Sraffa on von Bortkiewicz: Reconstructing the Classical Theory of Value and Distribution

Christian Gehrke and Heinz D. Kurz

Among Piero Sraffa's unpublished papers is a notebook with extensive excerpts from and critical comments on three contributions of Ladislaus von Bortkiewicz: "Der Kardinalfehler der Böhm-Bawerkschen Zinstheorie" (1906), "Zur Zinstheorie. II. Entgegnung" (1907b), and "Wertrechnung und Preisrechnung im Marxschen System" (1906–7).[1] The reading notes and commentaries on Bortkiewicz's three essays were mainly written between January and April 1943, with some additions in December 1945 and June 1955. It was presumably the discussion of Bortkiewicz's contributions in Paul Sweezy's *Theory of Capitalist Development* (1942) that brought them to Sraffa's attention, who up until then appears to have been unaware of them.[2] What will perhaps come as a surprise to

Correspondence may be addressed to Christian Gehrke and Heinz D. Kurz, Department of Economics, University of Graz, Resowi-Centre F 4, A 8010 Graz, Austria; e-mail: heinz.kurz@uni-graz.at. Earlier versions of this article were presented at conferences in Strasbourg in October 2001 and in Salvador de Bahia in September 2002, and on the occasion of a PhD seminar of the DEA at the Université de Paris I–Panthéon-Sorbonne in November 2004. We are grateful to the participants at the conferences for useful discussions and observations. We should like to thank Pierangelo Garegnani, literary executor of Sraffa's papers and correspondence, for granting us permission to quote from them. Citations beginning with the letter *D* followed by a series of numbers (e.g., D1/91: 5–33) refer to Sraffa's papers at Trinity College Library, Cambridge; the format of the citations follows the catalog prepared by Jonathan Smith, archivist. We have used Sraffa's annotations in his personal copies of various books, which are also in the Wren Library at Trinity College; in our reference list, the catalog numbers of the corresponding items are given in parentheses. Unless otherwise stated, all emphases are in the original. Sraffa frequently abbreviated *and* by + ; we shall use the word instead

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some readers is that there are no excerpts from or comments on Bortkiewicz's famous paper "Zur Berichtigung der grundlegenden theoretischen Konstruktion von Marx im 3. Band des *Kapital*" (1907a) in Sraffa's papers.[3] While the three articles mentioned above are the only writings of Bortkiewicz from which Sraffa appears to have excerpted, he may well have read other contributions by him.[4] As we shall see below, Sraffa apparently held Bortkiewicz in high esteem because of what he, Sraffa, dubbed "Bortkiewicz's dictum" and his "dogma," which concerned criteria that the theory of value and distribution ought to satisfy. These

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of the symbol. Since in his texts Sraffa used both parentheses and square brackets, all additions by us, to Sraffa's texts and to all other quoted passages (whether by Sraffa or not), will be indicated by curly brackets. We are grateful to Jonathan Smith and the staff of Trinity College Library for continuous assistance while working on the Sraffa papers. We gratefully acknowledge receipt of valuable comments on an earlier draft of this essay from Gilbert Faccarello, Pierangelo Garegnani, Geoff Harcourt, John King, Gary Mongiovi, Arrigo Opocher, Neri Salvadori, and two anonymous referees. We should like to stress that the views contained in this article have not been discussed with the other participants in the project of preparing an edition of Sraffa's papers and correspondence (we are involved in that project as well) and therefore do not implicate them.

1. See folder D1/91: 5–33. Sraffa read Bortkiewicz's articles in the original German and excerpted them either in German or by translating the relevant passages into English. His summaries and comments are in English, except for a few short statements in Italian. Most of the entries are dated and the pages are numbered throughout. The copies of Bortkiewicz's articles that Sraffa used are not in his papers; presumably he used copies from the Marshall Library. This is certainly the case with regard to Bortkiewicz's "Der Kardinalfehler" (1906), because Sraffa noted on the first page of his excerpts from this article, "N.B. Marshall's copy of the offprint in the M.L. {Marshall Library} was unopened till this day, when I cut it" (D1/91: 5). Marshall's offprint copy of "Der Kardinalfehler" is not annotated. (We are grateful to Katia Caldari, who cataloged Marshall's books and articles, for helping us track down this copy.) Unless otherwise stated, translations from German sources are ours.

2. In his notebook Sraffa in one place refers to Sweezy's summary account of Bortkiewicz's argument (see D1/91: 20–21), and the relevant passage is annotated in Sraffa's copy of Sweezy's book. It seems fairly safe to assume that Sraffa first became aware of Vladimir K. Dmitriev's contributions via Bortkiewicz's "Wertrechnung" (1906–7); Bortkiewicz, as is well known, drew heavily on Dmitriev's analysis.

3. Sraffa in January 1943 copied the (German) title of Bortkiewicz's 1907 paper into his notebook (from a reference to it in a footnote in Bortkiewicz's 1906–7 article), which suggests that it was not known to him before. There is no copy of Bortkiewicz's 1907 article in Sraffa's papers, and neither the English translation in Sweezy's *Karl Marx and the Close of His System* (1949) nor the Italian translations in Sweezy's *Economia borghese ed economia marxista* (1971) or in Luca Meldolesi's edition of Bortkiewicz's papers titled *La teoria economica di Marx* (1971) are annotated (see Sraffa 3682, 2324, and 2325).

4. In Sraffa's library are copies of Bortkiewicz's *Das Gesetz der kleinen Zahlen* (1898), "Die Rodbertus'sche Grundrententheorie" (1910–11), and "Zweck und Struktur einer Preisindexzahl" (1923–24); there is also in Sraffa's papers a copy of "Böhm-Bawerks Hauptwerk" (1925).

criteria Sraffa had established independently of him and had actually met in terms of his own analysis of the problems of value and distribution. On the other hand Sraffa accused Bortkiewicz of having put forward misleading interpretations of Ricardo and Marx and of inconsistencies in the 1906–7 article.

The paper is organized as follows. Section 1 describes where Sraffa stood in his own constructive and interpretive work when he came across Bortkiewicz's papers in 1943. Without a clear idea of what Sraffa had himself accomplished by that time, it is impossible to understand his response to Bortkiewicz's criticism of Marx and its role in his reconstruction of the classical theory of value and distribution. Section 2 provides a brief account of Bortkiewicz's essay on the "cardinal error" in Böhm-Bawerk's theory of interest and of Sraffa's comments on it. Sraffa approved of Bortkiewicz's specification of the task of interest theory, a task Sraffa had accomplished (with regard to single production) with his "second equations" relating to an economy with a surplus and given real (i.e., subsistence) wages elaborated toward the end of 1927. Section 3 turns to Sraffa's detailed notes on Bortkiewicz's "Wertrechnung und Preisrechnung im Marxschen System" ("Value and Price Calculation in the Marxian System"). The emphasis is on alternative conceptualizations of production—as a circular flow or as a unidirectional process—and their implications for the theory of value and distribution. An important issue will be the effects of the accumulation of capital on income distribution and thus the Ricardian and Marxian explanations of a falling tendency of the rate of profits. Sraffa's notes were composed not least with a view to how the earlier authors' doctrines related to the concept of a falling marginal product of capital and what was wrong with it. While we touch upon this important critical task in Sraffa's work, it is far beyond the scope of this essay to deal with it in depth. Sraffa defended Marx against some of Bortkiewicz's criticisms. He supported especially two elements of Marx's analysis: (1) the circular flow concept of production, which implies that the maximum rate of profits is finite, and (2) his view that over time this rate is bound to fall as capital accumulates, where, in Sraffa's interpretation, Marx's argument invariably refers to the special case in which capital accumulates but there is no technical progress proper ("invention"). Marx is thus seen to closely follow Ricardo, who in a first step had investigated the implications of the accumulation of capital on the rate of profits in conditions of constant technological knowledge. Section 4 assesses the

importance of Bortkiewicz's contributions and Sraffa's critical disquisition on them for the latter's overall task of reformulating the classical approach to the theory of value and distribution and providing the basis for a criticism of marginalist theory.

Before we proceed, some specific difficulties we encountered when working on this article deserve to be mentioned. Sraffa's notes, including those on Bortkiewicz, were not meant to be published. They were written in an attempt to reach clarity on some of the more difficult analytical and interpretive problems he faced in the course of reconstructing the surplus approach to the theory of value and distribution. These concerned, first, the impossibility of reducing commodities to finite series of dated quantities of labor in a circular flow framework. However far back one traces the process of production (in logical time), one will never arrive at a stage where labor is employed without being assisted by produced means of production. This fact has far-reaching implications and was at the center of some of Sraffa's criticisms of Bortkiewicz and his admiration for Marx. One of the implications is that the maximum rate of profits of a given system of production (corresponding to zero wages) is finite, not infinite. This fact has an immediate bearing on the second issue we are concerned with: the impact of the accumulation of capital on the general rate of profits. This issue occupied center stage both in Ricardo's and in Marx's alternative explanations of a falling tendency of the rate of profits, and it recurred in a somewhat different form in the concept of the marginal productivity of capital advocated by neoclassical authors. Hence Sraffa was not only confronted with an intricate analytical problem but also with intricate problems of interpretation: How did Ricardo formulate his theory, and on the basis of which assumptions did he reach which conclusions, and was his reasoning sound? Was Marx's discussion of the falling tendency of the rate of profits premised in the same way as Ricardo's, and if not, could the differences in results be fully explained in terms of differences in assumptions? How did the marginalist authors frame their problem and how does their formulation relate to those of Ricardo and Marx? Given the intrinsic complexity of the problems at hand, it should come as no surprise that none of the doctrines under consideration is easy to interpret, a fact that is reflected in competing views on each of them and on the relationship between them in the literature. Also, Sraffa's understanding of these doctrines, their merits and demerits, underwent considerable change over time. This is evidenced by his comments on certain propositions of the authors he

dealt with, by his side remarks in his working notes, and by his annotations in his books.

It hardly needs to be stressed that the various dimensions of the aim of this article pose not only difficult questions of interpretation, but also of presentation. In order to deal with those questions within the confines of a single essay, we must expect from our readers some familiarity with the doctrines of Ricardo, Marx, and Böhm-Bawerk, with Bortkiewicz's assessment of their achievements and failures, and with Sraffa's *Production of Commodities by Means of Commodities* (1960)—the point on which Sraffa's critical and constructive work on the classical approach was to converge. His discovery of Bortkiewicz's "Wertrechnung" (1906–7) occurred at a crucial stage of the work on his book, shortly after he was able to resume his studies, which he had to abandon during the 1930s because of his absorption with the Ricardo editorial project, and soon after he had studied in great depth Marx's *Capital* at the beginning of the 1940s. Bortkiewicz's essay turned out to be the touchstone of Sraffa's own analysis as he had been able to develop it up until then and of his understanding of the classical authors, most notably Ricardo and Marx. The period from January to April 1943 must therefore be regarded as a most vibrant phase in Sraffa's intellectual development. Had Bortkiewicz anticipated in important respects what Sraffa was about to accomplish? Or had Sraffa by the time he came across Bortkiewicz's work already succeeded in reaching a higher standpoint and a deeper understanding of the classical authors? Without a clear view of the outcome of Sraffa's critical disquisition on Bortkiewicz's views, it is difficult to understand the development of his studies in the 1940s and thereafter.

1. Sraffa's Analytical Achievements up until the Beginning of 1943

To someone not familiar with the state of Sraffa's analytical and interpretive work at the beginning of 1943, many if not most of his comments on and criticisms of Bortkiewicz might be incomprehensible. Therefore we must prepare the ground by first giving a summary account of where Sraffa stood when he was exposed to Bortkiewicz's studies.[5]

5. The discussion that follows is based on Garegnani 2004, 2005; Kurz 2002, 2003; and Kurz and Salvadori 2001, 2004a, 2004b, 2005.

1.1. Sraffa's Sources and Program

Sraffa's constructive work can be traced back to the mid-1920s; it gained momentum in the second half of 1927 and developed with accelerating speed until 1931, when it was abruptly stopped because of the Ricardo edition project to which Sraffa had been appointed in early 1930 by the Royal Economic Society. For the following ten years Sraffa's constructive work was basically at a standstill. However, not surprisingly, because of his editorial work his understanding of Ricardo's theory and of the contributions of other classical economists grew remarkably and made him see things not seen or plainly misunderstood in the received interpretations of Alfred Marshall, Edwin Cannan, Jacob Hollander, and others. When at the beginning of the 1940s Sraffa was finally able to get back to his old notes and to continue his constructive work, he did so with a substantially increased knowledge of the classical approach to the theory of value and distribution and the reasons why it had prematurely been abandoned. Sraffa had already been clear for a considerable time that Marx was the last major classicist before the marginalist doctrine rose to predominance. Therefore two questions were close at hand: First, how did Marx's analysis relate to the analysis especially of Ricardo—did it involve analytical progress or, as some commentators (including Bortkiewicz) maintained, regress? Second, what went wrong—why had demand and supply theory, which Sraffa considered to be inherently flawed, managed to prevail over classical theory? This explains why Sraffa would read the recently published reprint of volume 1 of *Capital* (Marx [1867] 1938) while he was in an internment camp on the Isle of Man from 4 July to 9 October 1940. Back in Cambridge he then carefully scrutinized volumes 2 and 3 of *Capital*, which is reflected in several notes and references in Sraffa's papers and in annotations in his books. It is worth mentioning that Sraffa's annotations in his copies of the various editions of *Capital*, especially the French and English ones, typically contain indexes prepared by him on the flyleaves at the ends of the books or on their inside back covers. These indexes were apparently composed at different times, reflecting Sraffa's progressing analytical preoccupations. This can be inferred from Sraffa's handwriting, which changed over time, and from the parallel reflection of the different problems he was concerned with in his working notes.

We now take a brief look at Sraffa's work in the periods 1927–31 and 1942–43. We begin by mentioning a number of aspects that provide the

background against which Sraffa started to reformulate the surplus approach to the theory of value and distribution.

1.1.a. Circular Flow, Physical Real Costs, and Social Surplus

Sraffa was deeply interested in and impressed by recent advances in the natural sciences, especially physics, chemistry, and biology. He was fascinated by quantum physics and thermodynamics and was keen to develop an approach in economics in full recognition of the developments in the natural sciences and the laws regarding the physical and chemical world established by them. This met with his materialist and objectivist orientation, which he had brought to Cambridge not least as a fruit of his long discussions with Antonio Gramsci, and which, he felt, was corroborated by recent developments. He studied authors such as Jules-Henri Poincaré, Heinrich Hertz, Arthur Stanley Eddington, Alfred North Whitehead, and Percy Williams Bridgman. In the late 1920s, Sraffa appears to have wanted to adopt a "natural science point of view" and to develop a "purely objective theory"—an "atomic analysis," as he called it in the summer of 1929 (see D3/12/13: 16 (9), 18). His "first equations," developed in November 1927 and which eventually became chapter 1 of *Production of Commodities* (1960), relate to an economic system without a surplus and thus revolve around the concept of balancing inputs and outputs taken as a whole. Close at hand is the analogy between a product that obtains as the result of the "destruction" of necessary quantities of means of production and means of subsistence, on the one hand, and a chemical reaction conceived of as a balance of the weights of inputs and outputs.[6] In both cases the balance expresses conservation of matter. Sraffa traced the objectivist or natural science point of view back to William Petty (see below) and the physiocrats and discerned a close relationship between his equations and François Quesnay's *Tableau économique*. In the physiocrats, he pointed out, "il valore sia una quantità

6. It deserves mention that Sraffa at first wrote down systems of equations in which apparently heterogeneous things were added up and equated with one another (on this, see Garegnani 2005). To a chemist, for example, this would not necessarily have looked strange or even offensive, because an equation such as "$2H_2O = 2H_2 + O_2$" simply expresses the equality of constituents and compound. Similarly with regard to Sraffa's equations. However, once the necessary prices—what Sraffa called "absolute values"—were to be determined, it was clear that each quantity had to be expressed by two letters, one being the amount of the commodity, the other its value (in terms of some standard). See the respective comment by Frank Ramsey, with whom Sraffa in the early summer of 1928 discussed his first and "second" (i.e., with-surplus) equations and their solutions (D3/12/2: 28); see also Kurz and Salvadori 2001, sec. 5.

intrinseca degli oggetti, quasi una qualità fisica o chimica {value is an intrinsic quantity of objects, a quasi physical or chemical property}" (D3/12/12: 7). And with regard to Adam Smith's doctrine of "natural value" he emphasized that the Scotsman was concerned with "that physical, truly natural relation between commodities" (D3/12/11: 83). He also used the term "physical value" of products and insisted that it "*is* equal to what has been consumed" (D3/12/1: 5; see also D3/12/10: 54).

Throughout his work Sraffa did not vacillate as regards his main objective: to explain profits and rents, and the relative prices supporting a given distribution of income, in terms of the concept of *social surplus*. The surplus was obtained after the means of production and the means of sustenance (or wages) in the support of the workers necessary to produce given outputs had been deducted from those outputs. With a given real wage, conceived of as an "inventory" of commodities, the costs under consideration were *physical real costs*. Sraffa at the time saw the history of economics as characterized by a gradual degeneration from this concept of cost to that of psychic costs in contemporary marginalism—Marshall's "real cost" (see Garegnani 2004). Keen to lay a solid foundation of fact revolving around the twin concepts of physical real cost and surplus, Sraffa avoided all subjectivist elements. Subjectivism, he was convinced, made it too easy to slip in ideological elements in economics. Cases in point were the "abstinence" and "waiting" theories of interest, which he considered to be outright apologetic. And he was careful to avoid circular reasoning, that is, to explain values in terms of values.[7] 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).[8]

7. As early as the late 1920s Sraffa accused marginal productivity theory of circular reasoning because the concept of "quantity of capital" could not be defined independently of relative prices and thus the rate of interest, which, however, was the unknown to be ascertained.

8. There is a striking similarity between Sraffa's approach and Whitehead's description of the approach generally adopted in physics since the seventeenth century: "Search for measurable elements among your phenomena, and then search for relations between these measures of physical quantities" (Whitehead 1926, 63–64). Sraffa put a vertical line in the margin

1.1.b. Simultaneous Equations

An important further aspect concerns Sraffa's use of simultaneous equations. An approach to the theory of value and distribution that was based on the concept of circular flow could obviously not exploit its full potentialities without the use of simultaneous equations and the mathematics needed to solve them. This is why we see Sraffa from November 1927 onward formulating such systems of equations. In order to find out their properties, he first consulted textbooks of algebra and then sought the assistance of his "mathematical friends"—Frank P. Ramsey in 1928 and Abram S. Besicovitch and Alister Watson in the 1940s and 1950s (see Kurz and Salvadori 2001, 2004b). Sraffa referred to "my equations," and for good reasons. Simultaneous equations were a tool that he had not encountered in the writings of the classical authors, and the fact that these authors had lacked this tool was in no small degree responsible for their inability to fully master the analytical difficulties encountered. At the same time, Sraffa was aware that this tool played an important role in the most advanced version of marginalism—general equilibrium theory—and was extolled by its advocates, especially Vilfredo Pareto, as involving a huge progress compared with earlier economics. Sraffa had been exposed to Pareto's "equazioni dell'equilibrio generale" (Pareto 1906) while still in Italy, and he had referred to general equilibrium theory in his "Sulle relazioni fra costo e quantità prodotta" (1925).[9]

From a philological point of view it is interesting to note that in describing his first sets of equations and their solutions, Sraffa typically used the term *equilibrium*. Although, as Sraffa noted in the course of his studies of the classical authors, the notion of "equilibrium" had also been employed, among others, by Robert Torrens and Marx, it was, of course, in the late 1920s *the* central concept of marginalism. Sraffa therefore appears to have felt almost at once the need to specify the nature and meaning of his equations as opposed to those of marginalist theory. In a document contained in a folder dated by Sraffa "November 1927" that appears to have been composed immediately after he had elaborated his first and second equations, he noted that "I have not clearly defined nor have clearly in mind" the assumptions underlying "the equations from which the equilibrium is

beside this passage in his copy of the book. For a more detailed account of the issues at hand, see Kurz and Salvadori 2004a, 2005.

9. See also in this context Sraffa's annotations in Pareto's *Les systèmes socialistes* (1902) and *Manuale di economia politica* (1906) and the references to the Lausanne economist in his early papers.

determined" (D3/12/11: 67). The following addendum to the passage just quoted suggests that he was intent on defining his equations with regard to those of marginalist theory and especially of contemporary welfare economics championed by A. C. Pigou and Pareto: "Obviously, among these assumptions there must be a definition of the maximum or optimum of some sort, towards which the whole system tends—something comparable to the 'maximum of utility.'" This concern with an optimum is then reflected in Sraffa's attempt to find out at which set of (nonnegative) prices compatible with the given equations and a self-replacing state of the economy is the total value of the (net) product a maximum. However, Sraffa quickly saw that this did not lead anywhere and gave up the idea. It then did not take him long to render precise the purpose and meaning of his equations. In a document titled "Man from the Moon," probably written in 1928, he expounded as follows:

> The significance of the equations is simply this: that if a man fell from the moon on the earth, and noted the amount of things consumed in each factory and the amount produced by each factory during a year, he could deduce at which values the commodities must be sold, if the rate of interest must be uniform and the process of production repeated. In short, the equations show that the conditions of exchange are entirely determined by the conditions of production. (D3/12/7: 87)[10]

As early as the first period of his work Sraffa also began to see that his equations could serve a critical purpose in addition to the constructive one. Since contemporary (i.e., long-period) general equilibrium theory sought to determine the competitive (uniform) rate of interest and the corresponding set of prices, the equilibrium it established necessarily had to satisfy Sraffa's equations. The latter could thus be used to find out, as Sraffa stressed variously and also in a note dated 2 April 1957, "whether there is room enough for the marginal system" (D3/12/46: 32a). A concern with this critical task permeates all three periods of his work.

10. Sraffa apparently added the title only later, while preparing the edition of the *Works and Correspondence of David Ricardo*. He had learned that in a parliamentary debate on 30 May 1820 on petitions upon the subject of "agricultural distress," Ricardo had been accused of having "argued as if he had dropped from another planet" (Ricardo 1951–73, 5:56). In a note Sraffa related his metaphor of the "man from the moon" to this incident (see D3/11/227: 48). The metaphor was also referred to by Sraffa when resuming the work on his book in 1955 (see D3/12/49: 10).

1.1.c. The Whole and Its Parts

There is an important feature of Sraffa's equations to which we have to turn briefly. This concerns the assumption of given gross outputs. Adopting the method of simultaneous equations did by no means involve adopting Paretian general equilibrium theory. While Sraffa credited Pareto with having improved upon traditional marginalist theory by introducing indifference curves and refining the general equilibrium method, major flaws of the theory had been left untouched.[11] The "forces" the theory contemplated as bringing about a tendency toward equilibrium—"demand" and "supply," conceived of as schedules or functions—were essentially the traditional ones. According to Sraffa, these had no objective contents: nothing corresponded to them in the real world; and they were based on the untenable assumption of continuity. Inequality of income, customs, collective agreements, etc., were of much greater importance than individual utility and disutility or their modern equivalents. Sraffa agreed with methodologists and ethnologists like François Simiand and Bronislaw Malinowski who had argued that the marginalist perspective of *homo economicus* on human nature and society could not be sustained. Some of the difficulties besetting the theory had recently also surfaced in the writings of the more attentive marginalist authors themselves. With reference to the works of Alfred Marshall, Henry Cunynghame, Francis Y. Edgeworth, and A. C. Pigou, Sraffa pointed out that the allowance for *external economies* had undermined the strictly individualistic point of view. Hence, general equilibrium theory was not only confronted with the phenomenon of great complexity, as Pareto had maintained; it was also confronted with a kind of complexity that could not, as a matter of principle, be captured in terms of the individualistic approach. As regards the problem of externalities and demand, Sraffa stressed in a note composed in the summer of 1927 when preparing his lectures on advanced value theory "that it is not sufficient to make {the} utility of one commodity {a} function of all others consumed by {the} individual," but it would have also to be made dependent on the consumption of the "community" as a whole! Sraffa drew the following parallel: "It would be as if in astronomy we said the movement of each star depends upon all the others, but we have not the faintest idea of the shape of the functions!" (D3/12/3: 63).

This raised the question whether the part should be considered as constitutive of the whole, as neoclassical authors assumed, or vice versa.

11. See Sraffa's annotations in Pareto's *Manuale* (1906).

Sraffa, for reasons that should by now be obvious, sided with the latter methodological standpoint and found himself in agreement with the "objectivism" of contemporary natural sciences (see, for example, Whitehead 1926). The view that the whole is constitutive of the part is reflected, inter alia, in Sraffa's assumption of given gross outputs. To take gross outputs as given was clearly dictated by the ubiquitous nature of externalities and by increasing returns that are external to the industry as they had been investigated by Adam Smith in his analysis of the division of labor. This methodological position Sraffa shared with the classical economists and also with John Maynard Keynes.

When Sraffa began his constructive work, his knowledge of the classical authors, although swiftly growing, was not yet very developed. Edwin Cannan's lectures at the LSE and Marshall's *Principles* had exposed him to the conventional interpretation of the classical authors as early and crude demand and supply theorists. In 1927 and 1928 he read the newly published French edition of Karl Marx's *Theorien über den Mehrwert*, the *Histoire* (Marx [1861–63] 1924–25), which contains a radically different perspective on the classical authors. He had already encountered versions of this perspective in the early 1920s while consulting the available Italian literature devoted to the theory of value (e.g., books by Augusto Graziani and Arturo Labriola). Reading the *Histoire* appears to have contributed a fair measure of confidence to Sraffa's growing conviction that there must have been a fundamentally different approach to the theory of value and distribution that had been "submerged and forgotten since the advent of the 'marginal' method" (Sraffa 1960, v). Sraffa also saw that Marx had to be credited with having rediscovered this approach, but for reasons given further down he originally thought that Marx's reconstruction involved a "corruption" of it. Also, in terms of sophistication, modern marginalist theory could not be compared with the demand and supply theories Marx had attacked and dubbed "vulgar economics." The former had to be scrutinized closely in order to see whether and to what extent it had managed to overcome the deficiencies of its "vulgar" predecessors.

Hence Sraffa was confronted with three huge tasks that he specified as early as November 1927 in the following way:

1. Identify the "essence of the classical theories of value" by going back to the writings of Petty, Cantillon, the physiocrats, and the English classical political economists.
2. Reconstruct this "essence" in terms of a formulation that sheds the weaknesses and elaborates on the strengths of its earlier versions.

3. Find out "what is the difference with the later theories" and why the classical theory had been abandoned.

(With respect to these three tasks, see, in particular, D3/12/4: 12.)

1.2. Identifying the Essence of the Classical Theories of Value

Sraffa at the time was already clear that major classical economists had adopted a strictly "objectivist" point of view. He was particularly impressed by William Petty's "'physician's' outlook," which consisted in expressing himself only "in Terms of Number, Weight or Measure, . . . and to consider only such Causes, 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" (Petty [1899] 1986, 244). Sraffa saw that, several differences notwithstanding, the contributions of Smith, Ricardo, Marx, and many other authors exhibited a similar orientation and analytical structure and sought to explain all shares of income other than wages in terms of the surplus product within a circular flow framework of the analysis. In Sraffa's interpretation, physical real cost held the key to the classical approach to the problem of value. He saw this view corroborated in the writings of numerous authors. A particularly clear expression of it had been given by James Mill ([1821] 1826, 165), who had insisted that, in the last instance, "the agents of production are the commodities themselves. . . . They are the food of the labourer, the tools and the machinery with which he works, and the raw materials which he works upon."[12] Or, as Sraffa stressed toward the end of 1927, "the sort of 'costs' which determines values is the collection of material things used up in production" (D3/12/7: 106). And, "the fundamental force is physical real cost," which, however, is "seen only in general equilibrium" (D3/12/42: 46). The reference to "general equilibrium" was close at hand, because with the "Production of Commodities by Commodities," as Sraffa for a considerable time intended to title the book he was in the process of composing, echoing Mill's dictum above, the determination of values involved solving a set of simultaneous equations.

It will not have escaped the reader's attention that up until now the concept of "labor" and with it the labor theory of value, which had played a

12. See the excerpts Sraffa took around May 1932 from Mill's *Elements of Political Economy* in D3/12/9: 106–18.

central part in the classical authors and Marx, have not been mentioned. The reason for this is that at the beginning of his constructive work Sraffa was convinced that these stood for the failure of the earlier authors to elaborate a coherent theory of value and distribution. The right starting point, he insisted, was that of Petty, who had singled out workers' means of subsistence, their "food," not labor, as the "ultimate measure of value." Sraffa accused Ricardo and Marx of having "corrupted" the concept of physical real cost (see, for example, D3/12/4: 2). As late as 1929 he still considered labor as "not a quantity at all" and called the concept "metaphysical" (see, for example, D3/12/11: 64). He questioned the special treatment of the labor of a wage earner as compared with that of a slave, a horse, or a machine, as it was advocated by some classical authors and also by Marshall, and maintained that "it is a purely mystical conception that attributes to human labour a special gift of determining value" (D3/12/9: 89). This view was understandable with regard to what Sraffa called his "first" and "second equations" (see below), that is, those relating to an economy without and with a surplus and given *real*, that is, *commodity*, wages, as we encounter them again in Sraffa 1960 (see paragraphs 1–5 of that book). In such a framework, the problem of value and distribution could be dealt with without any need of ever mentioning labor.

Yet, as soon as Sraffa, following Ricardo's lead, turned to the case in which workers participate in the sharing out of the surplus product in his "third equations," a new wage concept was needed—a fact that forced him to reconsider his views on labor. Sraffa was impressed by the way in which Ricardo had attempted to deal with the case under consideration in terms of what Sraffa called "proportional wages," that is, "the proportion of the annual labour of the country . . . devoted to the support of the labourers" (Ricardo 1951–73, 1:49).[13] Toward the end of the first period of his constructive work, if not earlier, Sraffa had eventually convinced himself that the classical authors had good reasons to treat labor as an economic quantity in proportion to which wages were paid. Because with workers receiving a share of the surplus product, wages could be given only in some more or less abstract standard and their magnitude could be specified in proportion to the labor (time) performed. And when at around the same time he developed what he called his "second way of approach" to the problem of value in terms of the reduction to dated amounts of wages paid

13. For a detailed account of Ricardo's concept of proportional wages, see Gehrke 2003.

in the production of a commodity or the quantities of labor, the first being simultaneous equations, he was finally possessed of a solid basis from which to assess the merits and demerits of the labor theory of value in a circular flow framework. He saw that to a share of wages equal to unity corresponded a zero rate of interest and relative prices which, using the method of reduction to wages or labor, could be seen to be proportional to the total wages paid or the quantities of labor needed directly and indirectly in the production of the various commodities.

We now turn briefly to Sraffa's equations.

1.3. Reconstructing the Classical Theory of Value and Distribution

1.3.a. Sraffa's "First Equations"

In November 1927 Sraffa began to elaborate his systems of equations. He quite naturally started with an economy that produces just enough, neither more nor less, to recover the necessary means of production used up in the process of production and the necessary means of subsistence in the support of workers—a situation reflected in what he called his "first equations." He emphasized that this amounts to considering wages "as amounts of fuel for production" (D3/12/7: 138) and identified the situation as the realm of *pure necessities*, or "natural economy." In this case the concept of physical real cost applied in an unadulterated way. With respect to value in such conditions, Sraffa insisted that there was no problem of "incentives," the grand theme of marginalism: what mattered were exclusively the material costs of production of a commodity. The means of subsistence in the support of workers were an indispensable part of these physical real costs, because only their (recurrent) consumption "enabled" workers to perform their function. The periodic destruction of such commodities is a necessary condition for the economic system to realize a "self-replacing state," but it is not alone sufficient. The system must be able to restore periodically the initial distribution of resources in order for the (re)productive process to continue unhampered. Commodities must be exchanged for one another at the end of the uniform period of production. But which exchange ratios guarantee the repetition of the process? Sraffa showed that the sought-after ratios, or what Ricardo had called "absolute" values, were uniquely determined by the sociotechnical conditions of production and could be ascertained by solving a set of linear homogeneous production equations.

1.3.b. Sraffa's "Second Equations"

Next Sraffa in his "second equations" turned to the case in which the system produces a surplus over and above the necessary physical real costs, including subsistence wages. He stressed, "When we have got surplus, natural economy stops" (D3/12/11: 42) and social and institutional factors become important. Technically this is reflected in the fact that "the equations become contradictory" (D3/12/6: 16). Materially, "the 'absolute values' have no more the appeal to commonsense of restoring the initial position—which is required if production has to go on" (D3/12/6: 10). Indeed, in the with-surplus economy a whole range of exchange ratios is, in principle, compatible with the condition of self-replacement (see D3/12/6: 9). Sraffa stressed that "within those limits value will be indeterminate." "It is therefore necessary to introduce some new assumption, which in substance will amount to determine . . . according to which criterion the surplus is distributed between the different industries" (D3/12/6: 16). With free competition, and focusing attention on the case of only circulating capital, the surplus is distributed in terms of a uniform rate of interest on the value of the "capital" advanced in the different industries. How is this rate determined? It is determined, Sraffa insisted, *simultaneously* with relative prices and thus the value of capital employed in each industry and in the system as a whole. By June 1928 he had managed, with the help of his friend and colleague Frank Ramsey, to establish that a solution existed and what it was (see Kurz and Salvadori 2001, 262–64). (His respective considerations foreshadow paragraphs 4–5 of his 1960 book.)

1.3.c. Sraffa's "Third Equations" and Ricardo's "Proportional Wages"

While in his second equations he retained the assumption of given inventory wages, Sraffa almost in parallel began to investigate the case of a change in wages and its impact on the rate of interest and relative prices, given the system of production, in terms of his "third equations." (His respective considerations foreshadow paragraphs 8–12 of his 1960 book.) He did this first in terms of a redistribution of the surplus product away from profits and toward wages in proportion to the original vector of the surplus product.[14] This assumption allowed him to conceive of the redistribution of the surplus in straightforward physical terms and yet advocate a share concept of surplus wages that is independent of relative prices. He demonstrated that an increase in wages implied a decrease in

14. See also in this context the numerical example in Ricardo 1951–73, 1:50.

the rate of interest and in general a change in relative prices. However, for obvious reasons he was not happy with the idea of variable surplus wages with a constant commodity composition: how could the latter be known independently of the prices of commodities? He saw that Ricardo had also allowed for a participation of workers in the surplus product and was especially fascinated by the way Ricardo had done this analytically in terms of proportional wages, which had allowed him to circumnavigate the problem just mentioned. The germs of Sraffa's work in this regard can be traced back to the latter part of the first period of his constructive work, but it was only as a consequence of his work on the Ricardo edition in the 1930s that he understood more clearly the new conceptualization of real wages as proportional wages that Ricardo had adopted in the *Principles* (see also Sraffa 1951, lii). In particular, Sraffa became aware of the fact that Ricardo's argument was not meant to be limited to the case of a given economy at a given time but was designed to cover in at least one important respect also the development of the economy *over time*. More specifically, Ricardo's demonstration of the inverse relationship between the rate of profits and wages was seen to encompass the case in which the productivity of labor changes. It was on the basis of the new wage concept (and on the premise that the social capital consisted only of, or could be reduced to, wages) that Ricardo had felt he could assert what may be called his "fundamental proposition on distribution": that the *rate* of profits depends on *proportional wages*, and on nothing else.

Before we proceed with a summary account of Sraffa's achievements in the first period, it is worth noting that Sraffa upon resuming his work on his book in the summer of 1942 adopted for good a share concept of wages in his third equations, with wages, w, expressed as a proportion of the net product ($1 \geq w \geq 0$). However, at first he retained the Ricardo-Marx assumption that wages as a whole were paid out of the capital advanced at the beginning of the uniform period of production, that is, *ante factum*.[15] It was only toward the end of 1943 that he abandoned the classical assumption and took wages to be entirely paid out of the product. A consequence of this was the replacement of the classical socio-economic distinction between "necessaries" and "luxuries" with the more technical distinction between "basic" and "nonbasic" products.

15. For Ricardo, it would have been difficult to assume wages paid *post factum* because it would have meant that in many of his observations on profits, capital, which he tended to identify with the wages bill, would have vanished.

1.3.d. Relative Prices and Distribution: The Austrian Concept of "Period of Production" and Sraffa's Statistical Hypothesis

In the context of an investigation in the late 1920s of how a change in wages affects the rate of interest and relative prices, given the system of production in use, Sraffa saw that solving a set of simultaneous equations for each and every level of wages was cumbersome and the results not very transparent. He was therefore on the lookout for a second method designed to render the properties of the system easier to grasp. The method sought, as we have already noted, was the reduction to dated quantities of labor (or wages appropriately discounted forward). Could the series of dated labor terms be expressed in a compact form, in a single magnitude, that was independent of distribution? As is well known, Eugen von Böhm-Bawerk had thought that this was indeed possible and in his *Positive Theory of Capital* ([1889] 1959) had elaborated such a measure in terms of the "average period of production." Sraffa around the turn of 1928 studied Böhm-Bawerk's attempt and saw that the concept could not be defined independently of the rate of interest. Therefore it could not be used as a primitive technical data, or given, in the theory of value and distribution. However, in studying the impact of a change in distribution on relative prices, it was possible to employ the average period as a measure of the capital-to-labor ratio with which a given commodity was produced at the level of the rate of interest taken as the starting point of the investigation. Sraffa in fact for a while used the concept for this purpose and was even provisionally prepared to accept two doctrines Böhm-Bawerk had advocated. First, with a rise in wages (and the corresponding fall in the rate of interest), consumption goods would fall in price relative to capital goods. This was seen to be an implication of the Austrian unidirectional conceptualization of production which starts with unassisted labor and leads via a finite sequence of intermediate or capital goods to final or consumption goods. Being obtained at the very end of the production process, the latter were generally taken to be produced with a higher capital-to-labor ratio (or average period of production) than capital goods. Second, in the case in which there is a choice of technique, cost-minimizing producers at a lower (higher) rate of interest would invariably adopt that method of producing a given commodity which is associated with a higher (lower) average period of production.

Sraffa soon got doubts as to the validity of these doctrines. In a manuscript he began to write in February 1931 he stated that, contrary to the marginalist proposition, consumption goods were not necessarily produced in a more capital-intensive way than capital goods. In a circular

flow framework, the Austrian classification of goods according to their greater or smaller distance from the maturing of the final product made no sense: wheat, for example, was both a means of production (seed) and a consumption good. Sraffa concluded as follows with regard to the sum total of capital goods compared with the sum total of goods produced:

> It may be said that *the value of total capital in terms of total goods produced cannot vary* {as a consequence of a variation of wages and a contrary variation of the rate of interest}, *since the goods are composed exactly in the same proportions as the capitals which have produced them*. (D3/12/7: 157(3); emphasis added)

Sraffa added that the proposition is "false, but may contain an *element of truth*." Some twelve years later, in a note composed in November 1943, he clarified that his proposition was based on the "statistical compensation of large numbers" (D3/12/35: 28). Henceforth he called the assumption that the value of social capital relative to that of social product does not change with a change in distribution "My Hypothesis" or simply "Hypothesis."

Exploring the "element of truth" mentioned, Sraffa eventually had to abandon the idea that any actual economic system could ever be expected to satisfy the hypothesis. He therefore had to construct an artificial system out of his equations that did so. This he accomplished in late January 1944 in terms of the device of the "Standard commodity" and "Standard system" (see the pages beginning with 61 in D3/12/36).

However, prior to mastering this task, and actually helping him a great deal in this respect, Sraffa at the beginning of the 1940s credits Marx explicitly with a number of important analytical achievements. Since there are no traces of the attributions under consideration to be found in Sraffa's papers relating to the first period of his work, it appears safe to assume that at the time he was not aware of these achievements. His findings must have come as a formidable surprise to him and apparently must have greatly contributed to his growing admiration for Marx, the economic theorist, as distinct from Marx, the materialist philosopher and social critic.

1.3.e. Sraffa on Marx's Analytical Achievements

Studying carefully Marx's *Capital* (and anew the *Theories of Surplus Value*) at the beginning of the 1940s, Sraffa found that Marx had detected an important error in Ricardo's argument. Marx had approved of Ricardo's new conceptualization of real wages as proportional wages (see Marx

[1861–63] 1989, 226–27, 419) and had translated it into the relation between the value of the social surplus product (S) and that of the social variable capital (V), or *rate of surplus value* (S/V).[16] Accordingly, Ricardo's proposition that the level of the general rate of profits is inversely related to proportional wages is equivalent to the statement that its fall (rise) is conditional on a fall (rise) in the rate of surplus value. Marx ([1861–63] 1989, 10) had objected to this that Ricardo had erroneously identified the rate of profits with the rate of surplus value: he had been led to this identification because "in his observations on profit and wages, Ricardo . . . treats the matter as though the entire capital were laid out directly in wages." If we take into account nonwage capital—or, more precisely, if we take into account that capital cannot be resolved entirely into direct and indirect wages in a finite number of steps, as Ricardo had been inclined to assume—then his proposition held not necessarily true any more: *the rate of profits can fall (or rise) even if proportional wages remain constant*.

However, as Sraffa noted, Marx had not always been consistent in his own treatment of wages. Notwithstanding his approval and adoption of Ricardo's concept of proportional wages, Marx—especially in his own working notes on the law of the falling tendency of the rate of profits—had freely moved between this concept and the traditional one of real wages conceived of as an inventory of commodities. As will be seen below, in Sraffa's view the existence side by side of these two conceptions, which are not mutually compatible with each other, was a fertile source of confusion and misinterpretation.

While Sraffa had always held Marx in high esteem, at the beginning of the 1940s he saw in detail what in the late 1920s and at the beginning of the 1930s he appears to have seen only vaguely, if at all, namely, that Marx had grappled with similar problems and had made some considerable progress over and above the state in which Ricardo had left the theory of value and distribution. According to Sraffa, Marx's most remarkable and closely related achievements were the following:

1. Marx's representation of a given system of production in terms of his schemes of reproduction shared the same outlook as the circular flow approach of the physiocrats.[17]

16. In Marx's terms, proportional wages are given by $V/(V+S) = [1 + (S/V)]^{-1}$.

17. In Sraffa's own indexes of the French edition of volumes 2 and 3 of *Das Kapital* we find "1st equations 444" and "Equations 440" respectively; see Marx 1900, 1901, 1902. There is

2. Closely related to this was Marx's concept of "Constant Capital," which expresses the fact that commodities are produced by means of commodities. This is why, as we shall see, Sraffa defended this concept against Bortkiewicz, who, starting from Dmitriev's "Austrian" representation of production as a linear flow of finite duration, had maintained that the concept was unimportant and could be dispensed with.
3. In terms of his labor-value-based approach, Marx had been able, however imperfectly, to see through the complexities of the system under consideration and establish the fact that the rate of profits was bounded from above. In Marx's conceptualization, the maximum rate of profits that obtained when wages were nil was equal to L/C, that is, the ratio of total living labor expended during a year ($L = V + S$) and social constant capital (C). It was thus equal to the inverse of the "Organic Composition of Capital" of the system as a whole.[18] Sraffa must have been especially flabbergasted when he found out that Marx in terms of what Sraffa called the former's "Value Hypothesis" had presupposed a fact which he, Sraffa, had sought to establish with his statistical "Hypothesis": both postulated that the ratio of social capital to social product was independent of the rate of profits.
4. With the capital-to-output ratio being independent of the way in which the product is shared out between wages and profits, Marx had paved the way to the establishment of the inverse relationship between the *rate* of profits and proportional wages in a circular flow system.

As a reflection of his deeper knowledge and understanding of Marx's contribution, in the 1940s we see Sraffa use such notions as simple reproduction, constant and variable capital, rate of surplus value, and organic composition of capital. However, Marx's concepts are typically not simply adopted, but are adapted to Sraffa's own non-labor-value-based approach.

By the end of the first period of his constructive work, Sraffa had understood that relative prices depended in a possibly intricate manner on the distribution of income. However, it was not immediately clear how this

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every reason to presume that these entries were written in the early 1940s, when Sraffa discovered Marx's achievements as an economist, and not, as has been contended, in the late 1920s.

18. This is why, in our view, Sraffa was to credit Marx, and not Ricardo, with the discovery of the maximum rate of profits in circular systems of production (see Sraffa 1960, 94).

dependence could be given a precise expression nor how the distributive variables, the rate of profits and proportional wages, were related. In the early 1940s he saw that by taking the rate of profits as given, which was suggested by considerations that eventually led to the short paragraph 44 of his book, he could render the equations of production linear. The only thing that was missing in order to determine relative prices at each level of the rate of profits was the relationship between the latter and proportional wages. Once this relationship was found, Sraffa could proceed in a familiar way: with a given rate of profits he could determine the corresponding share of wages. These two magnitudes could then be plugged into the equations and the latter could be solved using the mathematical tools Sraffa had acquainted himself with. This explains why he spent so much time on establishing the relation between the two distributive variables.[19] He was able to fully solve the problem for systems with single production in 1944 in terms of the Standard commodity. With wages paid *post factum* and expressed as a proportion of the Standard net product, the sought-after relation between the two distributive variables is linear and, most important, it applies also to the actual economic system.

We are now ready to discuss Sraffa's comments on Bortkiewicz's papers. We begin with Bortkiewicz's criticism of Böhm-Bawerk's theory of capital and interest because it contains a specification of an important criterion that interest theory has to meet, a criterion that Sraffa shared. This discussion prepares the ground for Sraffa's treatment of Bortkiewicz's disquisition on Marx and Ricardo.

2. Bortkiewicz on the "Cardinal Error" of Böhm-Bawerk's Theory of Interest

2.1. Böhm-Bawerk's "Third Ground"

In his paper "Der Kardinalfehler der Böhm-Bawerkschen Zinstheorie," Bortkiewicz (1906) criticized the "Three Grounds" put forward by Böhm-Bawerk in his theory of capital and interest in favor of a positive rate

19. There is another reason for his interest in establishing a relationship between r and w. Such a relationship implied that the rate of profits could be ascertained independently of relative prices, which, in turn, could be seen to provide support for Ricardo's dictum that "the great questions of Rent, Wages, and Profits must be explained by the proportions in which the produce is divided," and that the laws of distribution "are not essentially connected with the doctrine of value" (Ricardo 1951–73, 8:194).

of interest: (1) the differences between wants and provision in different periods of time; (2) the systematic underestimation of future wants and the means available to satisfy them; and (3) the technical superiority of present compared with future goods of the same quality and quantity. Bortkiewicz focused attention on the third ground—according to Böhm-Bawerk ([1889] 1902, 286) the "main pillar" of his theory of interest—which referred to a "purely objective factor" (Bortkiewicz 1906, 945). Was it possible to derive from it a value agio in favor of present goods as the basis of a positive rate of interest?

Bortkiewicz did not think so—he rather considered Böhm-Bawerk's respective argument to contain the "cardinal error" of his entire construction.[20] To show this, he turned to a numerical example in the *Positive Theory of Capital* meant to illustrate the superiority of "more roundabout" processes of production. The example, Bortkiewicz maintained, was misleading because Böhm-Bawerk had given only an incomplete picture of the case under consideration. The example concerns production processes started in consecutive years. Alas, Böhm-Bawerk had assumed without any justification that all processes stop at the end of the process started first. If each process was instead taken to break off after the same number of years as the first one, we arrive at a uniformly staggered system of production. Now the process started first is no longer superior to all other processes with regard to all future time periods, because after its truncation the other processes still generate outputs, whereas the first one no longer does. Without a knowledge of the value relations between the goods obtained at different points in time, the result is a "*non liquet*" (Bortkiewicz 1906, 954). Bortkiewicz concluded that,

20. Bortkiewicz was also critical of the other two grounds and particularly of Böhm-Bawerk's argument in favor of a positive rate of time preference. He insisted that one ought to be "extremely cautious" with any sort of "psychological reasoning" and (as Friedrich von Wieser, Böhm-Bawerk's brother-in-law, had argued before him) that it would have to be shown that a positive time preference exists independently of the phenomenon of interest, because if the latter is positive, the former must necessarily be positive too: a positive time preference would have to be shown to be the "*prius*" relative to the phenomenon of interest (Bortkiewicz 1906, 948). He also attacked the view that a positive time preference follows from the fact that all future possessions are more or less uncertain. Since Böhm-Bawerk was concerned with explaining interest proper, that is, net interest as opposed to gross interest, which includes a risk premium designed to take account of the element of uncertainty just mentioned, myopic behavior due to uncertainty can play no role in his argument. "Taken all together, the purely subjective foundation of Böhm-Bawerk's doctrine turns out to be uncertain and precarious" (950).

> seen from a purely formal point of view, he {Böhm-Bawerk} did not reason correctly. His argumentation, on which he puts the main weight, suffers from an internal mistake. . . .
>
> It appears that we need not go beyond the very abstract scheme of v. Böhm-Bawerk to prove that interest cannot be determined, in the way he attempts to (nor, as I believe, in any other way), *from the technical conditions of production*. (958; emphasis added)

Sraffa excerpted this passage and marked his translation of the last sentence with a straight line in the margin (D1/91: 5): it was precisely this task (i.e., to determine interest exclusively from the technical conditions of production) he had put to himself in 1927–28.

Next, Bortkiewicz had turned to a critical examination of Böhm-Bawerk's discussion of which method(s) of production will be chosen by cost-minimizing producers when there is a choice of technique, and which interest rate and prices would obtain. The discussion was based in the usual marginalist way on the assumption that different "quantities of capital" available to producers involve the adoption of different methods of production. More precisely, "the more capital a producer has at his disposal, the higher the output (per unit of labor employed) he produces." Bortkiewicz added that in this version, which avoided the disputed "average period," Böhm-Bawerk's basic underlying idea "can most likely be advocated." But, Bortkiewicz asked,

> is it allowed, when the question is to explain the phenomenon of interest, to make a comparison between producers who are endowed with capital goods in different quantities? Has not Böhm-Bawerk himself explained to the followers of the productivity theory {the reference is especially to Thünen} that a plus of product obtained through a plus of capital is not as such identical with a plus of value, since as a consequence of a stronger participation of the factor capital in production a cheapening of the product may result? (959)

Bortkiewicz added that Böhm-Bawerk's objection obviously assumed that the more capitalistic method was universally employed, because otherwise the value of the product could not be regulated by it. As Rudolf Stolzmann (1896) had already pointed out, this had the fatal implication that Böhm-Bawerk's objection now applied also to his own theory. If Böhm-Bawerk was right in maintaining that with the universal use of the more capitalistic method the value of the product was bound to fall, then it was unclear whether this fall left any room for interest. At any rate, as Stolz-

mann had rightly stressed, interest "can no longer be derived from the difference between the amount of product which can be obtained *without* the capitalistic roundabout, and the amount of product which can be obtained *with* the help of it" (as quoted in Bortkiewicz 1906, 959). Bortkiewicz concluded:

> With these remarks Stolzmann has, I believe, really shown up the weakest point in the Böhm-Bawerkian theory of interest. The objective basis of this theory could in fact be held to be valid if it {were} established, on whatever grounds, *that methods of production of different degrees of productivity are applied side by side*, or, more exactly, must be applied under the condition that each producer follows uncompromisingly the economic principle. (960; emphasis added)

The italicized part was marked by Sraffa with two vertical lines in the margin (see D1/91: 6).

2.2. "Bortkiewicz's Dictum" on the "Touchstone" of Interest Theory

In Bortkiewicz's view, Böhm-Bawerk had not succeeded in explaining interest. He had failed not least because of his inability to integrate the theory of interest and the theory of value in a coherent manner. And he had put the problem in a quasi "dynamic" setting where it did not belong. This becomes clear in Bortkiewicz's (1906, 970–71) following remarkable proposition:

> I believe that this can be regarded as *the touchstone of such a theory*: whether it is able to show the general cause of interest also for the case in which not only *no technical progress*, of whichever type, takes place, but also the length of the periods of production appears to be technically predetermined, so that *no choice* is possible between different methods. (emphases added)[21]

In other words, interest had to be explained in conditions of a *given* system of production—setting aside a choice of technique and technical progress. Sraffa marked this passage in the margin, and in brackets referred to a number of further passages in Bortkiewicz's paper with similar or related statements. As we have seen in section 1.3.b above,

21. To the above passage Bortkiewicz appended a footnote in which he stressed that J. B. Clark's theory of marginal productivity also does not satisfy this requirement.

Sraffa in 1927, unaware of the conditions Bortkiewicz had enunciated two decades earlier, met them in terms of his "second equations."[22]

The next entry in Sraffa's notebook is an excerpt of two statements from Bortkiewicz's article "Zur Zinstheorie. II. Entgegnung" (Bortkiewicz 1907b), which is a rejoinder to a critical comment by H. Oswalt (1907) on the "Kardinalfehler" article. The two statements are closely related to the passage quoted above and strike a recurrent theme in Sraffa's papers:

> Now my opinion is that in general the value of goods can only depend upon such technical knowledge as is applied in practice. But the value of goods remains unaffected by knowledge which, on whatever grounds, is not utilized. . . . The result thus obtained can be summed up in the following brief formula: *for [the determination of] the value of goods there come into consideration only actual methods of production (Verwendungsarten), and not merely potential ones*. (D1/91: 7; see Bortkiewicz 1907b, 1296–97, 1299)

Sraffa marked these passages approvingly in the margin and then noted, apparently having looked up the "Critical Excursions" in the *Positive Theory of Capital*,[23] in which Böhm-Bawerk had answered his critics, that the Austrian had misunderstood Bortkiewicz: "And he begs the question by saying that the touchstone of no choice of period cannot be applied to his theory which professes to be based on just such a choice" (D1/91: 7). In Sraffa's papers, Bortkiewicz's insistence on the exclusive relevance in the theory of value of methods that are *actually used* recurs repeatedly as "Bortkiewicz's dictum" (see, for example, D3/12/18: 9). Sraffa had actually stated the same maxim, independently of Bortkiewicz, in a document of October 1929:

> Clearly, we must reduce *all* the data to things that actually happen, excluding inexistent possibilities. Only such things are measurable, and can enter the theory as "knowns," or "constants"; and, in reality,

22. Bortkiewicz praised the Russian mathematical economist Vladimir K. Dmitriev for having solved the task under consideration, "provided the technical conditions of production of commodities (including the commodity labor-power) are given" (Bortkiewicz 1906–7, pt. 2, 39). It should be noted, however, that Dmitriev had assumed unidirectional processes of production of finite length and had thus set aside the intricate problem of circular production. Bortkiewicz (1906–7) was to follow Dmitriev in this regard, with negative implications for his understanding of Marx; see section 3.

23. See Böhm-Bawerk 1909–14.

> only really happening things can be real causes and determine effects. (D3/12/13: 1(2))

In the next entry, dated 21 April 1943, Sraffa takes up Bortkiewicz's "Der Kardinalfehler" again. While Bortkiewicz had requested that the theory of interest must be able to explain the cause of interest also when there is no choice of technique, he had not been of the opinion that the problem of choice has no role to play in it. However, he had maintained, adopting Böhm-Bawerk's (in)famous distinction, that while it is of no import with regard to the *cause* of interest, it plays a role as regards the determination of its *size* (Bortkiewicz 1906, 971). Sraffa commented on this distinction:

> Now if one interprets it as distinguishing between "causes of existence" and "causes of size," it seems frightfully metaphysical. One can start asking, how can "existence" be determined in the abstract, without being a particular, specific, existence determined in its magnitude and its location? etc.
>
> But more probably he means that the *total of profits*, or proportion of the product, or 1—*w* {*w* stands for the share of wages in net income} is determined on other grounds, and that the "coefficients" and "alternative methods" can only determine the quantity of capital and thereby the *numerical value of the rate of interest*. (D1/91: 8)

Sraffa thus agreed with Bortkiewicz that the "touchstone" of the theory of interest was to show the "general cause of interest" for a *given system of production* in which "no choice is possible between different methods." This specification flew in the face of the marginalist explanation of interest in terms of a hypothetical *change* in the proportion of "factors" of production and thus a change in technique. As Sraffa was to write in the preface of his 1960 book, "In a system in which, day after day, production continued unchanged in those respects, the marginal product of a factor . . . would not merely be hard to find—it just would not be there to be found" (v).

Therefore, Sraffa must have been taken aback when Bortkiewicz, who had so clearly and convincingly spelled out the requirements the theory of interest had to meet, toward the end of his paper on Marx and Ricardo opted for incorporating the cost equations into a Walrasian system of equations. However, before we come to this aspect we must first provide a summary account of Sraffa's assessment of Bortkiewicz's views on Marx and Ricardo.

3. Bortkiewicz on Marx and Ricardo

3.1. Preliminary Observations

We learned in section 1 that Sraffa showed little interest in the problem of the so-called "transformation" of labor values into prices of production, which had bothered Marx and whose approach Bortkiewicz had scrutinized critically. According to Sraffa, the early classical economists had rightly started from physical real costs and were only pushed toward basing their theory of value on labor magnitudes as a consequence of their inability to overcome the analytical difficulties they faced vis-à-vis the circular flow of heterogeneous commodities. The method of simultaneous equations, which would have solved their problem, was not at their disposal. As Sraffa's early work demonstrates impressively, the classical theory of value and distribution could be elaborated without any reference to "labor values."

Sraffa was instead interested in whether Bortkiewicz's essay contained anything that was of help to better understand marginalist theory and its deficiencies. According to Sraffa this was indeed the case. Sraffa's concern with marginalism is particularly obvious in his discussion of the problem of the impact of capital accumulation on the rate of profits. Indeed, the marginalist asks what would be the effect of an infinitesimally small increase in the "quantity of capital" on the rate of profits, given the technical alternatives from which cost-minimizing producers can choose. This perspective is made very clear in a document dated 20 August 1943. Sraffa there assumed "conditions of stationary technical possibilities (i.e. no inventions)." He qualified this assumption as "in itself utterly absurd," but justified it in the following terms: "1) *It adopts the basic outlook of the marginal product theory of capital and therefore serves to refute it*—2) it shows the tendency of r to fall in the absence of technical invention, and thereby shows the necessity of the latter" (D3/12/34: 5; emphasis added).

Reading Sraffa's comments, one gets the impression that while none of Bortkiewicz's results struck him as true novelties, he perceived the latter's essay as a welcome opportunity to test and sharpen his own argument. Sraffa had thought through similar problems in terms of the different framework of a circular flow of production and was keen to relate Bortkiewicz's unidirectional (or "Austrian") analysis to his own. He saw that in important respects Bortkiewicz's essay corroborated his own reconstruction of the classical approach to the theory of value and distribu-

tion. However, he also felt that in a number of respects Bortkiewicz had not been faithful to the true problems Ricardo and Marx had been confronted with and the concepts they had forged to solve them, and had therefore arrived at a distorted picture of the issues under consideration. These concerned in particular Ricardo's and Marx's respective demonstrations of the falling tendency of the rate of profits.

3.2. The "Law of the Tendency of the Rate of Profits to Fall": Sraffa's Reading of Ricardo and Marx

For a proper understanding of Sraffa's comments on Bortkiewicz's criticism of Marx's law, it is necessary to reconstruct his own reading of Marx's explanation of the falling rate of profits. Since there is no single document in which Sraffa set out his understanding of Marx's law, it had to be pieced together from a number of working notes (which are scattered across several folders) and annotations in his books, first and foremost in his copies of *Capital* and the *Theories of Surplus of Value*.[24] Due to space constraints we can here only briefly summarize the argument without providing full details.[25]

According to Sraffa, Marx had developed his law strictly against the background of Ricardo's explanation of a falling tendency of the general rate of profits. As we noted in section 1.3.c, Ricardo (1951–73, 1:49), in ascertaining the level of the general rate of profits and its development over time in changing technical conditions, had taken as given "the proportion of the annual labour of the country . . . devoted to the support of the labourers." Ricardo's concept was subsequently adopted by Marx in terms of a given rate of surplus value. In his observations on the wage-profit relationship, Ricardo typically assumed that the social capital consists only of wages (or can be fully reduced to wages in a finite number of steps), so that the rate of profits, r, is given by the ratio of profits, P, to wages, W,

$$r = \frac{P}{W} = \frac{1 - w}{w},$$

24. See also, however, Sraffa's annotations in his copies of Robinson's *Essay* (1942) and Sweezy's *Theory* (1942).

25. See, therefore, Gehrke and Kurz 2004. For a reconstruction of Ricardo's and Marx's ideas on the falling rate of profit that has some elements in common with Sraffa's reading with regard to the major analytical elements involved, see Schefold [1976] 1997.

where *w* designates proportional wages (i.e., the wage share). Starting from this relationship, Ricardo had then argued that as capital accumulates, proportional wages tend to rise, and the rate of profits tends to fall, because of increasing costs of production due to diminishing returns in agriculture. The rising money prices of agricultural commodities, in particular food, necessitate increases in money wages in order to keep "real," that is, commodity, wages constant. To this Ricardo added the following argument. With the rise in nominal wages and the associated fall in the rate of profits it becomes profitable to introduce known but hitherto unused methods of production ("machinery"). In Ricardo's words, "Machinery and labour are in constant competition and the former can frequently not be employed until labour {i.e., the money wage} rises" (1:395). The introduction of machinery in turn can temporarily check the rise in money wages and the associated fall in the rate of profits. However, with further capital accumulation and a growing population, money wages, and hence also proportional wages, will sooner or later have to start rising again.

In Sraffa's reading, Marx had detected an important error in Ricardo's line of reasoning, which emanated from his neglect of nonwage capital in the analysis of the wage-profit relationship.[26] As Marx ([1861–63] 1989, 73) stressed over and over again, this neglect had serious implications, and in particular had misled Ricardo into focusing attention on the wrong causes in his explanation of a falling tendency of the rate of profits:

> But because for Ricardo the *rate of profit* and the *rate of surplus value* . . . are identical terms, a permanent fall in profit or the tendency of profit to fall can only be explained as the result of the *same causes* that bring about a permanent fall or tendency to fall in the *rate of surplus value*, i.e. in that part of the day during which the worker does not work for himself but for the capitalist. What are these causes? If the length of the working day is assumed to remain constant, then the part of it during which the worker works for nothing for the capitalist can only fall, diminish, if the part during which he works for

26. In order to avoid misunderstandings, it should be stressed that Marx was of course fully aware of the fact that nonwage capital, both circulating and fixed, played a prominent role in Ricardo's analysis of prices and values. What Marx insisted on was that Ricardo had neglected to take into account nonwage capital in his analysis of the wage-profit relationship.

> himself grows. And this is only possible (assuming that LABOUR is paid at its VALUE) if the *value* of the NECESSARIES—the means of subsistence on which the worker spends his wages—increases. But as a result of the development of the productive power of labour, the value of industrial commodities is constantly decreasing. The diminishing rate of profit can therefore only be explained by the fact that the value of FOOD, the principal component part of the means of subsistence, is constantly rising.

For Ricardo, the general rate of profits falls if, and only if, proportional wages rise. This proposition was not correct: as Marx had pointed out, it only holds if one disregards the nonwage capital and argues *as if* capital advances consist only of the wages bill. However, once this very restrictive assumption is abandoned, the rate of profits can fall (or rise) even if proportional wages remain constant.

Marx, as Sraffa noted approvingly, had introduced two important concepts into political economy that paved the way to a better understanding of some of the properties of the modern economic system: first, "constant capital," that is, that part of social capital that consists of (produced) means of production; and, second, the "organic composition of capital." The former concept expresses the fact that commodities are produced by means of commodities, a fact that can never be made to disappear completely in a circular system of production. This means that the rate of profits is bounded from above: whereas in Ricardo vanishing wages would be reflected in a rate of profits that tends to infinity, in Marx there is a finite maximum rate of profits, R. The maximum rate corresponds to zero wages and is equal to L/C; it is thus equal to the inverse of the organic composition of the system as a whole. Marx considered the maximum rate of profits to be a purely technological datum of the system as a whole, independent of relative prices and the actual rate of profits. The latter is given by

$$r = \frac{S}{C + V} = \frac{S/L}{C/L + V/L} = \frac{1 - w}{1/R + w} = \frac{R(1 - w)}{1 + Rw}.$$

The expression shows that the actual rate of profits depends on two magnitudes instead of on only one, as Ricardo had contended: on the share of wages, w (or the rate of surplus value, $(1 - w)w^{-1}$), and on the maximum rate of profits, R. Differentiating r partially with respect to R gives

$$\frac{\partial r}{\partial R} = \frac{1 - w}{(1 + Rw)^2} > 0 .$$

If the maximum rate of profits falls in the course of economic development, and proportional wages (the rate of surplus value) remain constant, the rate of profits is bound to fall. Even moderately falling proportional wages (a rising rate of surplus value) cannot prevent this fall of the rate of profits.

In Sraffa's reading, Marx had developed his law as a critique of Ricardo's explanation of the falling rate of profits, incorporating major elements of Ricardo's in his own analysis. Thus Marx had argued that an accumulation process without technical change is bound up with a tendency of rising money wages and a falling rate of exploitation (i.e., rising proportional wages)—quite independently of rising costs of food production or the so-called law of population (see Marx [1867] 1954, 581–82).[27] According to Sraffa, Marx had incorporated also another element of Ricardo's doctrine in his own analysis: Ricardo's "machinery substitution argument" recurs in Marx's law of the falling rate of profits in terms of an "increasing organic composition of capital." Moreover, in Sraffa's understanding Marx had based his argument on the same "natural course" scenario as Ricardo had: both had started with an analysis of the case of *accumulation with given technical knowledge*, where known but hitherto unused methods may be introduced in consequence of changes in the distributive variables and relative prices, but technical progress proper is set aside.

It is important to stress that in Sraffa's interpretation, Marx in his theory of the long-run trend of the rate of profits had *not* assumed a constant real wage rate in terms of commodities. Marx is rather taken to have held that real wages in terms of commodities could rise but that due to a lack of organization and strength on the part of workers in the conflict over the distribution of income, workers would typically not obtain a proportionate share of the additional quantities of commodities that are made

27. Marx ([1867] 1954, 575) had argued in section 1 of chapter 25, "The General Law of Capitalist Accumulation," in book 1 of *Capital* that in the case of accumulation with an unchanging composition of capital, "the demand for labourers may exceed the supply, and, therefore, wages may rise. *This must, indeed, ultimately be the case if the conditions supposed above continue*. For since in each year more labourers are employed than in its predecessor, sooner or later a point must be reached, at which the requirements of accumulation begin to surpass the customary supply of labour, and, therefore, *a rise of wages takes place*" (emphases added).

available by the increase in labor productivity associated with the introduction of machinery. Hence the rate of surplus value would tend to rise and proportional wages fall—and yet, Marx ([1861–63] 1989, 73–74) had maintained, the general rate of profits was bound to fall:

> The rate of profit falls, although the RATE OF SURPLUS VALUE remains the same or rises, because the proportion of variable capital to constant capital decreases with the development of the productive power of labour. The rate of profit thus falls, not because labour becomes less productive, but because it becomes more productive.

What is remarkable is that in interpreting the analyses of Ricardo and Marx, Sraffa distinguished carefully between the case of *capital accumulation* without any technical progress, on the one hand, and the case with "*inventions*" or *technical progress*, on the other. And he related Marx's law of the tendency of the rate of profits to fall exclusively to the former case. This contradicts a widespread interpretation according to which Marx in volume 3 of *Capital* tried to establish a falling tendency of the rate of profits for an economic system in which capital accumulates *and* there is technical progress. More specifically, Sraffa read Bortkiewicz's argument with that part of Ricardo's analysis of the machinery question in mind, in which Ricardo had argued that improved machines can frequently not be employed immediately after they have been invented, because it would not be profitable to do so: they can only be introduced once *nominal* wages have risen in the course of accumulation. However, Sraffa insisted, this case of induced technical change must not be confounded with technical progress. Sraffa had been working on the case of accumulation with induced technical change, the so-called Ricardo effect, since 1942, because he felt that a correct answer to the question at hand had implications for his criticism of marginal productivity theory. This theory, by design, approaches the problem of the explanation (and determination) of the rate of profits in terms of *changes* in known methods of production and in the proportions of factors used (see D3/12/29: 1–7 and D3/12/33: 40 (1–3)). As should have already become clear and will be seen in greater detail below, this earlier work shaped and directed Sraffa's understanding of Bortkiewicz's contribution.

In the following we see the reasons why Sraffa defended Marx against some of Bortkiewicz's cricitisms. The essence of his defense turns out always to reside in Marx's understanding (1) that any actual system of production is possessed of a finite maximum rate of profits, and (2) that

over time this rate is bound to fall as capital accumulates with *no* technical progress proper, that is, *no* invention.

3.3. Sraffa's Critical Comments on Bortkiewicz's Essay of 1906–7

3.3.a. Values and Prices: On Bortkiewicz's Criticism of Marx's Transformation Algorithm

The first part of Bortkiewicz's tripartite essay (Bortkiewicz 1906–7) was devoted to a critical summary account of the existing literature on Marx and the transformation problem. Sraffa showed little interest in Bortkiewicz's detailed criticism of Marx's transformation algorithm and excerpted only the following remark: "This objection {that Marx should have recalculated also the constant and variable capital in the various lines of production} foreseen 'to a certain degree by Marx'" (D1/91: 12), together with Bortkiewicz's page reference to chapter 9 in volume 3 of *Capital*.[28] The statement under consideration can be seen as a confirmation of Sraffa's view that Marx was only driven to adopting his erroneous transformation algorithm because he did not have the method of simultaneous equations at his disposal. What interested Sraffa was rather Bortkiewicz's contention that Marx's blunder had serious implications for his law of the falling rate of profits. As Sraffa noted, according to Bortkiewicz the law "rests on this, that Marx establishes a definite (and indeed quite simple and false) arithmetical relation between magnitudes of which one belongs to his 'Value and Surplus-Value Scheme' and the other to his 'Price and Profit Scheme'" (D1/91: 10). Sraffa also excerpted Bortkiewicz's statement that "Tugan-B. {Tugan-Baranovsky} 'is quite right against Marx' on the two profit rates and that the one based on prices is the correct one. And that this is by no means a subordinate point, appears at its best from the fact that this point is closely connected with the Law of Falling Profit Rate" (D1/91: 10). However, with regard to

28. The reference is especially to the following statement of Marx ([1894] 1959, 161): "So far as the constant portion is concerned, it is itself equal to the cost-price plus the surplus-value, here therefore equal to cost-price plus profit, and this profit may again be greater or smaller than the surplus-value for which it stands. As for the variable capital, the average daily wage is indeed always equal to the number of hours the labourer must work to produce the necessities of life. But this number of hours is in its turn obscured by the deviation of the prices of production of the necessities of life from their values."

Bortkiewicz's "'Proof' of Error in L. of Fall. R. of Profit" (1906–7, part 1, pp. 47–48), Sraffa then only noted drily:

> Formula $\frac{m}{c+v} = \frac{m}{v} \cdot \frac{m}{c+v}$. {$m$ here designates surplus value}
>
> If first factor constant, and second falls, the Law is "obvious." The "error" is that the second factor is expression of the (wrong) "value-profit," not of the "price-profit." That's all! (D1/91: 11)

Sraffa was apparently not very impressed with this sort of criticism. While he fully agreed that Marx's law had to be formulated in terms of prices rather than labor values, he did not consider this to be all that important and, in particular, he did not consider the validity of the main idea underlying the law to hinge on this. With reference to Bortkiewicz's discussion of the method used by Tugan-Baranovsky in his criticism of Marx, Sraffa stressed the following:

> The whole argument of Tugan and Bortkiewicz is based on assuming widely different Org. Comp. in the production of the three Depts (viz., Means of Prod., Workers-cons.-goods, Capitalists-cons.-goods) from which they get two different rates of profits, reckoning in prices and in values. *Yet they find no difficulty in admitting equal Org. Comp. in the production of the Means of Production used in the three Depts*! See remark on p. 46. (D1/91: 11; emphasis added)

Actually, in footnote 129 on page 46, Bortkiewicz had drawn the reader's attention to that assumption which underlies Tugan-Baranovsky's method. While Bortkiewicz had been aware that this was a very special assumption, it had not prevented him from adopting it himself in "Zur Berichtigung" (1907a). In Sraffa's view, this assumption was seriously misleading, because it implied that the "Hypothesis" must of necessity be wrong: the hypothesis supposes that the two *social aggregates*, $(V + S)$ and C, could be taken to exhibit approximately the *same* organic composition precisely because each of them is made up of a large number of individual commodities that are produced with possibly vastly *different* organic compositions of capital.

3.3.b. Circular Flow vs. Unidirectional Production: In Defense of Marx's Concept of "Constant Capital"

Bortkiewicz's essay (1906–7, pt. 1, p. 22) continued with the presentation of "a correct solution of the theoretical problem that Marx had set

himself." Sraffa was critical of several aspects of Bortkiewicz's analysis. A first criticism concerned the assumption of unidirectional production. Sraffa stressed that Bortkiewicz's reasoning was based on a "Formula of Reduction to labour in {a} *finite* number of steps." He then quoted Bortkiewicz's statement that the analysis of the value of the product has to be carried "up to the point when one reaches a constant capital which is the exclusive product of direct labour," and concluded: "This is the same blunder as Böhm Bawerk!" (D1/91: 12).

In a closely related criticism, Sraffa insisted on the importance of Marx's distinction between *constant* and *variable* capital, a distinction that Bortkiewicz had considered to be superfluous, at best. Sraffa noted that Bortkiewicz had repeatedly blamed "Marx for distinguishing Const. and Var. Cap. and not seeing ('as Ricardo did,' for which B. praises him) that it can be eliminated by reducing all to labour at various times." Sraffa then leveled the following objection at Bortkiewicz's reasoning:

> B. does not see that *all* his argument rests upon making a labour series of a finite number of terms. The consequences of this assumption are:
>
> 1) The rate of profits can become infinitely large with the fall of wages [which leads to not seeing the cause of the Law of Falling rate of profit]
> 2) With a sufficient fall of wages the value of capital must tend towards 0.
> 3) The idea that Surplus Value "comes out of" Constant and not only Variable Capital
> 4) The Smith-Ricardo fallacy that "savings are consumed by others"
> 5) The false idea that means of production ("higher stages") *must* have a different organic composition from consumers' goods.
> 6) Another consequence of the finite labour series is that the Value Hypothesis becomes impossible even to be conceived of: the total Const. Cap. *must* change in price in terms of the Product with changes in the rate of profits. (D1/91: 13–14)

Before we proceed, a few clarifying remarks are apposite. As regards the first consequence mentioned, it should be pointed out that according to Sraffa, Marx's explanation of a falling tendency of the rate of profits had as an important first step the demonstration that the *maximum rate of profits*, R in Sraffa's notation, was bound to fall. In a system in which with regard to the production of each commodity one could always discern a stage with labor "unassisted" (to use Ricardo's phrase) by constant capital,

there simply was no maximum rate of profits and hence no falling level of that rate. This implied "not seeing the cause" contemplated by Marx of a falling tendency of the rate of profits. The closely related second consequence stresses the fact that if all capital is supposed to be reducible to advanced wages, then the value of capital is bound to vanish with vanishing wages. Third, if the constant capital can be entirely reduced to advanced wages, that is, variable capital, the distinction between the two types of capital becomes blurred and the idea is close at hand that surplus value "comes out of Constant and not only Variable Capital."

The fourth implication mentioned by Sraffa concerns an erroneous proposition of Adam Smith, which was also adopted by Ricardo, and which was first noticed (and explicated at length in chapters 19 and 20 in volume 2 of *Capital*) by Marx. As is well known, Smith ([1776] 1976, II.iii.18) had contended that "what is annually saved is as regularly consumed as what is annually spent, and nearly at the same time too; but it is consumed by a different set of people. . . . The consumption is the same, but the consumers are different." As Marx had pointed out, this proposition is false, because a part of what is annually saved and invested must always consist of means of production which have previously been produced. Smith's error is closely related to his false claim that the portion of the annual gross produce which is devoted to the replacement of the materials used up in the production of the goods which are annually consumed "withdraws no portion of the annual produce from the *neat revenue* of the society" (II.ii.9; emphasis added). Marx had traced this inconsistency in Smith's treatment of (circulating) capital back to his view that the price of every commodity resolves itself entirely, "that is, without leaving any commodity residue, into wage, profit, and rent—a claim which necessarily presupposed the existence of 'ultimate' commodities produced by pure labour without means of production except land" (Sraffa 1960, 94). This is the background to Sraffa's observation that Bortkiewicz's construction, which follows Smith and Ricardo in making a labor series of a *finite* number of terms, gives rise to "the Smith-Ricardo fallacy that 'savings are consumed by others.'"[29] The fifth consequence draws attention to the fact that in an Austrian conceptualization of production, the consumption goods produced by means of intermediate products, that is, capital goods, generally exhibit higher capital-to-labor

29. Fernando Vianello (1999, sec. 5) provides a detailed account of Smith's error and Marx's criticism of it.

ratios, or longer periods of production, than the intermediate products. Yet this is not so in circular systems of production.

As regards the sixth consequence, we have already learned that in the early 1940s Sraffa contemplated the conditions to be met in order for the ratio between the value of the product and that of the capital employed in its generation to be invariable with regard to changes in the rate of profits. As we know, the upshot of these considerations was the elaboration of the closely related concepts of Standard commodity, Standard system, and Standard ratio in January 1944. However, at the time of his reading of Bortkiewicz's essay, Sraffa had not yet fully developed these important concepts by means of which he was able to simplify significantly the investigation of the dependence of relative prices on income distribution. What was at his disposal at that time was the concept of the "corn model," which with regard to a single sector at least—the corn sector, in which corn is assumed to be produced by means of seed corn only (and labor)—exhibits a product-to-capital (capital here being seed) ratio that is independent of the level of the rate of profits (and relative prices). This constellation can be said to reflect with regard to a single sector what Marx's "Value Hypothesis" is taken to reflect with regard to the economic system as a whole: according to the latter the ratio between living labor (L), that is, the sum of variable capital (V) and surplus value (S), or value added, on the one hand, and dead labor, or constant capital (C), on the other, *is given independently of the rate of profits*; it actually equals the *maximum rate of profits*, as conceptualized by Marx, L/C, which obtains in the hypothetical case in which $V = 0$ and $S = L$.

The gist of Sraffa's criticism can be summed up as follows: by adopting the "Austrian" device of a reduction series of finite length, Bortkiewicz had focused attention on a special case which is seriously misleading. He did not see that Marx had made an important analytical advance over Smith and Ricardo in the analysis of the wage-profit relationship by recapturing the circularity aspect of production (which had been present in the physiocrats, but was somewhat lost by Smith and Ricardo). Bortkiewicz, Sraffa maintained, by criticizing Marx from the standpoint of Ricardo's "Austrian" construction, had indeed taken the analysis of the wage-profit relationship a step backward from where Marx had left it.

3.3.c. The "Essential Nature" of the Problem under Consideration

Sraffa summarized his criticism of the conceptualization of production underlying Bortkiewicz's essay in the following way:

> It is clear, from his context and examples, that B. has always in mind a finite number of terms. When the number is infinite, the description must stop at some point and contain a "residue" term of Const. Capital. Besides, he only sees the production of the particular commodity: he fails to see that, *for Social Capital, the Organic Composition is by far the most important (instructive) aspect—and when the Value Hypothesis holds, the only one that one need use at all.* (D1/91: 15; emphasis added)

He added:

> The formal objection against B's point of view (reducing all to rotation periods of labour, while neglecting the distinction between Variable and Constant Capital) is that it can only be done by an infinite number of steps [i.e. it can never be done] and the resulting series is not uniformly convergent: in other words, there is always a Residue, and, so long as *r* is variable, it is never negligible.
>
> But the real objection (though somewhat vaguer) is this: That B.'s point of view, for the sake of obtaining absolute exactness in a comparatively trifling matter, sacrifices (by concealing it) *the essential nature of the question*—that is, that *commodities are produced by labour out of commodities*. Suppose that it were true that only corn, besides labour, is used in the production of corn and that this were true of all commodities, i.e. *the relative price of each product and its Const. Cap. were constant with respect to r*: Then, to find the value of, or q{uantity} of labour that produces, a bushel of wheat, we should deduct the seed from the product, and divide the rest ("net product") by the N° of days' labour, and obtain the result. We could also do it by reduction, and the limit of the sum of the infinite series would be the q{uantity} of labour "embodied" in the *gross* product—identical result as before.
>
> *But of course we should not dream of doing so—it would be mad*; it is only the damned fluctuation of price that drives us to it. It is well to remember (as A. Smith did) that a considerable degree of abstraction is involved in saying that a calf is produced entirely by human labour (rather than by a cow and a bull, as well as labour) on the grounds that the bull and cow are themselves produced by bulls and cows, as well as labour, *and so on. The abstraction is useful, but it has its limitations; and it is good to have them well in sight.*
>
> We introduce it as a *correction* to cope with a deviation of price from value (which, note, can be as often on one side as on the other)

> and *it should retain that character. For, while it supplies exactness, it obscures a fundamental fact.* (D1/91: 16–17; all emphases added except for those on *gross*, *and so on*, and *correction*)

This clarifies neatly Sraffa's point of view on the matter. The appropriate scheme is the one in which commodities are produced by means of commodities, and this was the scheme elaborated by the physiocrats and then reintroduced by Marx in terms of his important distinction between constant and variable capital. The reduction to dated quantities of labor involves a formidable abstraction, "useful" though, but with "limitations." Bortkiewicz had managed to render "absolutely precise" a case that is not really interesting because it "sacrifices the essential nature of the problem": the circular flow of production.

3.3.d. The Impact of Changes in Distribution on Relative Prices: Bortkiewicz's "Monotonic Prejudice"

A further criticism of Sraffa's concerned Bortkiewicz's contention that it could safely be presumed that methods of production can generally be ordered monotonically with regard to their capital intensity—a view which we have encountered already in Bortkiewicz's article on Böhm-Bawerk. As Sraffa noted, Bortkiewicz had correctly pointed out, against Böhm-Bawerk, that there is "no 'average period of production'" which could be defined independently of the rate of interest but then had nevertheless put forward the erroneous proposition that "'*im allgemeinen* {*in general*}' there is lengthening" with a fall in the rate of interest; Sraffa dubbed this opinion "*monotonic prejudice*" (D1/91: 14 and 27 (verso); emphases added). As we saw in section 1.3.d, Sraffa had criticized this proposition as early as February 1931, and in his working notes he had in fact demonstrated the impossibility of a monotonic ordering of the methods of production long before he came across Bortkiewicz's essay. In one of his notes, commenting on Nicholas Kaldor's "Capital Intensity and the Trade Cycle" (1939), he had pointed out the following:

> There is no assurance that, owing simply to a change in the rate of interest, the order is not reversed. Suppose two commodities produced by similar proportions of capital and labour (i.e. which are similarly divided between profits and wages): but one contains more capital in the "early" stages and less in the later ones—i.e. although the total quantity of interest is equal in the two commodities, in this one it is made

> up to a larger extent of compound interest: it is clear that if the rate of profits rises, the composition of this commodity will come to contain more profits (i.e. capital) than the other. (D3/12/15: 10)

This finding was one of the results of Sraffa's earlier studies, carried out already in the early 1930s, of the impact of distributional changes on relative prices—a problem that Bortkiewicz addressed in part 2 of his 1906–7 essay. Sraffa scrutinized Bortkiewicz's analysis carefully and excerpted a passage in which the latter had taken the sign of the deviation of the price ratio of two commodities from their ratio of labor values to depend on whether the rotation or turnover period of one of the commodities is generally longer or shorter than that of the other commodity. To this Bortkiewicz had added a remark that Sraffa also excerpted and marked in the margin with two squiggly lines, signaling disapproval: "A more precise formulation of this relationship is not possible." This was not true, Sraffa insisted: things can be made more precise. He approved, however, of Bortkiewicz's following proposition:

> It would, for example, not be correct to maintain that as regards the ratio between p_i {the price of commodity i in terms of some other commodity that serves as numéraire} and w_i {the value of commodity i in terms of the standard} it would be decisive whether the average length of the rotation periods is greater with respect to one or the other of the two products. Such a proposition gets pretty close to the truth, at least in those cases in which ρ {the rate of profits, Sraffa's r} is such a small magnitude that one is justified in neglecting the second and higher powers of ρ. (Bortkiewicz 1906–7, pt. 2, p. 40)

In part 2 of his essay Bortkiewicz had provided the hitherto most sophisticated analysis of the dependence of relative prices on income distribution. Alas, his analysis was limited to the case of unidirectional production. Moreover, like Kaldor and many others, he had fallen victim to the "monotonic prejudice" in the analysis of the choice-of-technique problem.

3.3.e. Rejecting Bortkiewicz's Criticism of Marx's Law: "Those who deny the tendency always are unaware of the existence of a Max. Rate of Profit"

In Bortkiewicz's understanding, Marx's law of the falling rate of profits stated that with an increase in the organic composition of social capital

the rate of profits tends to fall even without a rise in proportional wages. Only a sufficiently strong fall in proportional wages "could paralyze or even overcompensate the falling tendency of the rate of profits" (Bortkiewicz 1906–7, pt. 3, p. 452). Bortkiewicz had then translated a rising organic composition of capital into a rising average length of the rotation period characterizing the production of the commodities constituting the real wage, δ, and had distinguished between "two modalities" of how a rise in δ can be brought about: "either in one or several of the corresponding lines of production a new preceding stage of production is added or the productivity relations on the different stages of production change" (455). With regard to the first case, on which Sraffa focused attention, Bortkiewicz had explained: "The first case is the one in which a new instrument of labor (e.g., a machine) is introduced where previously only 'manual labor' was used" (456). In this case, Bortkiewicz had stressed, δ may rise, but need not. If there is an increase in δ, "it is clear that . . . the amount of labor incorporated in the real wage must decrease, because the introduction of the new instrument of labor is only taken into account, if the productivity of the labor producing the real wage increases" (456). However, if this is the case, Bortkiewicz had concluded (457–58), then the rate of profits cannot fall. Sraffa commented on these passages as follows:

> B. tries to disprove Law of Falling Rate of P.
>
> Represents "increase in Org. Comp. of Social Cap." as lengthening average period of production (δ). p. 456, *he assumes real wage ("corn wage") constant: and his assumption implies (tacitly), not mere accumulation, but the introduction of a new, more profitable method of production*, e.g. a machine, which will of course reduce proportional wage (*U*) if corn-wage is constant, but (he acknowledges) will not necessarily increase period of production, i.e. Const. Cap.! He quotes an important passage in Kap. III_1 p. 247 on how "new" methods of production are introduced, and their effect on lowering profit-rate: but *B. overlooks that "new" here means "known, but not yet used; introduced only after accumulation," from which M's conclusion follows*: he (B.) refutes him on p. 457–8 by an argument which clearly implies that by "new method" he B. understands a "new invention"—and on the basis of this "proves" that rate of profit (*r*) need not fall! (D1/91: 22; emphases added)

In Sraffa's view, Bortkiewicz's attempt to disprove Marx's law of the tendency of the rate of profits to fall was marred with two misconcep-

tions. First, in Sraffa's reading Marx had not argued on the basis of a constant "commodity wage," as Bortkiewicz supposed. Second, Bortkiewicz had missed the fact that Marx's law was meant to apply only to the Ricardian case of capital accumulation with induced technical change: what was allowed for was only the introduction of methods of production that had been discovered in the past but up until now could not be profitably employed. Bortkiewicz had instead discussed the entirely different case of a choice of technique vis-à-vis the discovery of new methods of production, that is, technical progress. In the latter case the problem was whether or not a newly invented method of production will be introduced *at the going real wage rate*. Sraffa then excerpted (in German) the famous passage from volume 3 of *Capital* quoted by Bortkiewicz:

> No capitalist ever voluntarily introduces a new method of production, no matter how much more productive it may be, and how much it may increase the rate of surplus-value, so long as it reduces the rate of profit. Yet every such new method of production cheapens the commodities. Hence, the capitalist sells them originally above their prices of production, or, perhaps, above their value. He pockets the difference between their costs of production and the market-prices of the same commodities produced at higher costs of production. He can do this, because the average labour-time required socially for the production of these latter commodities is higher than the labour-time required for the new methods of production. His method of production stands above the social average. But competition makes it general and subject to the general law. There follows a fall in the rate of profit—perhaps first in this sphere of production, and eventually it achieves a balance with the rest—which is, therefore, wholly independent of the will of the capitalist. (Marx [1894] 1959, 264–65)

Sraffa commented:

> This is correct, *provided it is understood*:
> 1) that the "new method" was available all the time, but has only become cheaper *after* a rise in proportional wages
> 2) that this rise is consequent on accumulation
> 3) that the various capitals (of different commodities, and of old and new methods) differ *only* in Org. Comp., but not in "rotation period" (so that the relative prices of Const. Capitals don't change with *r*;

> and a rise of *w can only* bring in new methods of higher Org. Comp. (D1/91: 23; first emphasis added)

Hence, in Sraffa's interpretation there is no presumption that Marx's argument above was, and was meant to be, generally valid: it was rather tied to strict requirements. If interpreted along the lines of Ricardo's discussion of accumulation without technical progress proper, Sraffa maintained, Marx was right. In Ricardo's discussion, known but hitherto unused methods of production ("machinery") are eventually adopted, induced, as it were, by an increase in nominal (and proportional) wages and a change in relative prices, which is in turn entailed by the process of accumulation vis-à-vis rising costs of production in agriculture. In Sraffa's reading, Marx had in essence adopted the Ricardian machinery substitution argument, replacing Ricardo's argument of rising costs in agricultural production as the cause of a wage increase by the argument that the increased demand for labor-power due to accumulation per se must raise wages. With constant or even moderately falling proportional wages, w, a fall in the maximum rate of profits, R, is bound to result in a fall in the general rate of profits, r.

In Sraffa's view, Bortkiewicz's criticism in this regard was entirely beside the point. The eminent statistician and theorist had tilted at windmills. This Sraffa attempted to render clear by entering into a detailed criticism of Bortkiewicz's argument. Due to space constraints we can only briefly summarize Sraffa's respective disquisition, which contains a number of tedious numerical examples.[30] Suffice it to say that in a first step he was keen to translate Bortkiewicz's reasoning from the chosen Austrian (unidirectional) scheme of production to the circular flow framework adopted by Marx. Sraffa stressed once again that Bortkiewicz was right in insisting that a proper reasoning had to be in terms of prices of production rather than labor values, but added that Bortkiewicz's respective objection was out of proportion with regard to the importance of the issue under consideration. As Sraffa rendered clear in terms of simple numerical examples, the real issues lay elsewhere and concerned Bortkiewicz's misconceptions as regards the role of constant capital and the maximum rate of profits, on the one hand, and Marx's conceptualization of wages, on the other. This is succinctly stated by Sraffa in a working note of 29 August 1946:

30. See, in particular, the numerical examples in document D1/91: 27–8 and 27–8 (verso).

The idea of a Falling rate of Profit is based on:

1) The existence of a Maximum Rate of Profit
2) Its identity with the Org. Comp. of Cap.[31]
3) The tendency of the Org. Comp. of Cap. to fall with accumulation; and thus a tendency to fall of the Max Rate of Profit.

See Marx on "even if workers lived on air"[32]

Those who deny the tendency always are unaware of the existence of a Max. Rate of Profit: this is due to their belief (on Bohm Bawerk's {*sic*} line) that "ultimately," i.e. in a finite series, goods are made entirely by labour. This is swallowed even by Bortkiewicz (see my notes on his art. II, my p. 2).

More briefly: Falling rate of Profit is based on

a) Existence of Maximum rate of Profit
b) Tendency for Max. R. of P. to fall with accumulation

Hence, however much wages may fall, they cannot always make up for it. Those who argue against it always say: a sufficient fall in wages can offset any fall in rate of profits (Bortkiewicz, Joan Robinson).[33] (D3/12/44: 11)

3.3.f. Sraffa's Criticism of Bortkiewicz's Theory of Surplus Value: "This is B.'s theory, and a jolly bad one it is"

We now come to a problem with regard to which Sraffa's comments on Bortkiewicz are at first sight rather puzzling: Is the general rate of profits determined by the production conditions of *all industries*, as Marx had maintained, or only by those industries that directly or indirectly contribute to the production of wage goods, as Bortkiewicz had insisted? Readers who are familiar with the modern literature on this issue will probably be surprised to learn that Sraffa is critical of Bortkiewicz's view "that the

31. Here Sraffa implicitly defines the organic composition as *L*/*C*.

32. The reference is to the following statement by Marx ([1894] 1959, 247): "Inasmuch as the development of the productive forces reduces the paid portion of employed labour, it raises the surplus-value, because it raises its rate; but inasmuch as it reduces the total mass of labour employed by a given capital, it reduces the factor of the number by which the rate of surplus-value is multiplied to obtain its mass. Two labourers, each working 12 hours daily, cannot produce the same mass of surplus-value as 24 who work only 2 hours, *even if they could live on air and hence did not have to work for themselves at all*. In this respect, then, the compensation of the reduced number of labourers by intensifying the degree of exploitation has certain insurmountable limits. *It may, for this reason, well check the fall in the rate of profit, but cannot prevent it altogether*" (emphases added).

33. The reference is to Robinson's *Essay* (1942); Sraffa's copy (Sraffa 3687) is heavily annotated.

rate of profit depends *only* on those amounts of labour and those turnover periods which concern the production and distribution of the goods forming the real wage rate" (Bortkiewicz 1952, 32). Yet it is not difficult to see why at the time Sraffa was of this opinion. He marked the passage just quoted with exclamation points in the margin, and stressed: "It is on the above proposition that B. bases his theory of surplus value: he attributes its origin to Ricardo, and opposes it to the 'Falsche Konstruktion' {false construction} of Marx which is based on 'Rechenfehler' {errors of calculation} (i.e. the averaging of different rates of profit)" (D1/91: 18). Sraffa then excerpted Bortkiewicz's following statement:[34]

> If it is indeed true that the level of the rate of profits in no way depends on the conditions of production of those commodities which do not enter into wages, then the origin of profit must clearly be sought in the wage-relationship as such and not in the productivity-enhancing effect of capital. For if this effect were indeed relevant here, it would be inexplicable why certain spheres of production are irrelevant for the determination of the level of profits. (D1/91: 18)

Sraffa commented on this passage: "This is B.'s theory, and a jolly bad one it is. It would be easy for the marginalist to reply that this theory is based on the (commodity) real wage being given a priori, and then of course all is determined.[35]—We can add that it is because of this starting point that only wage-goods come into consideration—*that is the only way of changing (what Ricardo calls) proportional wages*" (D1/91: 18; emphasis added). Sraffa drew two straight lines beside the remark in the margin. This might be interpreted as indicating his approval, but things appear to be more complicated. The critical tone at the beginning of the remark suggests that Sraffa did not endorse Bortkiewicz's criticism of Marx. In the light of what we have heard above, this is hardly surprising. There is reason to think that at the time Sraffa was in all probability of the opinion that Marx had a valid point when he had argued against

34. Sraffa quoted this passage in the original German (see Bortkiewicz 1906–7, pt. 3, pp. 446–47); we give a slightly corrected version of the English translation (Bortkiewicz 1952, 33), which contains some inaccuracies.

35. Such a "reply" was indeed put forward by Knut Wicksell ([1893] 1954, 37) with regard to Ricardo's theory: "Since, according to Ricardo, wages represent a magnitude fixed from the beginning . . . , the cause of capital profit is already settled. It is neither possible nor necessary to explain capital profit in other ways."

Ricardo that the rate of profits depends not only on proportional wages, but also on the organic composition of capital of the economic system as a whole, and that therefore in the determination of the rate of profits *all* industries must be taken into account.[36] Sraffa at the time appears to have been convinced that Marx was right because if wages were not taken as given in commodity terms but as a share, what was a "wage good industry" was no longer well defined. As long as it was not known on which commodities workers spent wages, how could it be known which industries were producing "wage goods"? Bortkiewicz had attacked a straw man—an attack that had no bearing on Marx's rather different construction.

3.3.g. "Mathematical" vs. "Causal-Genetic" Method

Bortkiewicz, echoing Pareto, had been critical of what he dubbed the "causal-genetic" method of analysis. This method he had detected in Böhm-Bawerk and the Austrians who had tried to explain all prices and the distributive variables by tracing them back to the consumers' marginal (expected) estimations of goods of the first order, that is, consumption goods. A similar method, he maintained, had been adopted by Marx, who had attempted to explain all prices and the distributive variables by tracing them back to the quantities of labor needed directly and indirectly in the production of the various commodities. While strictly opposed in terms of content, both theories employed the causal-genetic method and thus were concerned with the search for an ultimate standard of value. This standard was (marginal) utility in one case and (abstract) labor in the other (see, in particular, Bortkiewicz 1921).

According to Bortkiewicz, both schools of thought were bound to fail: the kind of problems they faced could not be mastered in terms of the causal-genetic method. The phenomenon of ubiquitous interdependence of economic magnitudes necessitated the employment of what Bortkiewicz called the "mathematical method," that is, the method of simultaneous equations. Sraffa noted carefully that in Bortkiewicz's view "Value" (i.e., labor value) was merely a "Hilfsgrösse"—an *auxiliary concept*. To this Bortkiewicz had added: "Marx has not succeeded in substituting for it a consistent theory. . . . Das leistet vielmehr die mathematische Methode

36. The two straight lines in the margin Sraffa may have added only later, upon rereading his remarks, that is, after he had developed the concept of *nonbasic* industries, which indeed do not matter when it comes to the determination of the rate of profits in the case in which wages are paid *post factum* (and the standard of value is a basic commodity or a bundle of basics).

{This achieves only the mathematical method}" (D1/91: 32). Sraffa did not object to this proposition; indeed his work since 1927 confirmed it. However, as we have seen in section 1.1, adopting the "mathematical method" was not prejudicial as to the content of the theory advocated. There was no reason to trust the "forces" contemplated by Walras and Pareto (see, for example, D3/12/3: 4). As Sraffa observed in a note written in 1942, specifying the meaning of his own equations,

> This paper deals with an extremely elementary problem; so elementary indeed that its solution is generally taken for granted. *The problem is that of ascertaining the conditions of equilibrium of a system of prices and the rate of profits, independently of the study of the forces which may bring about such a state of equilibrium.* Since a solution of the second problem carries with it a solution of the first, that is the course usually adopted in *modern theory.* The first problem however is susceptible of a more general treatment, independent of the particular forces assumed for the second; and in view of the unsatisfactory character of the latter, there is advantage in maintaining its independence. (D3/12/15: 2; emphases added)

Against this background it is not surprising that Sraffa would take issue with the following statement by Bortkiewicz:

> The mathematical method achieves even more than that: it allows one to render the cost of production theory without any difficulties compatible with the law of supply and demand or the determination of relative prices in terms of the subjective value estimations of the buyers (and perhaps also those of the sellers) by incorporating, following Walras's procedure, the cost equations into a comprehensive system of equations, in whose conceptualization also the subjective value estimations are taken into account. (Bortkiewicz 1906–7, pt. 3, 478)[37]

Sraffa commented:

> *Thus Bortkiewicz shows that he is an idiot.* And that he did not realize the implications of his rule on "methods which are not used have no effect on interest": he applies it strictly only to Bohm {*sic*} and Clark. He does not see it applies to all these things, demand etc. And . . . he does not see that what Marx says on Demand and Supply is only an

37. Sraffa noted that on the same page Bortkiewicz had argued, against Gustav Cassel, that the cost equations could nevertheless be taken out of these relations and treated in isolation.

> extension of it. (D1/91: 32; the italicized sentence is marked with two straight lines in the margin)

Apparently, Bortkiewicz had forgotten his earlier "dictum" by the time he concluded his essay. How could it otherwise be explained that he now felt that what he called "cost of production theory" was compatible with marginalism? Whereas the former satisfied the dictum, the latter was explicitly designed to explain prices and the distributive variables in terms of hypothetical incremental *changes* of the proportions in which inputs are used and final goods consumed. Hence, both methods of production and of consumption that are *not* used are taken to have an effect on the rate of interest and prices.

In this context Sraffa sided with Marx, who had argued that, in equilibrium, demand and supply do not act anymore and therefore cannot explain value.[38] To this Bortkiewicz had objected that it only reflected Marx's mathematical incompetence and his lack of understanding the by then conventional demand and supply diagram. In Sraffa's view, Marx had instead made exactly the same point as Bortkiewicz himself: in a long-period equilibrium, and given one of the distributive variables, prices and the other distributive variable are fully determined by the methods of production and consumption in use, whereas methods that are not used play no role whatsoever (see D1/91: 33).

3.3.h. Bortkiewicz on Marx and Ricardo: A Summing Up

Sraffa felt that in important respects Bortkiewicz had forcefully expressed criteria that the theory of value and distribution was to meet that he, Sraffa, fully endorsed and actually, without at the time being aware of his precursor, had managed to translate into an analytically adequate framework. However, he accused Bortkiewicz of not having fully understood the implications of his maxims or of being inconsistent. While Sraffa shared some of Bortkiewicz's criticisms of Marx, he felt that Bortkiewicz had missed the fact that on the whole Marx had been possessed of a deeper

38. It is interesting to note that such otherwise diverse authors as Marx and Böhm-Bawerk held similar views as to the explanatory power of demand and supply in equilibrium. Marx had pointed out that in classical economics demand and supply were seen to regulate only "market prices," not "natural prices" or "prices of production." He had added: "If demand and supply balance, the oscillation of prices ceases, all other conditions remaining the same. *But then demand and supply also cease to explain anything*" (Marx [1867] 1954, 503; emphasis added). Similarly Böhm-Bawerk ([1889] 1959, 42), who had maintained that demand and supply "offers a *husk for a kernel*" (emphasis added). The authors mentioned, we might say, were interested in analyzing the kernel, not the husk.

understanding of the problems of value and distribution than Ricardo and, as a consequence, also his critic, despite Bortkiewicz's indisputable mathematical skills. Marx had made important progress over and above Ricardo in analyzing the problem of value and distribution in the context of a circular flow of production. Bortkiewicz, following Dmitriev's lead, had instead adopted an Austrian conceptualization of production and had erroneously tried to assess Marx's doctrine in terms of it. No wonder, then, that several of Marx's important achievements escaped his attention. In particular, in a circular flow framework constant capital could not be reduced to variable capital: however far the reduction of the former to the latter was carried out, there always remained some constant capital. This also implied that the maximum rate of profits was finite, not infinite. In terms of his "Value Hypothesis," Marx had been able to establish that this rate was equal to the inverse of the organic composition of capital for the economic system as a whole (that is, the inverse of the economy's average period of production). While Sraffa agreed with Bortkiewicz that Marx's theory of value and distribution was flawed, he did not agree with him as to the magnitude of the flaw involved. He rather credited Marx with having been the first to grasp, albeit in an analytically defective manner, important properties of the interdependent industrial system of production. The fact that the tools at Marx's disposal were not up to his sophisticated economic concepts was no reason to focus attention on the inadequacy of the tools instead of on the fertility of the concepts and how they could be formulated in a logically consistent way. Bortkiewicz with his access to much more refined techniques than Marx fell conceptually back before him. Bortkiewicz was unable to grasp the heuristic importance of Marx's assumption that the value of social capital in terms of the social product is independent of the rate of profits. While Bortkiewicz (in line with Tugan-Baranovsky) insisted on assuming widely different organic compositions in the three departments, he found no fault in admitting equal organic compositions in the production of the means of production used in the three departments. It thus of necessity escaped Bortkiewicz's attention that Marx's discussion of the falling tendency of the rate of profits revolved around the development over time of the maximum rate of profits, that is, the inverse of society's organic composition of capital: with given proportional wages, the rate of profits falls if and only if the maximum rate falls.

4. Concluding Remarks

In the course of his work on what was to become his 1960 book, Sraffa repeatedly referred back to "Bortkiewicz's dictum" and "dogma." In this concluding section we take a brief look at two examples reflecting the continuing importance of Bortkiewicz's propositions for Sraffa's own work. The first example relates to the constructive aspect of it and concerns the elaboration of the concept of the Standard commodity, whereas the second example relates to its critical task of refuting the marginalist theory of production and distribution. A few remarks must suffice.

4.1. Removing an "Incongruity" in Classical Analysis

In Bortkiewicz's view, Marx's "theory of exploitation" involved "a definite regress" compared with the "theory of deduction" that Bortkiewicz attributed to Adam Smith and also to Ricardo (Bortkiewicz 1906–7, pt. 3, p. 447).[39] Sraffa did not agree with this assessment. Things were invariably more complex. Both Ricardo and Marx had started from the concept of commodity wages but then had moved on to that of proportional wages, according to which wages, w, could be given as a dimensionless number, $0 \leq w \leq 1$. Alas, every so often both Ricardo and Marx had slipped back to the former concept when the latter was appropriate. The coexistence side by side of these two wage concepts in Marx's construction was confusing. This was aggravated by the fact that Marx had made a serious attempt to take into account the circular flow aspect of production in terms of the concepts of constant capital and the organic composition of capital. These difficulties are spelled out with great clarity in Sraffa's following comment on Marx's construction and Bortkiewicz's criticism of it:

> It comes to this. Marx says that as far as Surplus Value, and rate of S.V. are concerned, only wage-good industries come into consideration; but when the rate of profits is concerned all spheres of production, including luxury goods consumed only by capitalists, must be taken into account; for to obtain the rate of profits all the different rates of profit must be averaged out over all capitals. Now this amounts in effect to assuming (as Marx does) that the mass of profits is equal to the mass of Surplus Value—i.e. that they represent the same proportion

39. See also the summary account of Bortkiewicz's criticism of Marx on pages 123–25 of Sweezy's *Theory* (1942), to which Sraffa referred in his notebook.

> of the Social Revenue. But this is only true if the Org. Comp. of wage-goods industries is the same as that of luxury-goods industries; if the org. comp. is different (and that is the case under consideration) the proportion of Revenue occupied by Surplus Value is different from that occupied by Profits—the first being taken in Values, the second in Prices. Thus B. appears justified in concluding that, *given the wages in commodities, and the methods of production of wage-commodities, the rate of profits is ipso facto determined*, no matter what happens in luxury-industries. (D1/91: 20; emphasis added)

Bortkiewicz's insistence that the luxury-goods industries were unimportant could obviously not be disputed in the case of given *commodity* wages. Things were otherwise in the case of given *proportional* wages, even when wages were still taken to be advanced at the beginning of the production period and thus reckoned among the capital advanced. With his interpretation Bortkiewicz had missed the real deficiency of Marx's construction:

> *What Marx does is, on the one hand (1) to take wages as given (inventory) in commodities, for subsistence, and on the other (2) to take the mass of profits as a given proportion of the product of labour. The two points of view are incongruous, and are bound to lead to contradictions.* But B. wants to solve the contradiction by bringing (2) into agreement with (1). On the contrary, the *correct solution* is to bring (1) into agreement with (2). For the point of view of (1) useful as it is as a starting point considers only the fodder-and-fuel aspect of wages; it is still tarred with commodity-fetishism. *It is necessary to bring out the Revenue aspect of wages*; and this is done by regarding them as a *w*, or a proportion of the Revenue. *Thus is (1) brought to agree with (2); and the conclusion that all capital must be taken into account for the rate of profits becomes true.* (D1/91: 20–21; emphases added)

When wages, besides the ever-present element of subsistence, also constitute revenue over and above subsistence, it is no longer possible to identify a priori which commodities are "wage goods" and thus can be reckoned as a physically specified part of capital as a whole. It is also no longer possible to distinguish between "necessaries" and "luxuries": depending on the share of wages, each and every type of commodity could, in principle, be consumed by workers. It is from this consideration that Sraffa appears to have concluded in accordance with Marx that *all* capital and thus *all* industries have to be taken account of in determining

the general rate of profits. In this perspective (1) had to be brought in line with (2) rather than the other way around, as Bortkiewicz had (implicitly) suggested.

To the passage cited last Sraffa added in parentheses:

> *Now, what is wanted is a similar step in regard to the "advanced" constant capital, to divest it of its fetish character*, machines (etc), and consider its replacement as a proportion of the gross product. (D1/91: 21; emphasis added)

As we have seen, as against Ricardo's view that the division of the product between wages and profits is the *only* factor affecting the general rate of profits, Marx had rightly insisted that the proportion between labor (or advanced wages) and means of production—the organic composition of capital—is a *separate*, independent factor (see also Garegnani 1984). The "similar step," referred to by Sraffa, now requested that this second factor be expressed in a form that is congruent with the first one.

With the benefit of hindsight we may say that Sraffa's own attempts in this regard can be traced back to 1931 when he had put forward the Statistical Hypothesis that the actual composition of the net product and that of social capital were such that the price ratio of the two aggregates did not change with changes in the rate of interest (see section 1.3.d). He knew that this hypothesis was wrong, but at the time was not yet possessed of an alternative device that would have allowed him to render the properties of the economic system more transparent. When at the beginning of the 1940s he encountered Marx's parallel "Value Hypothesis," he was clear that it was not generally valid. As we have also seen (see section 3.4.e), he had noted carefully that in Bortkiewicz's interpretation value to Marx was merely a "Hilfsgrösse"—an auxiliary magnitude—employed in order to come to grips with the intricacies of the economic system under consideration. This interpretation Sraffa appears to have endorsed. He therefore must have been struck even more by the parallelism between Marx's and his own approach, because seen from this vantage point the Value Hypothesis and the Statistical Hypothesis served essentially the same purpose. It also had not escaped Sraffa's attention that the latter applied strictly only when the former did as well.

Alas, both hypotheses, useful as they had been in trying to understand value and distribution from a surplus point of view, could not be sustained. Sraffa convinced himself at the latest in the summer and autumn of 1942, if not earlier, in the course of developing, with the help of Abram S.

Besicovitch, models with circulating and fixed capital (see Kurz and Salvadori 2004b) that no *actual* system could be expected to satisfy the hypothesis. He therefore, in December 1942, drew the consequence and henceforth sought a solution in terms of an artificial device, a "construction," as he called it (see D3/12/27: 32). However, as he explained in some detail in a working note dated 22 and 27 December 1943, titled "Constant Capital as Proportion. (Cont. from Ring-book, note on Bortkiewicz III)," replacing the inventory with the proportion concept also with regard to social capital was a great deal more difficult:

> It has been easy to transform wages in that way; why is this other step so much harder? By transforming wages, we have avoided all the (Bortkiewicz's etc) difficulties as to different Org. Comp. of wage-goods and luxuries; can't we do the same for Const. Cap. (which would amount to dispensing with the necessity of assuming that the Value Hypothesis holds)? The transformation of wages has been done by introducing (in all but in name) money; and taking the Annual Revenue as unit of money (hence the "proportion" = money wage). . . .
>
> The root of the trouble is this:
>
> a) Bortkiewicz gets into trouble by considering, with the same "proportions" (i.e. rate of S.V.), values and prices, or different prices. Hence the necessity of puzzling whether, at different prices, the same wage goods can be bought by the same wage; and the necessity of going into the org. comp. of wage goods as opposed to that of luxuries.
>
> I have avoided this, by considering a given proportion *only* in relation to one set of prices—the one that corresponds to it. Hence I never meet the question whether that wage (proportion) can buy the same goods at different prices; for at different prices that wage (proportion) is different, and is not required to buy the same goods. The question does not arise.
>
> Now B.'s case does not arise in reality: commods. do not, in fact, exchange at their values unless $w = 1$; and, whenever $w < 1$, they exchange at the corresponding price, and no other.
>
> *The error of B. is to have carried the point of view ("transformation of values into prices") beyond its proper limits,—within which M. kept them.*
>
> b) *In considering Constant Capital, I have fallen into the same (a similar, not identical) trap as B.* For I have assumed that as w and r change, it is possible for R (i.e. Const. Cap.) to remain constant. Hence my trou-

> bles, the necessity of taking into a/c {account} its Org. Comp., as opposed to that of the product, and of introducing the Value Hypothesis.
>
> The comparison may be put thus:
>
> a) B's fault is that he abstracts from the condition of "equal profits."
>
> b) My fault is to abstract from the condition of "maximum profits."
>
> (D3/12/35: 9(1–3); emphasis added)

There is no space to enter into a detailed discussion of the path Sraffa followed until, in a set of notes dated 27 January 1944 and interestingly titled "Hypothesis" (see the manuscript D3/12/36: 61–85), he at long last accomplished the task in terms of the construction of the Standard system and Standard commodity (with regard to single-product systems). An important step on the way toward this *Hilfskonstruktion* was the change from *ante* to *post factum* payment of wages: the former, Sraffa had convinced himself, was incompatible with the revenue aspect of proportional wages. However, as soon as wages as a whole were taken to be paid out of the social product rather than out of the social capital, the way was open to replacing the *socioeconomic* distinction of the classical authors between "necessaries" and "luxuries" with the purely *technical* distinction between "basics" and "nonbasics." Basics enter directly or indirectly in the production of all commodities. In the Standard system, nonbasic products are eliminated and the maximum rate of profits, R, is shown to equal the Standard ratio of the Standard system, a ratio of two vectors of commodities that are linearly dependent. The Standard commodity allowed Sraffa to establish the sought-after congruity between wages and capital in the circular flow framework in terms of a linear relation between the rate of profits, r, and proportional wages, w:

$$r = R(1 - w).$$

This linear relation applied also to the actual system, provided wages and prices were expressed in terms of the Standard commodity. As Sraffa was to emphasize in his 1960 book, "The same rate of profits, which in the Standard system is obtained as a ratio between *quantities* of commodities, will in the actual system result from the ratio of aggregate *values*" (23).

It is interesting to note that in the moment of his analytical triumph Sraffa was to jot down a nota bene saying:

> That M. {Marx} knew all this is shown by the (otherwise contradictory) applying "simple rule" in reduction of values to prices and s to r, while elsewhere denying that org. comp. of cons. goods and of means

of prod. are equal. Contrast nonsense of Tugan B. and Bortkiewicz. (D3/12/36: 67 (verso))

4.2. Criticizing Marginal Productivity Theory

The second example concerns an element of the grand theme of Sraffa's criticism of marginal productivity theory. As we have seen, Sraffa fully endorsed Bortkiewicz's principle that methods of production (and consumption) that are not actually used can have no effect on the rate of profits and relative prices. In Sraffa's view, marginalist theory violated this principle. In a working note dated 10 October 1943, titled "Bortkiewicz's Dogma," he in this context addressed the problem of cause and effect. Did a given "quantity of capital" determine the rate of profits, as marginalist theory implied, or did a given rate of profits, by deciding the choice of technique by means of which given levels of output were produced, decide the quantity of capital?

> Put it like this: We cannot say that r is 5% . . . because . . . these methods are adopted, and so much capital is used. But we can say that these methods were adopted . . . because . . . r was 5%.
>
> The fact is that however much we examine the method of production we cannot discover in it any circumstance that compels a rate of 5% rather than any other. . . .
>
> It is only when we consider the *alternative possible methods of production*, that we discover a connection between the particular method and the rate of 5%. And the connection is, that at that rate that method is cheaper than any other. But does the reverse connection hold too? Is it true that, "given the quantity of capital," a certain method will be adopted and a certain rate be verified?
>
> We must ask "in what sense '*given*'" . . . ? (D3/12/35: 30 (1–2); first emphasis added)

Sraffa denied that the concept of quantity of capital could generally be defined independently of the rate of profits, and, even if it could, that a causal link could be established leading from a given amount of capital via the use of a certain technique to the rate of profits.

We must leave things at that. Suffice it to say that the importance Sraffa attributed to "Bortkiewicz's dictum" for a critique of marginalism is also shown, for example, by the fact that as late as January 1958 he composed a note headed "Margins and margins" (D3/12/46: 52–3) that

comprises references to, and quotations from, Bortkiewicz's "Der Kardinalfehler" (1906) and "Zur Zinstheorie" (1907b), a note he originally meant to include in the preface of *Production of Commodities by Means of Commodities* but then did not.

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