# Classical economics after Sraffa

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It can hardly be disputed that the edition of *The Works and Correspondence of David Ricardo* and especially Piero Sraffa's Introduction in Volume I, containing Ricardo's *Principles*, together with his *Production of Commodities by Means of Commodities* had a major impact on the way in which the Classical economists and especially Ricardo are seen today. The paper shows first how Sraffa's contributions cast new light on the centrepiece of Classical economics—the theory of value and distribution. The latter forms the foundation of all other economic analysis, such as, for example, the problems of capital accumulation and economic development, of foreign trade and of taxation. Sraffa deserves the credit for having freed that approach from under thick layers of misinterpretation and for having shown that it had wrongly been abandoned—"submerged and forgotten"—prematurely. In particular, the Classical approach was not flawed beyond remedy, as Sraffa's reformulation and elaboration of it demonstrated. Secondly, the paper illustrates the fecundity of the reformulated Classical approach by reviewing the work done on its basis in several fields of research, including production, scarce natural resources, income distribution, economic growth and foreign trade. Third, the Classical approach turned out not only to provide a solid basis for further research, but also provided a standpoint from which the major deficiencies of marginalist theory can be seen, which previously had passed unnoticed. Apparently, the development of economics does not follow a path shaped by a perfect selection mechanism that abandons anything that is erroneous and weak and keeps everything that is true and useful. After Sraffa, economics is no longer what it was.

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## 1. Introduction

It can hardly be disputed that the edition of *The Works and Correspondence of David Ricardo* and especially Piero Sraffa's Introduction in Volume I, containing Ricardo's *Principles* (Sraffa, 1951), together with Sraffa's *Production of Commodities by Means of Commodities* (Sraffa, 1960), had a major impact on the way in which the Classical economists and especially Ricardo are seen today. Sraffa's contributions cast new light on the centrepiece of Classical economics—the theory of value and distribution. The latter forms the foundation of all other economic analysis of the Classical authors, such as, for example, the problems of capital accumulation and economic development, of foreign trade and of taxation.

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In this paper we focus attention on this centrepiece and adopt Sraffa's view as to the "standpoint … of the old classical economists from Adam Smith to Ricardo." According to him, their (and also his) "investigation is concerned exclusively with such properties of an economic system as do not depend on changes in the scale of production or in the proportion of 'factors'" (Sraffa, 1960, p. v). Profits (and rents) are explained in terms of the surplus product left after all used-up means of production and real wages have been deducted from gross outputs and a uniform rate of profits obtains in conditions of free competition. The concept of "Classical economics" under consideration is defined in *analytical*, not in *chronological* terms. It focuses attention on authors who advocated a *surplus approach* to the theory of value and distribution. The widespread chronological definition, which also subsumes under Classical economics contributions from, for example, Thomas Robert Malthus or Jean-Baptiste Say, is therefore of little help, because it patches over crucial differences in the various authors' respective theories.

While Sraffa's edition and new interpretation was at first received with great enthusiasm and was approved of by scholars from different intellectual camps,[3] things soon changed when it was gradually understood that it undermined not only the received view of the Classical authors, but also, and more importantly, the view that modern marginalist or neoclassical economics, in whatever form, was the legitimate heir of the Classicals. The use of terms such as "neo"-classical, "new" classical etc. bear witness to the apparent desire of the advocates of the analyses under consideration to present their contributions as continuing the tradition the Classical economists had established.[4] By putting forth a new and sharp definition of the essence of the Classical approach to the theory of value and distribution, Sraffa provided a criterion that allowed one to discriminate between legitimate and spurious uses of the term "Classical". Still more importantly, it allowed one to embark on the challenging task of excavating and then developing what had been "submerged and forgotten since the advent of the 'marginal' method" (Sraffa, 1960, p. v).

This was indeed badly needed, since thick layers of interpretation, conceiving of the Classical authors as marginalist economists "waiting to be born" (Samuelson, 1978, p. 1415), stood in

[3] See, for example, the numerous reviews of Sraffa's edition of Ricardo's works and correspondence, written by economists representing various intellectual orientations in economics.

[4] A little more than a decade ago, Robert Lucas (2004) expressed this view in the following way: "I think of all progress in economic thinking, in the kind of basic core of economic theory, as developing entirely as learning how to do what Hume and Smith and Ricardo wanted to do, only better." However, it is not clear which elements in Lucas's writings are supposed to reflect the influence of the Classical economists. For example, the assumption of a single "representative agent" is totally alien to the Classical authors, who stressed power and information asymmetries in society and distinguished between different social classes, whose interests, as Adam Smith insisted (WN I.xi.p), are by no means the same; see also Kurz, 2015.

the way of a thorough reception of Sraffa's new view. Attempts to ward off his re-interpretation abounded. The picture became blurred again and split the profession into three groups: those who accepted and elaborated on Sraffa's interpretation; those who were keen to defend the received marginalist interpretation of Ricardo, as it had forcefully been advocated by Alfred Marshall; and those who criticised Sraffa without necessarily embracing the marginalist view of the world and of the Classical economists. The first group included, among others, Krishna Bharadwaj, Pierangelo Garegnani, Luigi Pasinetti, Bertram Schefold and Ian Steedman; the second group Paul Samuelson, John Hicks and Samuel Hollander; and the third group Mark Blaug.[5]

In his hitherto unpublished papers, Sraffa maintained that the study of the varied history of the theory of value and distribution was the truly important thing, not least because this history ran in parallel with major economic and socio-political developments. He intended to write the history of the subject, but was prevented from doing so because of the difficulties he encountered with regard to the Ricardo edition (see Gehrke and Kurz, 2002) and the analytical obstacles he had to overcome, frequently with the help of his "mathematical friends", in elaborating on the reformulation and rectification of the Classical theory of value and distribution. His unpublished papers contain a huge amount of material, and critical comments on it, designed to be used in such a history. They also contain the elements on the basis of which we can reconstruct how Sraffa arrived at his "equations of production" and the inspiration he received from the writings of the Classical authors. As such, they can be expected to lead to a renewed interest in the characteristic features of the Classical theory of value and distribution and a re-assessment of the difference between it and marginalist theory. This paper will focus attention on the material under consideration as it is available in Sraffa's papers, which can deepen our understanding of Sraffa's published work and his view of the genuine significance of the Classical theory and its fundamental difference from the marginalist one.

The composition of the paper is the following. Section 2 summarises the situation as regards the interpretation of the Classical economists at the beginning of the 20th century. Section 3 summarises the essence of Sraffa's understanding of the Classical "standpoint" as it comes to the fore in his unpublished writings. Section 4 deals with the labour theory of value, which according to many interpreters is an indispensable part of the Classical theory of value and distribution, whereas Sraffa was of the opinion that it involved a "corruption" of it (see, for

[5] The culminating point of the attempted "counter-revolution" was arguably Samuelson (1978), to which Garegnani (2007) replied; see also the debate between the two in Kurz, 2013.

example, Sraffa Papers D3/12/4: 2(1)). Section 5 provides a short summary account of contributions to various fields in economics rooted in a reformulated and rectified Classical theory after Sraffa; the fields mentioned include the treatment of fixed capital, capital utilization, renewable and exhaustible natural resources, foreign trade, economic growth and taxation. Section 6 summarises the criticism of marginalist theory. Section 7 concludes.

We have individually, together, or jointly with other authors written on various different aspects of the issues here under consideration. In the present paper we will draw on our earlier work, large parts of which are conveniently available in Kurz and Salvadori, 1998, 2003, 2007, 2015; see also Kurz, 2012.

## 2. The conventional view

In the first half of the twentieth century there was a fairly wide consensus as to the nature of the Classical economists' contribution to political economy, especially to the theory of value and distribution, and its relation to marginal economics, which already had or was about to become the mainstream in large parts of the profession at around the turn of the 19th century. This position was well expressed by Alfred Marshall in his *Principles of Economics* (1890). He portrayed Adam Smith, David Ricardo and other authors he dubbed "Classical" as precursors of his own theory of demand and supply. The Classicals, he argued, were possessed of a fairly well developed theory of production and thus supply, but lacked an equally developed theory of demand. Classical theory, which had provided us with the concept of marginal productivity in the theory of intensive diminishing returns, could easily be reconciled with modern theory, based on the concept of marginal utility. A judicious combination and amalgamation of the two, as he, Marshall, had elaborated, was considered to accomplish the task and bring to fruition the seed the Classical economists had sown. Marshall thus disagreed strongly with William Stanley Jevons, who in his *Theory of Political Economy* (1871) had contended that the Classical analysis was entirely useless. Jevons deplored what he called "the mazy and preposterous" assumptions underlying the doctrine of the "Ricardian school" and advocated its abandonment rather than its further development and completion.

There were, of course, still scholars who neither thought that the legacy of the Classicals was worthless nor that it could easily be absorbed into marginalist theory. They felt that the Classicals had developed a theory of value and distribution that was fundamentally different from marginalist theory and that the former's shortcomings did not reflect deficiencies beyond remedy, as Jevons and his followers had contended. Interestingly, amongst those keeping the Classical flag flying in various countries there was almost unanimous agreement that a defining characteristic of the Classical approach to the theory of value and distribution was the labour theory of value.[6] In fact, Classical and especially Ricardo's economics came close to being erroneously identified with the labour theory of value. It was then only natural to consider Marx's labour-value-based reasoning as a straightforward confirmation of the Classical tradition, although Marx ([1867] 1954) himself had given *Capital* the subtitle *A Critique of Political Economy*, meaning, of course, first and foremost the political economy of Smith, Ricardo, James Mill, Torrens, etc.

This elicits two remarks. First, with the benefit of hindsight one might say that both supporters and critics of Classical theory, as well as those who saw a continuity between the "innovators"—that is the marginalists—and the Classicals, got it wrong. In particular, the idea that the labour theory of value (interpreted as meaning that labour is the only source of value) is an integral part of the Classical theory and that the latter stood or fell with it, on the one hand, and the idea that in the marginalist theory there was no room for it whatsoever, on the other, cannot be sustained. Scrutiny shows that despite their insistence on the original novelty of their approaches, authors such as Jevons, Eugen von Böhm-Bawerk and John Bates Clark were—ironically—all convinced that in conditions of free competition relative prices in long-run equilibrium equal relative labour values.[7] What they essentially disputed was the causality invoked by the Classical authors, which leads from cost of production in terms of amounts of labour to normal prices. As against this they insisted that the natural starting point is the needy individual and its estimation of goods. The choices of individuals are then said to bring about a situation in which relative marginal utilities with respect to the various goods are equal to relative prices, which in turn are equal to the relative quantities of labour needed directly and indirectly in their production.

Secondly, as is well known, Marx distinguished between what he called "classical political economy" and "vulgar economics". By the latter he meant an economic analysis that fails to analyse the inner relations and contradictions of bourgeois society, but deals only with its surface and is essentially apologetic. Yet his main criticism concerned propositions of the Classical economists, and especially of Smith and Ricardo, whom he took seriously and from whom he learned a great deal. This appears to have (mis)led many commentators into

[6] For evidence with respect to the German-speaking world, see Kurz, 1995. German authors who can be mentioned in this context include Heinrich Dietzel, Franz Oppenheimer and Emil Lederer.

[7] Jevons (1871, p. 182), for example, wrote: "thus we have proved that commodities will exchange in any market at the ratio of the quantities produced by the same quantity of labour."

thinking that Marx's analysis did not constitute an attempt at developing classical political economy by shedding its weaknesses and elaborating on its strengths (as Marx saw them), but was a fundamental break away from it. This view is based on a fundamental misunderstanding, which, alas, still shapes the perception of many Marxists, of the relationship between Marx and his precursors.

When in the above we referred to the benefit of hindsight, we had of course in mind the situation subsequent to Piero Sraffa's "Introduction" in Volume I of the Ricardo edition (1951), and even more so to his 1960 book. Sraffa's interpretation of the Classical economists as advocates of a "surplus" approach to the theory of value and distribution not only totally changed today's scholars' perspective on authors such as Smith and Ricardo, it also attributed to this approach a genuine significance that is fundamentally different from the marginalist one. After Sraffa the situation was completely different from what it was before. This does not mean that there were no other authors who had anticipated elements of Sraffa's interpretation of the Classicals (such as, for example, Ladislaus von Bortkiewicz) or who had insisted on striking differences between the marginalist and the Classical approaches (such as, for example, the young Joseph A. Schumpeter). It means that only Sraffa managed to fundamentally alter the perception of the analytical core of Classical economic theory, of how it compares to the marginalist one, and of how insights derived from the former lead to a criticism of the latter.

## 3. Sraffa: Classical economics—a "science of things"

We now turn to Sraffa's reconstruction of the Classical approach to the theory of value and distribution, followed by his rectification of it, which overcomes the deficiencies of the version that was handed down from Smith via Ricardo and Marx to later authors. Put briefly, the Classical economists and Marx were unable to develop a coherent, logically unassailable theory of value and distribution, because the analytical tools at their disposal were not up to the complexity of their highly sophisticated and empirically rich concepts: production conceived of as a circular flow generating a surplus product, where inputs are advanced at the beginning of the production period and consist of heterogeneous commodities. The mismatch between tools and concepts landed these authors in an impasse, with which they tried to cope as best as they could. The result of this impasse was the labour theory of value. Whereas Smith and Ricardo insisted that it held exactly true in explaining relative prices in exceptional circumstances only, and Ricardo opined that it could be seen as an approximation to a correct theory of value and distribution, of which he was not possessed, Marx contended that the "law of value" was true with regard to the aggregate of all commodities: in terms of labour-value-based reasoning both the general rate of profits of the system as a whole and the prices of production of commodities corresponding to this rate could be ascertained. This was the origin of the (infamous) problem of the "transformation" of values in prices.

According to Sraffa, the labour theory of value involved a "corruption" of the Classical approach to the theory of value and distribution. For example, in a note entitled "Degeneration of cost and value", probably written in November 1927, Sraffa insisted: "A. Smith & Ricardo & Marx indeed began to corrupt the old idea of cost,—from food to labour. But their notion was still near enough to be in many cases equivalent" (Sraffa Papers D3/12/4: 2(1)). In what sense did the labour theory of value involve a corruption of Classical theory? In the following we summarise in desperate brevity (to use one of Schumpeter's favourite phrases) how Sraffa arrived at this characterisation in the period extending from the second half of 1927 to 1931, and what it meant. The reader interested in a more thorough account of the chronology of Sraffa's early re-constructive and critical work is asked to consult some of our earlier works on the matter; see, in particular, Kurz and Salvadori, 2005a, 2005b, Gehrke and Kurz, 2006, and Kurz, 2012.

Sraffa was extremely well read in Alfred Marshall's *Principles* and for some time thought that *this* was economics, *tout court*.[8] He was critical of Marshall's analysis (see Sraffa 1925, 1926), but felt that any attempt at improving upon the state of the art in the field had to start from Marshall. He rejected Marshall's concept of "real costs", which involved subjectivist elements such as disutility, abstinence, waiting and the like. For a short while Sraffa even contemplated the possibility of purging Marshall's analysis of its subjectivist elements and tried to conceive of demand and supply schedules in purely objectivist terms. However, he soon realised that this did not lead him anywhere. At around the same time he delved deeper and deeper into the analyses of the Classical economists. He had been clear at an early time that their analyses differed in important respects from those of the later marginalists, but it was far from clear to him wherein precisely the difference consisted. He now grasped that a characteristic feature of their theory of value was that it was based on what he called "physical real cost", or "physical cost" for short: the value of a commodity reflected the amounts of commodities—raw materials, means of production and means of subsistence in the support of workers—that had of necessity to be "destroyed" in the production of the

[8] Sraffa's working copy of Marshall (1920 [1890]) is studded with annotations, criticisms and remarks.

commodity under consideration. Production involved destruction, and value had to do with the amounts of commodities so destroyed.

Sraffa encountered numerous expressions in the writings of the Classical authors of the physical real cost approach and noted them in his papers. The most remarkable ones are perhaps the following two—one by William Petty, the other by James Mill. Petty advocated a "physician's outlook" on economic matters; Sraffa cited approvingly Petty's 1676 decision "to express my self in terms of *Number*, *Weight*, or *Measure* … and to consider only such Cases, as have visible Foundations in Nature, leaving those that depend upon the mutable Minds, Opinions, Appetites, and Passions of particular Men, to the Consideration of others" (Sraffa's Papers, D3/12/4: 3). Petty's statement is particularly interesting, because it confronts the physical real cost point of view with an early expression of the subjectivist point of view. James Mill (1826, p. 165) on the other hand had put forward the following remarkable proposition: "The agents of production are the commodities themselves … They are the food of the labourer, the tools and the machines with which he works, and the raw materials which he works upon." Reflecting these statements, in a document composed in December 1927 Sraffa called Classical economics explicitly a "science of things" (D3/12/61: 2) as opposed to Marshall's economics, which was a science of motives.[9]

But how could one ascertain the values of commodities in terms of physical real costs? In order to determine the value of commodity U one had to know the values of commodities X, Y, Z … used up in its production. In short, it appeared as if one was trapped in circular reasoning, explaining (and determining) the values of commodities in terms of the values of commodities. So how did the Classical economists (and Marx) try to get out of the trap? They sought to reduce all commodities to an "ultimate measure of value" and render them commensurable in terms of it. Thus William Petty suggested to use a "loaf of bread" (or also "corn")—representing workers' bundle of means of subsistence—as an ultimate measure of value: "bread" was needed directly and indirectly in the production of all commodities, because in all productions workers had to be employed and fed. Similarly, Smith used "corn" as a generic term including all means of subsistence of workers (see WN I.xi.e.29); Ricardo followed him in this regard.

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[9] In a paper titled "A Plea for Pure Theory", William Cunningham (1892) had already confronted the different views of Petty and Marshall. Some time in the period from May to July 1928, Sraffa probably excerpted and commented on the following lines from it: "'Prof. Marshall describes economics as the science of *measurable motives* (Present Position, p. 31). This ... seems to me to be the very gist of the difference in treatment' C. is opposed to this and agrees with W. Petty. He wants to deal with 'external phenomena' 'laying a solid foundation of fact.' 'But when we start from motives, we lose all this advantage. What actually weighs with a man and determines him in any course of conduct, is not a thing we can observe ... Motives are not obvious and we are likely to be mistaken about them'" (Sraffa's Papers D3/12/9: 18).

In Sraffa's early manuscripts we also encounter attempts to reduce commodities to some ultimate measure of value. However, Sraffa did so by starting from systems of simultaneous equations. He quickly discovered that several commodities could serve as an ultimate measure of value: in the case of a system without a surplus product, all commodities produced are "necessaries", that is, they are indispensable in each and every line of production. Hence each and every commodity enters into the production of each and every commodity. Here things are relatively simple and each type of reduction must result in the same exchange ratios between commodities. In systems with a surplus, distributed in the form of wages or profits, things are not so. While the reduction of wages appears to cause no problem, to which ultimate measure of value ought profits to be reduced? And would all reduction series lead to the same exchange ratios between commodities?

As is well known, the Classical authors eventually took labour as the common measure of value, since labour was considered an indispensable input in the production of all commodities. According to Sraffa this involved the said corruption. Relative prices, Sraffa had convinced himself in late 1927, could be ascertained without falling into circular reasoning by formulating and then solving a system of simultaneous production equations. This was the tool the Classical economists would have needed in order to formulate their surplus approach to the theory of value and distribution in a consistent way and to avoid the pitfalls into which they had fallen.

Beginning in November 1927, Sraffa developed square systems of equations (dealing with single production) in which no more is produced of the different commodities than is consumed productively, that is, systems *without a surplus product*. This is what he called his "first equations". He swiftly moved on, in the late 1920s, to investigate *systems with a surplus product*, without and with durable instruments of production (fixed capital) and given and constant real wages in his "second equations", followed by an investigation of the impact of a variation in real wages on the "rate of interest", the notion he used at the time, and relative prices in his "third equations". This led him to analyse the mathematical properties of the following systems of equations (we take gross output quantities of the various quantities as defining one unit of the respective output).

*Without a surplus product*:

$$\mathbf{p} = \mathbf{A}^{+}\mathbf{p} \qquad (1)$$

Here $\mathbf{p}$ is the price vector and $\mathbf{A}^{+}$ is the input matrix (per unit of output) of the means of production-cum-means of subsistence in the support of workers productively consumed during the annual cycle of production (known also as the "augmented" matrix, which takes account of the fact that in the Classical perspective wages belong to the capital advanced at the beginning of the production period).

*With a surplus product*:

$$\mathbf{p} = (1 + R)\,\mathbf{A}^{++}\mathbf{p} \qquad (2)$$

Here $R$ is the general rate of profits and $\mathbf{A}^{++}$ is the production matrix in the new situation. (With wages at some socio-historical subsistence level, $R$ gives the rate of return in the prevailing socio-technical conditions.)

When Sraffa discussed the impact of a change (rise) in real wages on the rate of profits and relative prices, he at first followed Ricardo, who had contemplated a hypothetical redistribution that is proportional to the surplus product in the initial situation. If the entire surplus product goes hypothetically to workers, we are back to a system like (1) with $\mathbf{A}^{++}$ in the place of $\mathbf{A}^{+}$.

We need not dwell here on the long journey Sraffa undertook before arriving at his 1960 book, a journey that was twice interrupted for several years (basically between 1931-1942 and 1946-1956) because the Ricardo edition required all his attention and energy. Here it suffices to draw the attention to a passage in Whitehead (1926), which Sraffa annotated and which paraphrases the essence of what he was doing in the late 1920s. Whitehead had remarked on the success of science since the seventeenth century: "Science was becoming, and has remained, primarily *quantitative*. *Search for measurable elements among your phenomena, and then search for relations between these measures of physical quantities*" (Whitehead 1926, pp. 63–4, emphasis added).

We now discuss briefly why, according to Sraffa, the labour theory of value was not an indispensable part of the Classical approach to the theory of value and distribution, but rather reflected a weakness of their analyses. Had they been possessed of a coherent theory of value and distribution with regard to a system in which heterogeneous commodities are produced by the self-same commodities, they would not have had to have recourse to an assumption that was admittedly not fully true (Ricardo), but served as a device not to be "stopped by the word price", as Ricardo once put it (*Works*, IV: 348).

## 4. The Labour Theory of Value vs. the *Value Theory of Labour*

Once Paul Samuelson asked Sraffa whether Ricardo held a labour theory of value. Sraffa is reported to have answered: "He did and he didn't." What might at first sight be considered a sibylline response turns out to properly reflect Ricardo's point of view, which, for example, in the third edition of the *Principles* comes to the fore when Ricardo speaks "of labour as being *the foundation of all value*, and the relative quantity of labour as *almost exclusively* determining the relative value of commodities" (Ricardo *Works* I: 20; emphases added). The following note which Sraffa wrote in November 1927 may be read as a comment on Ricardo's statement and puts the issue under consideration into sharp relief:

> It is the *whole* process of production that must be called "human labour", and thus causes all product and all values. Marx and Ricardo used "labour" in two different senses: the above, and that of *one* of the factors of production ("hours of labour" or "quantity of labour" has a meaning only in the latter sense). It is by confusing the two senses that they got mixed up and said that value is proportional to quantity of labour (in second sense) whereas they ought to have said that it is due to human labour (in first sense: a non measurable quantity, or rather not a quantity at all). (Sraffa Papers D3/12/11: 64; emphases in the original)

Ricardo considered labour as the "foundation" of all value, "a non measurable quantity, or rather not a quantity at all" in the words of Sraffa, and he felt entitled to *approximate* value in terms of labour values.[10] Sraffa illustrated the confusing of the two senses with respect to Robert Torrens's approach to the problem:

> Torrens knew that the (absolute) value of the product is determined by (in fact, is) the amount of things that have been destroyed for its production. But he did not see his way through without finding a "common measure" of them: he probably felt a repulsion to, or thought that it could not be done, *to sum together quantities of heterogeneous things measured in different units. This was of course fatal: he started to find something common in them, upon which to base his measurement: the labour theory was ready at hand … The result was of course absurd.* (Sraffa's Papers D3/12/5: 26)

The statement that the result was "absurd" applies to a system with a surplus, whereas with regard to systems without a surplus it can be shown that the price vector in equation (1) is proportional to the vector of labour values appropriately constructed (see Kurz and Salvadori, 2009). Sraffa apparently was not aware of this when he developed and discussed his "first equations". The reason is obvious: there is no need to talk of labour—all that matters are

[10] A confusion of the two senses is widespread in the literature on Ricardo. For example, Mary Morgan recently wrote: "it is *labour alone that creates value*, and … there is a direct relationship between labour input and value" (Morgan, 2012, p. 60; emphasis added). As we have just seen, Ricardo was *not* of this opinion.

physical real costs of production. Labour values therefore are of no importance in the analysis, they are at best secondary magnitudes (we return to this question below). The labour theory of value, Sraffa concluded at the time, involved a "corruption" of the tradition established by Petty and the physiocrats, who are said to have had the right concept of "cost". In this context it is worth mentioning that in a document of some fifty pages composed in the summer of 1929, Sraffa explained in detail why he then thought that labour was *not* a "quantity" that could be taken as a datum in value theory (see also the reflection of his argument in D3/12/13: 2, and Kurz and Salvadori, 2009). He expounded that his objection to the approach in terms of labour quantities "è basata sulla veduta essenzialmente fisiocratica, che il *valore* sia una quantità intrinseca degli oggetti, quasi una *qualità fisica o chimica*." (Sraffa's Papers D3/12/12: 7, emphases added).[11] The physical interpretation is neatly corroborated by a document entitled "Physical Costs & Value", contained in a folder "Nov. [1927]", which reads:

> When I say that the value of a product is "determined" by the physical volume of commodities used up in its production, it should *not* be understood that it is determined by the value of those commodities. This would be a vicious circle, because the value of the product is equal to the value of the factors *plus* the surplus produced.
>
> What I say is simply that the numerical proportions between amount of factors and amount of product *is*, by definition, the absolute value of the product.
>
> (Sraffa's Papers D3/12/11: 101; emphases in the original, "not" is underlined twice in the original)

And in a document contained in the same folder, he also talked of "physical value" (Sraffa's Papers D3/12/11: 75).

Some people seem to think that labour values are something natural and simple. However, they are typically not (see Kurz and Salvadori, 2009). Here there is no need to enter into a discussion of the difficulties involved. We rather ask ourselves where labour values are supposed to come from. If in the production of one unit of commodity U certain amounts of commodities X, Y, Z, … are consumed productively, then in order to be able to ascertain the labour value of U one would have to know already the labour values of X, Y, Z, … . As Sraffa stressed, determining values by means of values involves "a vicious circle": values

[11] English translation: "is based on the essentially physiocratic point of view that value is a quantity that is intrinsic to the objects, almost a physical or chemical quality."

ought to be determined in terms of magnitudes that are not themselves values.[12] In a system with a circular flow of commodities and a surplus product labour values can be ascertained by solving a special system of simultaneous equations, namely the one in which the rate of profits is equal to zero: values are then shown to depend exclusively on the methods of production and productive consumption actually in use. Hence labour values reflect but a very special constellation of the sharing out of the product among workers and capitalists. To emphasize this fact, in the early 1940s Sraffa coined the term "Value Theory of Labour" (see Sraffa Papers D3/12/44: 3 and D3/12/46: 24): values are proportional to labour quantities if and only if there are no profits (setting aside the exceedingly special case of uniform input proportions across all industries of the economy).

Only in the case Ricardo contemplated, in which production processes start with "unassisted labour," can labour values be ascertained in an easy and straightforward manner by adding up labour quantities from the beginning of the time-staggered labour process until its end. Marx objected to this conceptualization of production as a unidirectional or linear process of finite duration that there is no stage in the production process of developed economies that does not involve some "constant capital", that is, produced means of production. The implication of this is, of course, that labour values can only be ascertained by solving a system of simultaneous equations—they are nothing else than production prices corresponding to a particular distribution of income ($r = 0$).

Finally we remark briefly on the "transformation problem". As Sraffa's interpretation of the Classical authors shows, if the Classical physical real cost approach is developed coherently, it simply does not face this problem. *In Classical economics there is no transformation problem*. This does not mean that one cannot in certain cases get from labour values to prices of production in a logically consistent way. It only means that the latter can be determined totally independently of the former, which are therefore redundant in the analysis (Steedman, 1977). Interestingly, in non-trivial cases in which one can go from labour values to prices of production, the use of Sraffa's Standard commodity is required (see Kurz and Salvadori, 2009). In this perspective the labour theory of value (interpreted as meaning that labour is the only source of value) is not an indispensable building block of Classical economics. Wrongly

[12] As he stressed in a document presumably written in the second half of 1929, echoing a dictum by Petty, relative prices and income distribution had to be ascertained exclusively in terms of "quantities [that] have an objective, independent existence at every or some instants of the natural (i.e. not interfered with by the experimenter) process of production and distribution; they can therefore be measured physically, with the ordinary instruments of measuring number, weight, time, etc." (D3/12/13: 2).

attributing to the Classical authors such a theory had the effect of rendering their whole analysis vulnerable to criticism and was responsible for its premature abandonment.

## 5. Applying the Classical approach

The impact of *Production of Commodities by Means of Commodities* was enormous. Roncaglia (1978 [1975]) includes an appendix with a list of publications on Sraffa's book published up to the mid 1970s. It includes hundreds of items. The first section of the appendix draws attention to a large number of reviews of the book and mathematical formulations of various parts of it, and the numerous interpretations put forward in relation to the received thought of Classical economists, Marx, and some neoclassical economists. More recently, Bellino (2008) has discussed 35 reviews of the book in some detail. In the second section of his bibliography Roncaglia lists works concerning particular aspects of Sraffa's book. Here we find several papers concerning the Standard commodity (its interpretation, its role within the book, its relationship with Ricardo's "invariable measure of value" and with the so-called "transformation problem" of labour values in prices of production in Marx), joint production, fixed capital, and land. We devoted a whole paper to the Standard commodity (Kurz and Salvadori, 1993) and will not discuss it here. For a more recent survey of the literature on Sraffa, see Aspromourgos, 2004.

While the problem of single production was investigated swiftly after the publication of Sraffa's book, the problems of joint production, fixed capital and land needed a great deal more time, and some were in fact investigated only after 1978. A summary account is apposite; see also the book edited by Salvadori and Steedman (1990), which includes the relevant literature up to the late 1980s. A common aspect concerning Sraffa's treatment of these issues concerns the fact that the number of processes involved may be equal to the number of commodities. The question is not trivial especially in the case of joint production, but Sraffa indicated the solution to it. The problem left was whether the number of processes involved *needs* to be equal to the number of commodities. Schefold (1978a, 1978b) and Bidard (1986), among others, proved that in some cases the answer is positive, but in some others it is not. This result led to the abandonment of the treatment of the problem in terms of equations (Sraffa) and to its treatment in terms of inequalities (von Neumann). However, in the cases in which joint production is not pure and is related only to the presence of fixed capital and/or land, the system is "square", to use the expression coined in the literature to indicate that the number of processes involved is equal to the number of commodities produced.

In Appendix D Sraffa explains how the method of treating what is left of fixed capital at the end of the year as a kind of joint product is foreshadowed in some Classical economists. We devoted an entire paper to this issue (Kurz and Salvadori, 2005a) and will not discuss it here. In Chapter X Sraffa presents his analysis of fixed capital, but he limits it to the case in which only one machine is used, the efficiency of this machine is constant, and the machine is not transferable between sectors. The subsequent literature has almost completely generalised the issue. Roncaglia (1971) analysed the case in which machines are jointly utilized and their efficiency is constant. (He did not investigate the transferability of machines, but on the basis of the assumptions he employed there would be no problem in doing so.) Schefold (1971, 1978c) investigated the case in which the efficiency is not constant and machines are not jointly used and not transferable. Salvadori (1988, 1999) studied both the case in which efficiency is not constant and machines are jointly used and not transferable and the case in which efficiency is not constant and machines are not jointly used and transferable, provided that efficiency paths are independent of the sector in which the machines are used. Huang (2015) provided an analysis in which efficiency, while not constant, is subject to some restrictions, and machines are jointly used and transferable. In all these analyses it is confirmed that prices do not depend on output proportions but only on income distribution, except for the case in which machines are jointly used; in this case the growth rate plays a role in the choice of techniques and therefore prices are determined once *both* the rate of profit (or the wage rate) and the growth rate are known.

In Chapter XI Sraffa presents his analysis of land. Actually Sraffa (1960, p. 74) refers to "Natural resources which are used in production, such as land and mineral deposits." However, we know from the correction of the proofs of his book that at the last minute he dropped parts of a section devoted to what he in his preparatory notes had called "wasting assets" (see Kurz and Salvadori, 2001, pp. 290-3). Sraffa considers extensive and intensive rent when a single agricultural commodity exists. The problem of multiple agricultural products is mentioned, but not dealt with. The analysis of extensive rent is limited to the case in which the rate of rent with regard to one quality of land is equal to zero, with no closer consideration of the quality of land to which this applies. Once again Sraffa is mainly concerned with the issue of the equality of the number of processes involved and the number of commodities the prices of which have to be ascertained, given the gross amounts of the different products that have to be produced. Sraffa's analysis of intensive rent is limited to two issues: the existence of two processes to produce the agricultural commodity, which guarantees squareness (§87), and the connection between this analysis and a process of "intensive" diminishing returns (§88). Quadrio-Curzio (1967, 1980), Montani (1972, 1975), Kurz (1978) and Salvadori (1986) provided detailed accounts of extensive and intensive rent.

The case of scarce natural resources such as land(s) makes it abundantly clear that relative prices and income distribution cannot be ascertained independently of the gross output levels of the different commodities to be produced (a fact that should have already been clear given Sraffa's warnings that constant returns to scale are not assumed in his book). In the case of intensive diminishing returns a rent will emerge if the land under consideration is scarce, which is typically reflected in the coexistence of two methods of production by means of which the land is utilized. It has also been confirmed that "fertility" (in the sense of unit costs of production) is not an intrinsic property of lands, but depends on the rate of profits. (Sraffa had clarified this as early as in Sraffa, 1925). Abraham-Frois and Berrebi (1980, chap 4) and Saucier (1981, chap X) have shown the possibility of external differential rent by operating one process producing corn and two processes producing an industrial commodity that need corn in different amounts per unit of output; Saucier (1981, p. 234) has called this variety of rent "external differential rent". Bidard (2011) has shown that similar results may obtain when more than one agricultural product exists. It has been confirmed that if the quantities in effectual demand are independent of prices, then the system is square, but it does not need to be so if they are not.

All these analyses on land have been carried out on the assumption that the economy is in a self-replacing state, that is, it is stationary. In case output quantities change over time, the scarcity of land(s) changes over time as well and prices, the rates of rent, and the competitive rate of profits (or, alternatively, the real wage rate) cannot remain constant. A similar problem arises when natural resources other than land—which Ricardo took to be possessed of "original and indestructible powers" (*Works*, I: 67)—are taken into account, which Sraffa did not do in any depth. The reference is to exhaustible resources, such as oil or minerals. These have been investigated starting from a Classical-Sraffian framework of analysis. In another paper (Kurz and Salvadori, 2015, chap. 16) we reviewed the whole debate, starting from what can be found on this issue in Sraffa's papers, followed by an analysis of the seminal paper by Parrinello (1983), and the subsequent debate, including an extensive analysis of Ricardo's views on mines.

In Appendix A Sraffa explains how from the economic system one can extract a "smaller self-replacing system the net product of which consists of only one kind of commodity"; this can be done for each and every commodity. Sraffa calls such a miniature system a "sub-system". The basic idea underlying the construction can be traced far back in the literature and is to be found, for example, in Marx and also in Ricardo. It is also known as a vertically integrated system. Its characteristic feature is that it needs only labour and natural resources as inputs from the outside, because all capital goods are reproduced within the integrated industry. A formalisation and elaboration of the concept was provided by Pasinetti (1988, 1989).

Sraffa's book provided also the basis for a reformulation of the pure theory of international trade, paying special attention to the fact that capital consists of heterogeneous produced means of production. A start was again made by Parrinello (1970), followed by several contributions by Steedman, Metcalfe and Steedman, and Mainwaring, who showed that several of the traditional trade theorems, derived within the Heckscher-Ohlin-Samuelson trade model, do not carry over to a framework with a positive rate of profits and heterogeneous capital goods; see in particular the collection of essays in Steedman, 1979b. Attention was also paid to the analysis of the small open economy, the world economy (see Steedman, 1979a) and taxation (see for instance Metcalfe and Steedman, 1971).

*Production of Commodities* was also an important tool in investigating issues in the history of economic analysis. The list of contributions and themes is too huge to be covered here; we illustrate the kind of findings in this literature in terms of three cases. As a matter of fact the price system studied by Sraffa (1960) can be found *in nuce* in many authors including Marshall and Walras, but also Marx and, obviously, Ricardo. Steedman (1977) scrutinised Marx's labour-value-based reasoning with the help of Sraffa (1960), and showed that it cannot generally be sustained. In a paper devoted to Walras's "Refutation of the English Theory" in the *Elements* we refuted Walras's criticism of Ricardo. We also showed that the Sraffa type of price system is contained in Walras's construction and showed that the Classical theory of value and distribution is fundamentally different from Walras's neoclassical one (see Kurz and Salvadori, 2002). In some other papers we have related the most prominent models of the New Growth Theory (NGT) literature to the Classical tradition of economic thought (see, for example, Kurz and Salvadori, 1998, chap 4). In a very precise sense the NGT can be said to involve a *return* to modes of thought and the method of analysis characteristic of the Classical authors. In terms of method, the NGT is *long-period* theory, advocated by Adam Smith and developed by David Ricardo. In terms of content, many of the models of the NGT dispense with the traditional neoclassical determination of the rate of profit in terms of the supply of and demand for "capital". Indeed the profit rate is determined by technology because it is assumed that there is a technology producing "labour". In order to render this fact acceptable to a twentieth-century audience, the factor has been given new names and enters the stage either as "human capital" or "knowledge". The readers of *Production of Commodities* may immediately recall that when at the beginning of chapter II (§§ 4-5) wages are regarded as entering the system "on the same footing as the fuel for the engines or the feed for the cattle" (Sraffa, 1960, p. 9), the profit rate and the prices are determined by technology alone. On the contrary, when workers get a part of the surplus, the quantity of labour employed in each industry has to be represented explicitly, and the profit rate and the prices can be determined only if an extra equation determining income distribution is introduced into the analysis. The additional equation generally used by advocates of neoclassical analysis is the equality between the demand and the supply of "capital", which requires the homogeneity of this factor. But no extra equation is required in the NGT since, as in Ricardo and in §§ 4-5 of Sraffa's book, there is a technology producing "labour".

## 6. A critique of marginalist theory

The subtitle of *Production of Commodities* is "Prelude to a critique of economic theory", the reference being to "the marginal theory of value and distribution" (Sraffa, 1960, p. vi). Indeed, for a long time after the publication of Sraffa's book the emphasis was almost exclusively on the explicit or implicit criticism of that theory contained in the book in the so-called Cambridge controversies on the theory of capital. Here we need not dwell on it; for summary accounts, see Harcourt, 1972; Kurz and Salvadori, 1995, chap 14; Garegnani, 2012; Petri, 2015. It suffices to draw the reader's attention to a book by Opocher and Steedman (2015) on *Full Industry Equilibrium* in which they chart out the implications of a rigorously long-period point of view for the supply side in conventional microeconomic theory. They show in particular that there is generally no presumption that the demand for a factor changes inversely with the factor price, as is commonly assumed in this kind of analysis. This has far-reaching implications for the theory, and implies that much of what economists conventionally take to be unobtrusive facts are not uncontroversial at all..

## 7. Concluding remarks

After the publication of the Ricardo edition and Sraffa's 1960 book, the perception and understanding of the Classical economists' approach to the theory of value and distribution changed markedly. Sraffa deserves the credit for having freed that approach from thick layers of misinterpretation and for having shown that it had been abandoned—"submerged and forgotten"—prematurely. In particular, the Classical approach was not flawed beyond remedy, as Sraffa's reformulation and elaboration of it demonstrated. What is more, the Classical approach turned out not only to be rich in content and now available in a logically consistent form, it also provided a perspective or standpoint from which major deficiencies of marginalist theory could be seen, which up until then had passed unnoticed. Apparently, the development of economics does not follow a path shaped by a perfect selection mechanism that abandons anything that is erroneous and weak and keeps everything that is true and useful. After Sraffa, economics is no longer what it was.

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