital endowment to be fully adjusted to the techniques adopted and outputs produced.<sup>6</sup>

<sup>6</sup> The uniformity of the rates of return on capitals’ supply prices of course excludes, as is generally done at the level of abstraction of the notion of normal price, the presence in the capital endowment of ‘obsolete’ capital goods—i.e. pertaining to methods of production presently dominated by other methods at *all* possible levels of the distributive variables. More embarrassing for a theory in which the capital endowment is a datum is the fact that the same uniformity of returns also excludes the presence in the endowment of kinds of capital goods that are not ‘obsolete’ in the sense above, but do pertain to methods of production other than those dominant at the prices of the equilibrium considered. (The question does not arise in Walras, who makes the special assumption that *all* methods require the *same kinds* of capital goods though in different proportions: but it reflects the general case and it reinforces the neoclassical need for capital as the single magnitude, which can take the form of any concrete capital good).

It has to assume, therefore, an *endogenous determination* of the physical composition of the capital endowment of the economy. But this is compatible with the basic neoclassical treatment of capital endowment as a *datum* only if the latter is conceived to be given only in terms of the fluid Walrasian commodity capable of taking any physical form.<sup>7</sup>

Without that uniformity of effective returns, the position of the economy as determined by the theory would have been no more *persistent*,<sup>8</sup> under free competition, than any position of the economy with, for example, different wages for labour of the same quality or with prices of products differing from their expenses of production—effects strictly analogous to those we have just seen for capital goods when the uniformity of returns does not hold under competition.

But, then, *why* this ‘persistence’, leading, as just seen, neoclassical theory towards the troublesome notion of the given capital endowment as a single magnitude? The fact is that to such a persistency has long been attributed nothing less than the possibility of ensuring *correspondence between theory and observation* in economics.

It was the role played, even across the deep divide between classical and neoclassical theories, by what we may indicate here as the ‘normal price’ or, more generally, the ‘normal position’ of the economy—the basis of economic theorising since, at least, Adam Smith’s notion of a ‘natural price’ as ‘the central price, to which the prices of all commodities are continually gravitating’ (Smith, [1776] 1950, book I, ch. VI, p. 51). The persistency of that normal price (or normal position of the economy) was in fact thought to allow for a *repetition of transactions* that, by occurring on the basis of *nearly unchanged data*, would generally suffice to compensate the temporary or ‘accidental’ deviations of the *actual* price from the *normal* price and thus allow the latter to generally correspond to an average of the actual prices prevailing over a sufficient interval of time.

Thus, in conclusion, it was certainly not for a matter of mere convenience or of mere simplification that capital endowment was taken as a given in terms of a *single magnitude*—a fact that characterised, with varying degrees of explicitness and with the single partial exception of Walras,<sup>9</sup> all mainstream expressions of neoclassical theory up to a few decades ago; up, that is, to the events we are going to discuss below. On that single magnitude there rested two key points of neoclassical theory: the plausibility of the notion of factor substitution lying at its very basis and, with the possibility of determining a ‘normal position’, that of a correspondence between theoretical variables and observable magnitudes—two points that, it would seem, were of primary importance to prevent the risk of the theory slipping into an intellectual game.<sup>10,11</sup>

<sup>7</sup> Cf., e.g., Hicks (1932A, pp. 20–1).

<sup>8</sup> ‘It is to the *persistence* of the influences considered, and the time allowed for them to work out their effects that we refer when contrasting Market and Normal price’ (Marshall, 1920, V, III, 6, p. 289; emphasis added). The question is discussed in Garegnani (2002).

<sup>9</sup> When discussing capital accumulation, however, also Walras referred to capital as a single quantity (1954, paragraph 242) inconsistently with his specification of capital endowments.

<sup>10</sup> It is the very risk to which Malinvaud appears to refer when he writes that ‘the risk seriously exists that economics loses touch with real problems and develops on its own into a scholastic’ (1991, p. 66).

<sup>11</sup> As we may expect from the homogeneity of capital goods for savers that will tend to be reflected in *any* theory of the market economy, classical authors also often tended to treat capital as a single magnitude. However, the absence of a theory of distribution founded on factor substitution with the resulting demand-and-supply apparatus exempted them from the above two needs for thus treating capital: Sraffa (1960) exemplifies this classical immunity to the problem.

### 3. On the nature of the contribution of Sraffa's *Production of Commodities*

The argument just conducted about the key role of capital as a single 'quantity' at the basis of the logical structure of neoclassical theory raises the problem, to which we shall proceed in Section IV below, that such a quantity does not exist in the terms independent of distribution and relative prices required by the theory, and that it accordingly has had to be replaced, at the level of contemporary pure neoclassical theory, by the very conception of capital as a set of distinct productive factors, whose incompatibility with a generalisation of classical rent we have just contended.

Before proceeding to that, it may however be noticed that the argument as so far developed may help to assess an interpretation of Sraffa's *Production of Commodities* (1960) as advanced by Professor Sen in a comparatively recent paper (2003), which contains some stimulating suggestions as to the Gramscian nature of Sraffa's influence on Wittgenstein's philosophy.

Professor Sen's interpretation of Sraffa (1960) accepts the prevailing view contrary to the one advanced here that neoclassical theory needs not be expounded in what he calls an 'aggregative form', i.e. with capital as a single magnitude, and that production may instead be analysed by referring only to the physical quantities of the several capital goods (Sen, 2003, p. 1246). Sraffa's critique of the neoclassical concept of capital as a single quantity would therefore be pointless, according to Sen, if meant to invalidate neoclassical theory as a 'predictive' theory, where that concept is inessential. Similarly, he continues, the critique cannot be intended to replace that theory with an alternative, equally causal, 'predictive' theory. Sraffa's critique must rather be viewed, Sen contends, as relating to 'interpretational' uses of the theory, which he describes as above all concerned with 'descriptive accounts of the capitalist system having a normative relevance' (ibid., p. 1247).

Clearly, if we have been correct above, the reference to capital as a single magnitude, far from being a particular analytically inessential 'description', or interpretation, of neoclassical theory, lies at the very conceptual roots of it. It seems, then, clear that the critique of the concept of capital, the single magnitude, can hardly be intended to leave standing the demand-and-supply apparatus of the theory and be addressed to only some interpretations of it, detachable, so to speak, from the basic causal, predictive nucleus of the theory. In other words, the critique raises the question of the validity of the theory in its predictive purpose and, if correct, cannot but pose the question of its replacement by a better theory in the same 'causal' or 'predictive' role.

This is suggested by Sraffa himself (1960, p. v) when he refers to the classical economists as having a standpoint 'submerged and forgotten' after the advent of the 'marginal method' and, therefore, a standpoint *alternative* to that which characterises that method. It clearly is the alternative standpoint based on the notion of surplus that Sraffa himself had outlined in his 'Introduction' to Ricardo's *Principles*, when interpreting Ricardo's early principle of the determining role of agricultural profits (Sraffa, 1951, pp. xxxi–xxxii)—the standpoint that was to be developed in *Production of Commodities*.

Sen's (2003) contention about the 'interpretational' nature of the contribution of *Production of Commodities* appears, however, to be based on a second and more basic kind of argument, besides the denial of the 'causal' relevance of Sraffa's capital critique of neoclassical theory. This second argument is essentially that which Sen had advanced already in a 1978 article on Marx's problem of the so-called 'transformation' of 'values' into 'prices of production'.

Professor Sen had referred there to Sraffa taking as data for his price equations both the real wage (or the rate of profits) and the output levels, for what Sen describes as a determination of prices which ‘does not specify anything about causation’ (Sen, 1978, p. 180). This is so, he argued, because by using those data ‘the exercise begins at too late a stage of price determination...to be of great use in making actual predictions about the future’ (Sen, 1978, p. 181).

Previously (Garegnani, 1991), I had already objected that what Sen saw as a different kind of ‘determination’ was only the result of an analytical structure of classical theory radically different from neoclassical demand and supply. As implied in the surplus scheme rediscovered and developed by Sraffa (1951, 1960), the classical authors had determined the division of the product between wages and profits by referring, essentially, to a wage governed by broad social and historical forces, such as those controlling the notion of subsistence in any given society, at its stage of development, or those summarised by Adam Smith’s ‘progressive’ or ‘declining’ state of that society. This is what we can readily find in reading Adam Smith and other classical authors on capital accumulation and distribution.<sup>12</sup> A consequence was that that left the wage and also the output levels free, so to speak, from any pre-defined functional relations with other parts of the system, relations such as those taken to constitute factor substitution in neoclassical theory. Thus, for example, output levels were left free of their neoclassical role as intermediaries of the kind of factor demand (and substitution) operating through consumption choices. Similarly, the wage was left free of any pre-defined functional dependence on alternative techniques and alternative outputs. This meant that it was natural for classical economists to determine both the real wage and the output levels *separately* from prices and other connected parts of the system—though not necessarily *independently* of them.<sup>13</sup>

It was that *separation* between the determination of the wage or the outputs from the rest of the system—made possible by the absence of the notion of factor substitution—that entailed, and explained, the treatment of the real wages and the output levels as givens when determining prices. With that separation, however, the system in no way lost its explanatory or, in Sen’s terms, ‘causal’ and ‘predictive’ meaning. To realise that it is sufficient to think—as I recalled at the time—of Sraffa’s hint to a determination of the return on capital via the rate of interest fixed by monetary authorities, or for another example at a somewhat less general level, of Sraffa’s view that a change in the technical conditions of production of a basic product would change all prices and the residual distributive variable, unlike a similar change for a non-basic product (Garegnani, 1991, p. 112).

#### 4. The neoclassical problem of capital

We may now return to neoclassical theory as such. In the generalisation of classical rent to cover distribution between wages and profits, the ‘quantity’ of that special ‘factor of

<sup>12</sup> It would be very misleading to point to Ricardo for a different, less historically and more analytically founded view on the matter. Ricardo essentially defers to Smith’s *Wealth of Nations* for the wider sociological context of his analysis, while himself concentrating on the strict analytical points in which he differs from Smith, essentially those concerning the determination of the rate of profits. That in no way entails that his view of the scope and method of economics essentially differs from those envisaged by Adam Smith, Marx and the other classical writers.

<sup>13</sup> In other words, the interdependencies of the outputs or the wage with the rest of the system were not denied, but rather implied to be too variable according to circumstances to allow for any useful generalised formal treatment of them involving a simultaneous determination of the system (cf., e.g., Garegnani, 1984).

production', capital—required, as we noted, to allow for substitutability between factors and for the possibility of a correspondence between theory and observation—had to be measured independently of the distribution of the product between factors and independently of the relative prices, which it was brought in to determine, just as the classical quantities of labour and land had to be similarly measured in determining rent. However, the commodity demanded by savers clearly is not *directly* measurable in any such independent terms, since its primary expression for savers lay, as we noted, in the *value* of the capital goods in terms of some numeraire. A basic problem of the new theory was, therefore, how to measure capital, the postulated single productive factor, in terms that would be both *independent of distribution*—as the value of the capital goods is not—and at the same time appropriately related to the value quantity on which savers do make their decisions.

The 'average period of production' over which labour and, more generally, non-produced factors of production have to remain invested in order to produce the commodity according to any given technique (i.e. a set of methods of production, one for the commodity and one for each of its direct and indirect means of production) was the route along which a conciliation of the two requirements was long attempted. It was, however, an impossible task because of the necessary presence of fixed capital, of the multiplicity of non-produced factors of production and, above all, of the necessity of the compound rate of profits in passing from the commodity to its indirect means of production.<sup>14</sup>

The impossibility of consistently defining a concept as basic for the intended generalisation of classical rent, as we just argued the 'quantity of capital' was, might conceivably have led to the abandonment of that intent in favour of some return to classical analysis, as had happened, for example, after the demise of the 'wages fund' theories. However, the principle of factor substitution and the ensuing demand-and-supply explanation of distribution had apparently been rooted too deeply in mainstream economic theory for them to be extirpated. Thus, the reaction was instead to apply the principle of factor substitution to each kind of capital good taken as a distinct 'factor', with little explicit consideration of the drastic difficulties that would arise for the theory, i.e. the difficulties that are the mirror image of what we noted in Section 2 had made the theory rest at its birth on capital as a single magnitude.

As we mentioned, Hicks's *Value and Capital* (1939) appears to have been the main influence bringing into the mainstream that tentative way out of the problem.<sup>15</sup> It was, in effect, a question of returning to the conception that Walras had advanced as

<sup>14</sup> Cf., e.g., Garegnani (1960, part I, ch. III; part II, ch. IV) for, respectively, the notion of the average period of production and its shortcomings from the viewpoint of neoclassical theory. See also Garegnani (1990, pp. 23–31).

<sup>15</sup> It is interesting to note that the above difficulties of the Walrasian conception there adopted are not mentioned in *Value and Capital*. This is so, despite the fact that at least the question regarding factor substitutability had been prominent in a 1932 debate between Hicks and Robertson (cf. Hicks, 1932B; Robertson, 1931), when both authors stressed the necessity that the 'capital' endowment be allowed to change form in order to give rise to marginal products and, more generally, to sufficient substitutability between factors. The point returned with force in the *Theory of Wages* (1932A, pp. 20–1) where, for example, Hicks contrasts the 'full equilibrium' marginal product of labour with the 'short period' one where the 'form', as well as the 'quantity', of the capital is said *not* to change; the latter marginal product is then dismissed as something that is very doubtful, if '[it] can be given any precise meaning which is capable of useful application'. This passage regards primarily the difficulty of factor substitution, but the contrast drawn here between the 'short period' marginal product of labour and the 'full equilibrium' one appears to also imply awareness of the second deficiency of the vectorial conception of capital, i.e. the non-uniformity it entails in the effective rate of return on the capital goods' supply prices.



early as 1877,<sup>16</sup> having initially failed to realise the inconsistency between it and the uniformity of returns on the capital goods' supply prices of the normal position (cf. Section 2 above), which he, like all his predecessors, contemporaries and successors until comparatively recent decades, had in fact originally intended to determine.<sup>17</sup>

The recognition by Hicks of Walras's inconsistency—a recognition that, however, remains altogether implicit in *Value and Capital*—meant that he had to accompany the adoption of that conception of capital with the abandonment of the normal position and its uniform rate of profits. But then, under competition, the tendency to such a uniform rate could but be supposed powerful and quick in bringing about appreciable changes in the prices of productive services and commodities. The *persistence* that justified the determination of the equilibrium while abstracting from changes in future prices could no longer be assumed, and the attempt had to be made to remedy that by considering the effect of future conditions on the markets for current commodities and productive services, whether through expectations concerning future prices or present markets for future commodities.

These were presumably the difficulties that, variously perceived and expressed, explained the remarkable fact that despite the fame of its author, and the well-known difficulties of the alternative conception of capital as a single magnitude, Walras's conception had failed to enter the theoretical mainstream in the six decades that had elapsed since 1877 when it was first advanced. Indeed, even Hicks's own adoption of it, with the associated 'dynamics' of *Value and Capital*, originally had a limited impact on the mainstream: it failed, for example, to attract attention in what was then the main centre of economic theorising, the Cambridge of Marshall, Pigou, Keynes or Robertson.<sup>18</sup>

It was, I believe, the emergence two decades later of the striking phenomena of reswitching of techniques and reverse capital deepening, advanced in 'preview' by Joan Robinson, that rendered finally untenable the notion of capital as a single factor at the level of pure theory and opened the way to dominance for a treatment of capital on Walrasian lines, with the associated necessary reformulations of the concepts of equilibrium—marking what I have contended is a deep 'Hicksian divide' in the evolution of neoclassical theory.<sup>19</sup>

With this we have in fact reached the heart of the post-war capital controversy and have joined it at what we indicated above as its later stage—when the defence of neoclassical theory was conducted in terms of the reformulations of the theory to which *Value and Capital* had opened the way. We might have therefore expected that at such a stage—i.e. after the admitted failure of the notion of capital as a single magnitude—the difficulties of those reformulations would, if not take centre stage, at least emerge with sufficient clarity to be debated. However, the terms in which the reformulations in question had been introduced in *Value and Capital*, some 20 years before, made it difficult for the controversy to focus on such central questions. For those terms, and difficulties, we must therefore turn back to *Value and Capital* and to those aspects of Hicks's argument, which, I submit, have been decisive for the inconclusiveness of the later stages of the controversy.

<sup>16</sup> See Walras (1877, pp. 568–9), reproducing the paper Walras delivered in July 1876 at the Société Vaudoise des Sciences Naturelles. The year 1877 is also the one in which Walras published the second instalment of the first edition of the *Elements* (1874 and 1877) containing his 'theory of capital formation'.

<sup>17</sup> Cf. Garegnani (1960, Part II, chs 2 and 3); see also Garegnani (1990, paragraphs 3–18).

<sup>18</sup> Of course the Walrasian conception of capital had been used by mathematical economists long before Hicks, with little notice of it being taken in the mainstream literature at the time, however. Wald (1936) is a good example of that.

<sup>19</sup> Cf. Garegnani (2002).

### 5. Hicks's *Value and Capital*

Despite its title, what we find in the foreground of the book is not in any direct way the problem of capital, but, rather, the claimed need for a 'dynamic theory', accompanied by a critique of what is there called the 'static theory' of 'the economists of the past' (Hicks, 1939, p. 115).<sup>20</sup>

However, it is striking that when we come to a description of what such a 'static theory' consisted of, we do not find the 'normal position' that was the mainstay of those 'economists of the past'. What we find for that 'static theory' are instead two kinds of equilibria, both quite different from the normal position though having something in common with it. The first, Hicks says, is what that static theory should have been if stated in a 'strict' way (1939, p. 115). It is represented by the equilibria analysed in Parts I and II of *Value and Capital*—those by which Hicks, in effect, replaces using a Walrasian vector of physical capital the previous notion of the capital endowment as a given single magnitude. Hicks has, however, to admit that those equilibria cannot be taken to represent the thought of the 'economists of the past' as that actually was.

For what Hicks attributes to 'those economists' in *Value and Capital* we must therefore turn to the second of the 'static equilibria' he mentions there. And there we find the *stationary position*: i.e. the position of the economy, where the *incentive* to net savings has disappeared (Hicks, 1939, p. 116). However, this is, again, a notion quite different from the neoclassical normal position, though it shares with the latter the assumption of prices constant over time. In the neoclassical normal position, the constancy of the capital endowment that, when taken together with that of the other data, results in a constancy of the equilibrium prices is merely an *abstraction* from the changes that the capital endowment and the other data are admitted to effectively undergo in the economy. It is an abstraction founded only on the *persistence* of the position and the consequent slowness of the change in its data, when compared with the time required to correct and compensate accidental deviations from the normal position, in particular the slowness of the only such change that can be construed to be endogenous to the marginalist system: that in the capital endowment.<sup>21</sup>

In the stationary position instead, as we noted earlier, the same constancy of the capital endowment is the endogenous result of an equilibrium condition of zero net savings, and the capital endowment is therefore an *unknown* of the equations and not the *datum* it is in the normal position.<sup>22</sup> And the same is true for the proportion of capital to labour and the resulting constancy of prices of the 'steady-state', which since the post-war period has become the form of stationary state most commonly contemplated in the analysis (see Section 6 below), where net savings are exactly what

<sup>20</sup> Cf. Garegnani (1976, pp. 31–6) for the traces of that deeper line concerning capital in Hicks's (1939) criticism of previous theory (cp. also footnote 23 below).

<sup>21</sup> As, for example, Marshall wrote: 'if we are considering ... the whole of a large country as one market for capital, we cannot regard the aggregate supply of it as altered quickly and to a considerable extent' (Marshall, 1920, VI, II p. 443).

<sup>22</sup> Hicks's identification of the normal position with a stationary one was made easier by the frequent use, at the time, of the term 'stationary' to also indicate the normal position, because of its abstraction from changes in relative prices. However, Lionel Robbins (1930) had already lucidly clarified that ambiguity by his distinction between the 'static' and 'stationary' position of the economy. Hicks's attribution to 'the economists of the past' of a proper stationary state, and not of a normal position wrongly named stationary, is on the other hand made entirely clear when he writes that, in the stationary position of those economists, the 'quantity of intermediate products—the quantity of capital—will be determined through the rate of interest ... fixed at a level which offers no incentive for net saving or dissaving' (Hicks, 1939, p. 118).

is required to equip with that same proportion as the labour already employed, the increment of labour.

The paradox of *Value and Capital* is thus that in its account of the ‘usual course of economists in the past’, we do not find the hallmark of that ‘usual course’, down to Hicks’s own *Theory of Wages* (1932A): namely the normal position. That disappearance of the normal position entailed then, in *Value and Capital*, a second and even more striking paradox: it is that we do not find in there any specific criticism of the normal position of those economists—the very position that Hicks in fact proposes to reject and replace by his dynamic theory. The only criticism of that position remains the generic one of the lack of realism of assuming the constancy of prices in the definition of an equilibrium. It is a criticism that would have been more convincing if ‘previous theory’ had rested, as it clearly did not, on either Hicks’s ‘stationary states’ or on the fleeting equilibria of Parts I and II of *Value and Capital*.

In fact, the dependence of current prices on future prices was all but overlooked by those ‘economists of the past’—starting from Adam Smith and his dichotomy between ‘market’ and ‘natural’ prices, down to all later theorists until recent decades. To the extent to which the expected prices reflected merely accidental circumstances, or the undoing of those circumstances, their effects could be ignored in the relevant general context because they would be averaged out into the *normal price* through the repetition of transactions allowed for by the persistency of the normal position. And to the extent to which the expected prices expressed, instead, changes in the *data* of the normal position, they would be dealt with by the comparison between the corresponding two normal positions: the one before and the one after the change in question.

The real point behind the alleged past oversight of price changes—a point that remains, however, altogether implicit in *Value and Capital*<sup>23</sup>—was that the *persistency* allowing for the abstraction from those price changes had been made possible in the equilibria of past neoclassical theory by the treatment of the given capital endowment as a single magnitude, capable of adjusting its physical form. And this is just what the Hicks of 1939, as distinct from the Hicks of 1932, knew could not be done. The normal positions had therefore to be replaced by the ‘static equilibria’ of *Value and Capital*, whose fleeting character made the attempted remedy of dated prices and quantities all but inevitable. It thus appears that the ‘dynamics’ proposed in *Value and Capital* was the *effect* of an enforced change in the conception of capital from the single quantity to the physical vector, rather than the *cause* of that change, contrary to what Hicks seems to imply in his foreground argument in his 1939 book.

This explains, I believe, why Hicks and the neoclassical mainstream after him had to contradict and leave aside Marshall’s penetrating dictum—which Hicks certainly knew very well, but failed to directly criticise—according to which ‘dynamical solutions in the physical sense of economic problems are unobtainable [and] static solutions afford starting points for such rude and imperfect approaches to dynamical solutions as we may be able to attain’ (Marshall, 1898, p. 39).

<sup>23</sup> Except perhaps for what may be read into the following passage: ‘Of course people used to be able to content themselves with the static apparatus because they were imperfectly aware of its limitations. Thus, they would often introduce in their static theory a “factor of production capital” and its price interest supposing that capital could be treated like the static factors ... That some error was involved in their procedure would not have been denied’ (Hicks, 1939, p. 116 n). We are not told, however, what that ‘error’ was exactly. (Cp. also for a highly misleading account of the past difficulties in the measuring of capital, the quotation in the preceding footnote).

## 6. The capital controversy and the present situation

The disappearance of the normal position from Hicks's (1939) argument was, however, to weigh heavily on the controversy of 30 years later. The eclipse of that notion had a series of effects on the controversy, which, I submit, converged in obscuring beyond recognition the basic terms of the question of capital in neoclassical theory.

That eclipse meant, first of all, the disappearance of the most transparent form of dependence of neoclassical theory on capital as a single magnitude, namely its ultimate use as a datum for determining the normal position. That made the previous neoclassical use of that notion a confused bone of contention rather than the simple historical fact it was.<sup>24</sup> It also made it much more difficult to discern the role that the conception of the 'quantity of capital' plays at the very logical roots of the theory. As a result, and most importantly now, it made it difficult to grasp the *continuing* dependence on that conception of the reformulations of neoclassical theory that were being advanced in the later phase of the controversy, relying as they had necessarily to do on a sufficient degree of factor substitution—a continuing dependence of which more will be discussed presently.

Moreover, the disappearance of the normal position was made more complete by the associated disappearance of what used to be the key long period condition under free competition: the traditional uniform rate of profits—i.e. the uniformity of the effective returns on the capital goods' supply prices or costs (in other words, the equality between demand-and-supply prices for the non-obsolete capital goods)—ensuring the persistence of the position and the possibility of its correspondence with observation.<sup>25</sup> Thus, when that condition was referred to from the critical side in order to explain the rationale of the normal position and its neoclassical dependence on the capital endowment as a single fluid fund, that rationale was generally not understood and the condition was even confused at times with the altogether different condition of a uniformity in the commodity's *own rates of interest*, a condition that, however, is a mere synonym of assuming a constancy of prices in defining the equilibrium.<sup>26</sup> Further, these unclarified misunderstandings caused confusion at the outset of the discussion, which was made even worse by a tendency to see the neoclassical dependence on the notion of a 'quantity of capital' as pertaining to the empirical construct of an 'aggregate production function' purporting to represent the output of the whole

<sup>24</sup> Cp., e.g., 'It seems to me impossible (as a matter of intellectual history) to maintain that the possibility of perfect capital ... aggregation is a neo-classical doctrine' (Hahn, 1982, p. 354). It is, however, at least equally difficult to envisage an intellectual history in which, say, Böhm Bawerk, J.B. Clark, Pigou, etc. could use an 'aggregation' of capital whose possibility they did not admit.

<sup>25</sup> It is significant and again somewhat paradoxical that Hicks's revival of Walras's theory of capital in Parts I and II of *Value and Capital* went together with the total disappearance there of Walras's own equations of 'capital formation' (Walras, 1954, Lesson 23), which contained the condition of uniformity of returns as well as the relation equalising the demand and supply of 'net perpetual income' (see Section 2 above), i.e. in today's terms, savings and investment. That disappearance left a serious gap in the static theory of Parts I and II of Hicks (1939) into which we cannot, however, enter here.

<sup>26</sup> For a telling example of this confusion, see the discussion in Garegnani (2003, pp. 153–4) of a passage in Hahn (1975), in which he used the above uniform rate of return referred to by critics in order to characterise the 'special neoclassical case' to which, in his opinion, Sraffa referred. Now, Hahn saw that case as one in which 'the equilibrium price of a good for future delivery in terms of the same good for current delivery will be the same for all goods' (Hahn, 1975, p. 360). Clearly the latter is the case of uniform commodity-own rates of interest, i.e. constant prices, which is quite compatible logically with any divergence between rates of return on capital supply prices, with which it has in effect nothing to do. Similarly, the effective uniformity of the latter rates contradicts the uniformity of the *own* interest rates whenever price changes over time are considered in the equilibrium (cf. footnote 3 above).

economy as a single homogeneous aggregate, produced with a ‘capital’ homogeneous to it. Used for Solow’s 1956 simplified neoclassical answer to the long-term problems raised by Keynes, that notion was an initial target of criticism from some critics. Taken in isolation, however, that target was misleading, as it risked turning an inconsistency at the foundations of the neoclassical idea of a generalised ‘factor substitutability’ into difficulties pertaining only to an admittedly unrigorous approximation; therefore, it is presumably absent when the several productive sectors are distinguished in a general equilibrium system. It was thereby overlooked that the inconsistency was there, *whatever the number of sectors we might wish to distinguish in the economy*. In fact, the essence of the neoclassical problem of capital is not at all aggregation versus general equilibrium, but, if anything, one about *two kinds* of general equilibria: the traditional one based on normal positions, exemplified by, say, Wicksell ([1906] 1962) or even by Walras (as far as his original intentions went), versus the Hicksian one that renounces such positions in the attempt to avoid capital as the single magnitude.

If the *disappearance* of the normal position as such in *Value and Capital* had those effects of obscuring in the later stages of the controversy the essential terms of the neoclassical problem of capital, the *misinterpretation* of the normal position as a stationary state, which has been the cause of its effective disappearance, has had important *direct effects* on subsequent pure theory even beyond its indirect effects of obscuring the capital controversy. It did that by most authors taking for granted the Hicksian charge that the static method of ‘previous theory’ was inapplicable to the ‘real world’ (Hicks, 1939, p. 315) and that the kind of dynamics Hicks was propounding was, in one form or another, the only alternative to it, at the level of pure theory. In that way, Marshall’s conclusions noted above were neatly overturned in practice, with no critique of them being in effect advanced (see Section 5 above). Hence the paradox of the rejection as unrealistic of a past analysis, which was in effect based on the very tool, the ‘normal positions’, that economic theorising had developed since its very beginning in order to allow for the possibility of a correspondence between theory and observation in an enormously complex field of reality. This rejection had a second paradoxical consequence: that of in effect obscuring the *true undermining* of that possibility of correspondence—the one resulting from Hicks’s *own* proposal, i.e. from the impermanence of the new equilibria and the resulting dynamics, seen as the only alternative to an analysis founded on mere stationarity.

That *real* undermining of the applicability of the theory was indeed the one that Hicks himself had implicitly admitted when, in a little-quoted passage of *Value and Capital*, he had written that he assumed ‘the economy to be always in equilibrium’ (1939, p. 131), an assumption that should have shocked the readers of *Value and Capital*: no economist had previously supposed the economy to ever actually *be* in an equilibrium position, or more generally in a position of rest, except by fluke:<sup>27</sup> *gravitation around such positions*

<sup>27</sup> This assumption, to which Hicks is in effect led by the abandonment of the normal position, is similar to that we find in Bliss when he wrote ‘it may seem more sensible to simply assume that equilibrium will prevail and to thus confine our investigations to the equilibrium state. We could regard the object of our investigations not as “the economy” but as “economic equilibrium” ... This approach may seem more attractive, if only because more tractable than the Herculean programme of constructing a complete theory of the behaviour of the economy out of equilibrium’ (Bliss, 1975, p. 28). Bliss is here, so to speak, touching with his own hand the implications of that *abandonment of the normal position*, where the ‘Herculean task’ was instead largely left to itself by the simple Smithian device of the ‘centre of gravitation’, i.e. by the concentration of the analysis on persistent forces. Those implications appear to have in fact led to an impasse, such that the way out suggested by Hicks (1939) and Bliss (1975) comes close to assuming away reality. (Cf. again the passage by Malinvaud quoted in footnote 10 above.)

and not achievement of them being what was always thought relevant for the positions of the economy in the focus of the analysis.<sup>28</sup> Resorting to the above argument of the economy being always in equilibrium on the part of Hicks meant, in fact, admitting that those ‘equilibria’ were too fleeting to be conceived as centres of attraction of the variables in question. But it certainly was no remedy for that impermanence to imagine possessing instead a theory that could *determine* a one-for-one copy of the real economy, in each of Hicks’s ‘weeks’.<sup>29</sup>

Indeed, that much of a possibility for correspondence with observation, which has been claimed by mainstream pure theory after the eclipse of the normal position, has hardly been by means of Hicks’s ‘temporary equilibria’ or by the ‘intertemporal general equilibria’ with today’s markets for future commodities. It has rather been by means of the ‘steady-states’, the adaptation of the stationary state attempting to overcome the most obvious, though hardly the most important, of the contradictions between that state and reality, i.e. the fact that economies do change in size over time. On some ‘dynamical’ neoclassical basis, a long-term tendency has been argued or, more exactly, postulated to some such ‘steady-state’, redefined so as to somehow include technical progress and the other phenomena that cannot but occur over indefinitely long periods of time. The results of such ‘steady-state analyses’ have then been compared with the observable rates of change of aggregates such as social product, capital or distributive shares, supposing that, with appropriate manipulations, these could be taken to reflect some approximately achieved steady-state of that kind of analysis—and comparisons<sup>30</sup> between the two can allow the validity, or lack of it, of the steady-state analysis in question to be assessed.

Clearly, even at the purely methodological level it seems difficult to envisage in such ‘steady-states’ an analysis whose results are at all capable of having a correspondence in observable phenomena, unlike what was possible at a methodological level for an analysis in terms of normal positions. It is sufficient to note that the tendency to a normal position only assumes the simple competitive tendency to uniform prices for homogeneous commodities and productive services—whereas the tendency to a steady-state clearly has no such simple and clear foundation, as it already assumes to a large extent the validity of the theory whose results are being tested.

<sup>28</sup> As Denis Robertson wrote with admirable simplicity and lucidity, ‘[i]t seems to me that anybody who rejects these two ideas, that a system can move towards equilibrium and that it may never get into it—has made it extremely difficult for himself to interpret the course of events in the real world’ (Robertson, 1957, pp. 144–5).

<sup>29</sup> We are here in conflict with the view expressed in Harcourt (1981) and often advanced by Joan Robinson (see Garegnani, 1976). Samuelson appears, on the other hand, to seriously underestimate the difficulty of determining, one to one, the actual path of the economy (what Hicks’s passage reported in the text appears to imply) when in his *Foundations of Economic Analysis* (1947) he draws the analogy of a ‘cannonball [that] can be held to be in equilibrium at each point on its path’. The dominant forces acting on the cannonball at each instant of time are, however, comparatively few in number and their effects on the position of the cannonball can accordingly be calculated with a degree of approximation sufficient to establish a correspondence between the theoretical and actual position of the ball at that instant. This seems to be the only meaning attributable to the idea of a cannonball being in equilibrium at each point on its path. Given instead the numberless forces of similar strength that affect the economy at each instant of time, the instantaneous position of an economy cannot even in principle be determined with any approximation: only averages of observable positions reflecting the effects of the few most *persistent* among those forces can be determined. And the accumulation of the errors would seem to make the path of the economy even less calculable than its instantaneous position is by itself. This, it seems, is what prompted Marshall to write the passage quoted above, Section 5, p. 1427.

<sup>30</sup> Cf., e.g., Lucas (1988).

And when we leave aside the purely methodological level and pass to contents, it becomes clear that those analyses have been largely erected on no better basis than that mentioned at the beginning, i.e. on the credence that the temporary equilibrium or intertemporal general equilibrium versions of the neoclassical theory can validate the demand-and-supply apparatus as such—enough to justify the old concepts as acceptable approximations for applied work. It may therefore be contended that as far as contents are concerned, those analyses of reality owe their apparent plausibility to the multiple misunderstandings we noted above (Sections 5 and 6), which caused what, from a purely analytical point of view, was the inconclusiveness of the later phases of the controversy.

I think that neither that credence nor, therefore, that justification for the use of essentially the old concepts is well founded. I have argued elsewhere (Garegnani, 2003) that intertemporal equilibrium *does not* avoid the dependence on the notion of capital as a single magnitude. Though it no longer occupies its highly visible position as a *fund* among the factor endowments, the *homogeneous commodity 'future income'* demanded by savers cannot be made to disappear from the system any more than any other commodity demanded by the individuals in the economy. It can accordingly be shown to emerge as a flow, with the respective demand-and-supply functions and the corresponding markets. They are what, after Keynes, we call, respectively, (gross) savings *supply*, (gross) investment *demand* and yearly saving-investment *market*. The implications of the inconsistency of that notion of capital as a single magnitude—the same implications that enforced the abandonment of the traditional analysis in pure theory—are accordingly still there to be faced.<sup>31</sup>

The discussion on the matter is proceeding. However, we may already ask the following question: should we not begin to recognise that those difficulties are but the expression of a theory originally inspired by the concept of capital as an independently measurable single productive factor, which we now *all* agree does not exist?

## Bibliography

- Arrow, J. K. 1989. Joan Robinson and modern economic theory: an interview, in Feiwel, J. R. (ed.), *Joan Robinson and Modern Economic Theory*, London, Macmillan
- Arrow, J. K. and Debreu, G. 1954. Existence of an equilibrium for a competitive economy, *Econometrica*, vol. 22, no. 3, 265–90
- Bliss, C. J. 1975. *Capital Theory and the Distribution of Income*, Amsterdam/New York, North-Holland/American Elsevier
- Bliss, C. J. 2005. Introduction, in Bliss, C. J., Cohen, A. J. and Harcourt, G. C. (eds), *Capital Theory*, Cheltenham, Edward Elgar
- Debreu, G. 1959. *Theory of Value*, New Haven, Yale University Press
- Garegnani, P. 1960. *Il capitale nelle teorie della distribuzione*, Milan, Giuffrè
- Garegnani, P. 1976. On a change in the notion of equilibrium in recent work on value: a comment on Samuelson, in Brown, M., Sato, K. and Zarembka, P. (eds), *Essays in Modern Capital Theory*, Amsterdam, North-Holland
- Garegnani, P. 1984. Value and distribution in the classical economists and Marx, *Oxford Economic Papers*, vol. 36, no. 2, 291–325
- Garegnani, P. 1990. Quantity of capital, in *Capital Theory, The New Palgrave*, London, Macmillan

<sup>31</sup> Cp., e.g., the discussion of the idea, apparently subscribed to by Professor Arrow, that the adjustment between savings and investment in an intertemporal equilibrium is a perfectly consistent story that does not look any different from the story about choosing commodities today (Garegnani, 2000, p. 435 n, quoting Arrow, 1989, p. 155).

- Garegnani, P. 1991. The labour theory of value: 'detour' or technical advance? in Caravale, G. (ed.), *Marx and Modern Economics*, vol. I, Brookfield, VT, Elgar
- Garegnani, P. 2000. Savings, investment and the quantity of capital in general intertemporal equilibrium, in Kurz, H. D. (ed.), *Critical Essays on Piero Sraffa's Legacy in Economics*, Cambridge, UK, Cambridge University Press
- Garegnani, P. 2002. Sraffa's price equations: stationary economy or normal positions? in Boehm, S., Gehrke, C., Kurz, H. D. and Sturm, R. (eds), *Is There Progress in Economics?* London, Routledge
- Garegnani, P. 2003. Savings, investment and capital in a system of general intertemporal equilibrium, in Hahn, F. and Petri, F. (eds), *General Equilibrium: Problems and Prospects*, London, Routledge
- Hahn, F. H. 1975. Revival of political economy: the wrong issues and the wrong argument, *Economic Record*, vol. 51, no. 3, 360–4
- Hahn, F. H. 1982. The neo-Ricardians, *Cambridge Journal of Economics*, vol. 6, no 4, 353–74
- Harcourt, G. C. 1981. Marshall, Sraffa and Keynes: incompatible bedfellows? *Eastern Economic Journal*, vol. 7, no. 1, 39–50
- Hicks, J. R. 1932A. *The Theory of Wages*, London, Macmillan
- Hicks, J. R. 1932B. Marginal productivity and the Lausanne school: a reply, *Economica*, vol. XII, no. 37, 296–300
- Hicks, J. R. 1939. *Value and Capital*, London, Oxford University Press
- Lucas, R. E. 1988. On the mechanics of economic development, *Journal of Monetary Economics*, vol. 22, 3–42
- Malinvaud, E. 1991. The next fifty years, *Economic Journal*, vol. 101, 64–8
- Marshall, A. 1898. Distribution and exchange, *Economic Journal*, vol. VIII, 37–69
- Marshall, A. 1920. *Principles of Economics*, London, Macmillan
- Robbins, L. 1930. On a certain ambiguity on the notion of stationary state, *Economic Journal*, vol. XL, 194–214
- Robertson, D. H. 1931. Wage grumbles, pp. 42–57 in Robertson, D. H., *Economic Fragments*, London, King & Son
- Robertson, D. H. 1957. *Lectures on Economic Principles*, London, Fontana
- Robinson, J. 1956. *The Accumulation of Capital*, London, Macmillan
- Robinson, J. V. 1970. Capital theory up to date, *Canadian Journal of Economics*, vol. III, no. 2, 309–17
- Samuelson, P. A. [1947] 1983. *Foundations of Economic Analysis*, Cambridge, MA, Harvard University Press
- Sen, A. K. 1978. On the labour theory of value: some methodological issues, *Cambridge Journal of Economics*, vol. 2, 175–90
- Sen, A. K. 2003. Sraffa, Wittgenstein, and Gramsci, *Journal of Economic Literature*, vol. XLI, 1240–55
- Smith, A. [1776] 1950. *The Wealth of Nations*, 2 vols, London, Dent and Sons
- Solow, R. 1956. A contribution to the theory of economic growth, *Quarterly Journal of Economics*, vol. 70, no. 1, 65–94
- Sraffa, P. 1951. 'Introduction' to Ricardo's *Principles*, in Sraffa, P. (ed.), *Works and Correspondence of David Ricardo*, vol. I, Cambridge, UK, Cambridge University Press
- Sraffa, P. 1960. *Production of Commodities by Means of Commodities: Prelude to a Critique of Economic Theory*, Cambridge, UK, Cambridge University Press
- Wald, A. 1936. Über einige Gleichungssysteme Matematischen Ökonomie, *Zeitschrift für Nationalökonomie*, vol. 7, 637–70; On some systems of equations in mathematical economics, English translation, *Econometrica*, 1951, vol. 19, no. 4, 368–403
- Walras, L. 1877. *Théorie Mathématique de la Richesse Sociale*, Paris, Guillaumin
- Walras, L. 1954. *Elements of Pure Economics, or the Theory of Social Wealth*, London, George Allen & Unwin
- Wicksell, K. [1906] 1962. *Lectures in Political Economy*, vol. I, London, Routledge