

Reading Sraffa: The Philosophical Underpinnings of Production of Commodities by Means of Commodities*

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Abstract

This paper throws critical light on some influential readings of Sraffa by investigating the philosophical underpinnings of his book. It argues that both the Sraffians' interpretation based on the classical notion of centre of gravitation as well as the neoclassical interpretation based on the supposedly implicit assumption of constant returns to scale are incorrect. The paper highlights the absence of time in Sraffa's system and develops an understanding of the subtitle of the book, 'Prelude to a Critique of Economic Theory'. It argues that the central feature of Sraffa's project was to show that the notion of a causal functional relation between prices and methods of production, which is at the foundation of neoclassical theory, is illogical. This is the point where Sraffa's underlying philosophical position comes together with the philosophy of the later Wittgenstein.

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I Introduction

Piero Sraffa's slim volume *Production of Commodities by Means of Commodities* is perhaps the most intriguing work ever published in economic theory¹. A couple of remarks in the 'Preface' to this volume have given rise to ever increasing controversy in the history of economic thought on the one hand, and a critique of orthodox economic theory on the other². The intention of this paper is to throw some critical light on the readings of Sraffa by investigating the philosophical underpinnings of this work—an aspect that has largely gone unnoticed in the debates surrounding Sraffa's legacy³.

The Sraffians' interpretations of Sraffa have concentrated almost exclusively on the economic theory aspect of his work, i.e., he is read within the context of the

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theoretical debates in economics only. This notwithstanding Ludwig Wittgenstein's 'Preface' to *Philosophical Investigations*, where he writes,

For since beginning to occupy myself with philosophy again, sixteen years ago, I have been forced to recognize grave mistakes in what I wrote in the first book [*Tractatus Logico-Philosophicus*]. I was helped to realize these mistakes—to a degree which I myself am hardly able to estimate—by the criticism which my ideas encountered from Frank Ramsey, with whom I discussed them in innumerable conversations during the last two years of his life. Even more than to this—always certain and forcible—criticism I am indebted to that which a teacher of this university, Mr. P. Sraffa, for many years unceasingly practised on my thoughts. I am indebted to *this* stimulus for the most consequential ideas of this book⁴. (1978 [1953], viii)

Thus the philosophical sophistication of Sraffa's mind is beyond doubt, and it would be foolhardy to think that his own monumental work in economics remained untouched by his philosophy.

Below I shall argue that *Production of Commodities by Means of Commodities* is not designed just to show that the notion of 'aggregate capital' in the orthodox theory is illogical or that 'classical' theory of value and distribution can be rehabilitated. The intriguing nature of this work lies in its complete rejection of the notion of *mechanical causality*⁵. As the foundation of the orthodox theory, i.e., the 'marginalist method', is built on the notion of mechanical causality, a rejection of this foundation is most likely what 'prelude to a critique' refers to in the subtitle of the text. A complete rejection of subjectivity in his analysis can also be traced to the same reasons as those to the rejection of mechanical causality.

Given that Sraffa has left no statement about the philosophical underpinnings of his work in print and only a few hints in his unpublished notes, I naturally have to rely on informed speculation on this account⁶. It goes without saying that an understanding of Sraffa's influence on Wittgenstein will go a long way in explaining his philosophical position⁷. Keeping this in mind, Section II is designed as a philosophical backdrop against which Sraffa's *Production of Commodities* must be read. It contains a brief discussion of the nature of Wittgenstein's break from the *Tractatus* to the *Investigations*. A reader well versed in the philosophy of Wittgenstein may wish to skip this section and go straight to Section III and refer back to it whenever needed. Section III is devoted to a reading of the *Production of Commodities* and to establishing the thesis that Sraffa's central target is the notion of *mechanical causality*. It highlights an intriguing feature of the book, namely, an absence of *time* in his analysis, on the basis of which it has been possible to throw critical light on some influential readings of Sraffa. Section IV contains some brief concluding remarks.

II The Philosophical Backdrop

Wittgenstein's project in the *Tractatus* is to develop an abstract theory of meaning and to discover the limits of language and the general structure of facts⁸. His theory of the meaning of a proposition in the *Tractatus* is deeply rooted in his belief that the foundation of logic lies in *atomism*. For Wittgenstein, any proposition can be broken down or analysed into its elementary constituents, the 'elementary or atomic

propositions'. The elementary propositions are propositions that contain only one fact, i.e., no part of it contains a fact. All elementary propositions are independent of each other, for if they were logically connected or complex they could be further analysed. Given all the atomic facts, together with the fact that they are all, any true propositions, however complex they might be, can theoretically be inferred. This Wittgenstein is able to show through a complicated method of 'truth functions'. The conclusion of this exercise is that nothing can be deduced from atomic or elementary propositions. Hence "[t] here is no possible way of making an inference from the existence of one situation to the existence of another, entirely different situation. There is no causal nexus to justify such an inference. We *cannot* infer the events of the future from those of the present. Superstition is nothing but belief in the causal nexus" (47)⁹.

To establish how propositions get their sense, Wittgenstein argues that a proposition is a combination of words, and words are names of things or *simples* they represent. The "simples" are not necessarily the things to which proper names are attached in our day to day life. For example, a statement that 'Excalibur, a proper name, has sharp blade' makes sense even if the Excalibur is broken into pieces. Thus in this case the sentence 'Excalibur has a sharp blade' makes sense even when there is a word in it to which nothing corresponds. Thus, for this sentence to have sense, Excalibur must disappear when it is analysed and its place is taken by words that name simples. Thus, simples are the logical necessity of Wittgenstein's theory, even though he is unable to give concrete example of his "simples" or "objects" or "things" (See Wittgenstein, 1978). These simples or things are independent of one another, otherwise they would be complex and could still be broken down to simples.

Wittgenstein argues that the form of a thing or simple is to be a constituent of states of affairs. Any state of affair is a combination of things (or objects or simples). In a state of affair things are placed in a determinate order. This order is the structure of the state of affairs. The facts are the possibilities of the states of affairs. Thus the structure of a fact consists of the structures of the states of affairs. But to be able to represent facts a proposition must have a structure common to the structure of facts similar to a pictorial representation of facts. In a picture objects have the elements of the picture corresponding to them. The elements of the picture are related to each other in a determinate way—this is what constitutes a picture. Thus, the structure of a picture, i.e., the pictorial form of the picture, must represent the structure of the objects it depicts. A picture, however, cannot depict its pictorial form. It can only display it. Every pictorial form has a logical form, and a picture whose pictorial form is logical form is a logical picture. A proposition has a sense only if the fact it depicts has a logical form, i.e., we can picture it to ourselves—it is thinkable. And what is thinkable is also possible. Thus, the fact must have logical form since we cannot think illogically. What is the logical form, however, cannot be said in language through propositions-- it can only be shown.

Wittgenstein, in *Philosophical Investigations*, begins with a subtle attack on the idea that "Every word has a meaning. This meaning is correlated with the word. It is the object for which the word stands" (2^c). With careful construction of extremely simple languages, which Wittgenstein calls "language games", he shows that the words get their "meaning" from the context of their use. Such contexts are like games with their rules known to the players. The meaning of a word is neither attached to the things it

names (a word is like a tool that can be used for many purpose) nor derived from the subjectivity of its user. The rules of the game are *objective* and are known to all the players who use words in a particular language game. Thus, learning a language is akin to getting *training* in how to play a game — “ ‘language game’ is meant to bring into prominence the fact that *speaking* of language is part of an activity, or of a form of life” (11^e).

As mentioned above, in the *tractatus* Wittgenstein is unable to give examples of “simples”. It is taken as a logical necessity of the theory. In *Philosophical Investigations* however, he points out that the *Tractatus* dictum that ‘a word has no meaning if nothing corresponds to it’ uses the word “meaning” illicitly if it is used to signify the thing that “correspond” to that word. The first casualty of this is the disintegration of the concept of “simples” or “objects” that was the basic building block of his atomistic theory of meaning. After discussing several examples, he concludes that:

We use the word “composite” (and therefore, the word “simple”) in an enormous number of different and differently related ways (Is the colour of a square on a chessboard simple, or does it consist of pure white and pure yellow? And is white simple, or does it consist of the colours of the rainbow? — Is this length of 2 cm. simple, or does it consist of two parts, each 1 cm long? But why not of one bit 3 cm. long, and one bit 1 cm. long measured in the opposite direction?).

To the *Philosophical* question: “Is the visual image of this tree composite, and what are its component parts?” the correct answer is: “That depends on what you understand by ‘composite’” (And that is of course not an answer but a rejection of the question) (pp. 22^e-23^e).

Along with the collapse of the atomistic theory of meaning of the *Tractatus*, the *essentialist* aspect of his previous theory also falls by the wayside as Wittgenstein recognises that in general the meaning of words cannot be strictly defined. It varies from one context of its use to another and these contexts, which he calls language games, are not reducible to any common denominator such as, ‘logical form’ but rather only resemble one another like faces of individuals in a family. Thus, the *essence* of language does not lie outside of the language in the so-called *real*—that is, the meaning of words cannot look for support outside of language. A proposition is not a *pictorial representation* of the real world or facts but all the facts we have are the propositions themselves. Thus, Wittgenstein’s theory of meaning makes a decisive and dramatic shift from an *abstract* theory based on *logical necessity* to an *anthropocentric* theory. I concur with Ray Monk, who writes, “Wittgenstein once remarked to Rush Rhees that the most important thing he gained from talking to Sraffa was an ‘anthropological’ way of looking at philosophical problems. This remark goes some way to explain why Sraffa is credited as having had such an important influence. One of the most striking ways in which Wittgenstein’s later work differs from the *Tractatus* is in its ‘anthropological’ approach” (Monk 1990, 261).

What about Wittgenstein’s early critique of causality, however? Does that critique fall by the wayside as well? As a matter of fact, with the fall of essentialism of the *Tractatus*, Wittgenstein’s critique of causality becomes even more radical. As G.E.

Moore reports on Wittgenstein's lectures of 1930-33 in the special issue of *Mind* of January 1954 devoted to discussing Wittgenstein, "... he [Wittgenstein] also insisted on three negative things, i.e., that three views which have sometimes been held are mistakes. The first of these mistakes was the view that the meaning of a word was some image which it calls up by association—a view to which he seemed to refer as the 'causal' theory of meaning"(8). In *Philosophical Investigations* he argues that the subjective expectation of a causal relation based on the past experience (refer to foot note 9) has meaning only within a particular 'language game'— a language game in which high probability is accepted as a good ground for inferring a future occurrence based on the past experience. This, however, only means that the 'ground' measures up to a particular standard of good grounds, but the standard itself has no ground (136^e ff.).

III The Production of Commodities

In the Preface to *Production of Commodities by Means of Commodities* Sraffa begins by stating that:

The investigation [in the book] is concerned exclusively with such properties of an economic system as do not depend on changes in the scale of production or in the proportions of 'factors'.

This standpoint, which is that of the old classical economists from Adam Smith to Ricardo, has been submerged and forgotten since the advent of the 'marginal' method. The reason is obvious. The marginal approach requires attention to be focussed on change, for without change either in the scale of an industry or in the 'proportions of the factors of production' there can be neither marginal product nor marginal cost. In a system in which, day after day, production continued unchanged in those respects, the marginal product of a factor (or alternatively the marginal cost of a product) would not merely be hard to find—it just would not be there to be found (p. v).

Thus, at the very outset Sraffa is pointing out that his investigations in the book are not of the usual nature of discovering the *causes* of apparent phenomena, as a causal explanation can only be called for when there is a change. This could also point to the Humean notion of *time*, and thus an absence of time in his theory. As Hume argued, "For the quality of the co-existence of parts belongs to extension, and is what distinguishes it from duration. Now as time is compos'd of parts, that are not co-existent; an unchangeable object, since it produces none but co-existent impressions, produces none that can give us the idea of time; and consequently that idea must be deriv'd from a succession of changeable objects, and time in its first appearance can never be sever'd from such a succession" (Hume, 1739, p.36)¹⁰. The second point to note here is that Sraffa attributes "this stand point" to classical economists from Adam Smith to Ricardo. This, however, should not be interpreted as complete endorsement of classical theory, as we shall see later. All that is acknowledged here is the absence of laws of returns and returns to scale as tools of analysis in classical theory¹¹.

Further on in the Preface, Sraffa reveals the purpose of the book as:

It is, however, a peculiar feature of the set of propositions now published that, although they do not enter into any discussion of the marginal theory of value

and distribution, they have nevertheless been designed to serve as the basis for a critique of that theory (p. vi).

This points to the subtitle of the book, ‘prelude to a critique of economic theory’. To understand the significance of this claim one needs to put the two claims together. First it is claimed that the propositions of the book do not admit of any change and then it is claimed that these propositions are designed to serve as the basis for a critique of a theory that is built upon the notion of change. In some sense it appears that Sraffa wants to develop a sort of *geometry* (in Euclidean geometry the propositions do not admit of time or causation, they are simply relations of logical necessities) that would serve as a theoretical basis for criticising *mechanics*¹². Let us probe this point a little further. The propositions of the ‘marginal approach’ are based on functional relations, so that the theory builds itself by working out the effects of hypothetical marginal changes in the causes¹³. For example, utility is functionally related to consumption, and a hypothetical marginal change in consumption is supposed to cause a change in utility in a determinate manner. Similarly, cost is functionally related to production. Changes in the quantity of production would have a determinate effect on costs. These functional relations give rise to the notion of demand and supply functions, which together create a force field that explains both the equilibrium of the system and the movements of the variables given any shock to the equilibrium. Sraffa’s claim appears to be that the set of his propositions will negate the legitimacy of the causal functional relations of the neoclassical theory, thereby providing the basis for a critique of the theory.

Let us now look at the nature of Sraffa’s propositions. Chapter One of the book is entitled, ‘Production for Subsistence’. This chapter deals with a simple subsistence economy with specialization. Thus, the production process requires distribution of commodities given by the requirements of the technology (for subsistence economy consumption is part of technical requirement) whereas, commodities are concentrated in the hands of separate industries after the production process is over. In this case Sraffa finds that there is a set of exchange ratios or prices of commodities that “spring directly from the methods of production” which can restore the original distribution of the commodities and make it possible for the system to repeat itself at the same scale.

Chapter Two complicates the world by considering the case of a system that produces more than its minimum requirements (A system that produces less than its minimum requirements is not considered by Sraffa since such a system cannot have historical viability). Once a ‘surplus’ is admitted in the system, it becomes, in Sraffa’s words, “self-contradictory”. The required distribution of the commodities after production is no longer entirely determined by the methods of production. The problem of distribution of the ‘surplus’ must be solved. He argues that the surplus cannot be distributed prior to the determination of prices because “the surplus (or profit) must be distributed in proportion to the means of production (or capital) advanced in each industry; and such a proportion between two aggregates of heterogeneous goods (in other words, the rate of profits) cannot be determined before we know the prices of the goods” (p. 6). The upshot of the argument is that both the prices and the rate of profits must be determined simultaneously by the same mechanism. Accordingly, he adds a *uniform* rate of profits to his system of equations as an unknown, which gives him a system of n independent equations with n unknowns ($n-1$ prices and one rate of profits) that has an economically meaningful solution. One effect of the emergence of

surplus is that commodities can be divided into two separate categories. There can now be some commodities that appear in the system only as outputs but do not enter the system as inputs. Such commodities can be characterised as *non-basics* whereas the commodities that enter the system both as inputs and outputs can be characterised as *basics*¹⁴. Any change in the conditions of production of the basics would have an impact on the prices of all the commodities through its influence as input in the system. Whereas, any such change in the production of non-basics can affect only its own price. Sraffa further complicates the system by arguing that workers' remuneration may contain a part of 'surplus', thus adding another unknown to the system as *wages*. With this the system acquires one more unknown than the number of equations, and thus can move with one degree of freedom.

It is necessary to comment on some of the above propositions at this stage. Within the same Chapter we find that the measure of the 'surplus' has changed. In the beginning only profits were calculated as surplus whereas workers' remuneration was considered to be necessities. By the end of the Chapter, both profits and wages are counted as 'surplus'. So the question arises, what is this surplus and how is it determined? As a matter of fact the notion of surplus is not self-evident. It exists only in relation to the notion of 'necessity'. And the notion of necessity has definite meaning only from the subject's point of view. For a capitalist as a subject, the wages must constitute a necessity and only the profit over which s/he has total control can be taken as surplus. On the other hand, from a technical standpoint all the output over and above whatever has been used up in the production process must be characterised as surplus. From an entirely objective scientific point of view, however, there cannot be any surplus since there cannot be any effect without a sufficient cause or there cannot be any product without an equivalent cost¹⁵. Thus, it appears that Sraffa takes a technical standpoint towards his subject matter rather than either a class or a pure scientific standpoint.

Secondly, Sraffa identifies his surplus producing system with a capitalist system by identifying the form of surplus appropriation with profits. But not only that. Without any further ado he claims that the rate of profits "must be uniform for all industries". Soon after that he goes on to say that "Such classical terms as 'necessary price', 'natural price' or 'price of production' would meet the case, but value and price have been preferred as being shorter and in the present context (which contains no reference to market prices) no more ambiguous" (9). This has led to an almost unanimous opinion among Sraffa scholars that Sraffa's imposition of a uniform rate of profits on the system is an implicit acceptance of the notion of a centre of gravitation of classical economics¹⁶. As is well known, the 'natural prices' of Smith and Ricardo and the 'prices of production' of Marx are the centres of gravitation around which the market prices fluctuate. The gravitational point or the 'centre of gravitation' comes about because of competition and mobility of capital, given that capital seeks the highest profit rate.

This, however, does not appear to be a well thought-out interpretation, as Sraffa subtly points away from such an interpretation by stating that his system "contains no reference to market prices". The concept of 'gravitational point' has meaning only in relation to 'market price', which is supposed to gravitate towards this point because of capital mobility. Since Sraffa's system does not refer to 'market prices', the concept of 'centre of gravitation' loses all meaning in his system. Garegnani (1990b),

however, claims that the reference to the non-existence of ‘market prices’ is evidence in support of the notion of centre of gravitation (156). He argues that Sraffa’s system by his design is in equilibrium or at the ‘centre of gravitation’, i.e., the composition of his net output is such that they equal Adam Smith’s effectual demands and thus are market-clearing supplies. Therefore, Sraffa has no need to refer to ‘market prices’—“The outputs [Sraffa] takes as given are *ex ante normal* outputs just like the neoclassical ‘equilibrium’ outputs” (Garegnani, 1990a, 132). This, however, does not sit well with the evidence. The so-called ‘equilibrium’ market-clearing outputs have meaning only in relation to the notion of ‘effectual demand’. And as Harrod (1961) reminds us, “no reference is made to the *scale* or elasticity of demand for end-products. (The word ‘demand’ does not occur in the index [of Sraffa’s book])” (782, emphasis added). In his response to Harrod’s misreading of his method of price determination, Sraffa (1962) wrote, “Even in this simplest case [the case of the subsistence economy], however, if, with the same equations, the two commodities were produced in different proportions (so that the system ceased to be in a self-replacing state) the exchange ratio would remain the same” (478). Thus, it is evident that Sraffa’s outputs are not necessarily the market-clearing outputs.

Furthermore, if our interpretation is accepted, Sraffa’s system does not admit of time. The concept of ‘centre of gravitation’, however, has no meaning without any reference to time. It explicitly makes an arbitrary assumption that the adjustment of ‘market prices’ takes long enough to make the centre of gravitation the average ‘market prices’ but short enough to rule out any technical change. We do not find Sraffa giving any scope to such reasoning in his system¹⁷. As we have pointed out, Sraffa sees his system of equations as a snap-shot of reality at any moment of time. Since no real system is expected to be at the ‘centre of gravitation’, given that it is expected to be the average position, Garegnani’s interpretation seems to be swimming against the evidence. This, however, leaves us with the problem of making sense of Sraffa’s imposition of a uniform rate of profits on his system.

I could think of two possible solutions to this problem. First, it could be argued that Sraffa did not believe in a uniform rate of profits as a real phenomenon. He simply imposed the equilibrium condition of the orthodox theory on his system to be able to critically analyse its properties (this leaves the intertemporal general equilibrium as a different kettle of fish). Secondly, his last move of introducing a degree of freedom to his system may, however, point to a possible solution.

A degree of freedom in the system implies that the system is indeterminate unless one variable is *given* from *outside* the system. As Hahn (1982, 356) has correctly pointed out, taking either wages or the rate of profits or a price given from outside can formally solve Sraffa’s system. One could think of a price of a basic good being fixed by the government. Sraffa, however, considers only wages or the rate of profits as given from outside. Most likely this is because taking a price determined by the government could only give an arbitrary solution to the system. On the other hand, wages or profits have distinct status from the rest of prices given that they are income categories. Sraffa’s position appears to be that the same complex socio-historical processes that have given the technical configuration and the surplus of the system also determine the income categories. Giving one income category is tantamount to determining the other income category simultaneously, given the surplus. In the classical tradition real wages were generally taken as given by the socio-historical

forces at any given time. The classical economists (particularly Ricardo and Marx) took the standpoint of the capitalist in analysing the capitalist mode of production and identified surplus with non-wage incomes only. Sraffa's technical standpoint, on the other hand, leaves it open. As Sraffa later in the book argues, "The rate of profits, as a ratio, has a significance which is independent of any prices, and can well be 'given' before the prices are fixed. It is accordingly susceptible of being determined from outside the system of production, in particular by the level of the money rates of interest" (33). This suggests that Sraffa's position could be that the rate of profits is *conventionally* determined in relation to the going rate of interest, which of course is uniformly given by the monetary authorities. As Sraffa wrote, "It is possible to conceive of it [the rate of profits] as being 'given' from outside the system of production, such as conforming to the pattern of money rates of interest determined independently by the banking system or the Stock Exchange" (PSP D3/12/78, quoted in Ranchetti, 1998). This may explain the introduction of a uniform rate of profits in his system¹⁸. Unfortunately Sraffa did not elaborate on this crucial point. This notwithstanding, Sraffa's contention that the uniform rate of profits is "susceptible of being determined from outside the system of production" is yet another evidence against the 'centre of gravitation' interpretation. For, if the uniform rate of profits is the result of a gravitational mechanism then it cannot be conceived of being independent of the system of production, as it must depend upon the level of outputs in conformity with the effectual demand. A uniform rate of profits given from outside the system of production could, however, be applied to a system not necessarily in equilibrium. In this case disequilibrium would imply an unplanned fall or rise in the inventories of various sectors.

Chapters Three to Six are devoted to analysing the nature of the relation of prices to the distribution of income, given the technology and the surplus, in the case of single-product industries with only circulating capital. Sraffa finds that changes in wages would have no impact on prices if the proportions of means of production to labour were the same for all the industries. This is because a change in wages will have a proportionately equal impact on the costs of all the industries and thus a proportionate change in the rate of profits in all the industries will leave prices unaffected. In the general case where the proportions are not the same, however, a change in wages (or the rate of profits) would affect all the prices in a highly complicated way¹⁹. This is because as wages take on a higher (or lower) value the cost of production is affected more in one sector than in the other, thus affecting the rate of profits disproportionately. In this case prices must change to bring the rate of profits to equality across industries. The relation between changes in wages (or rate of profits) and prices is highly complicated. As Sraffa puts it, "the relative price of two products may move, with the fall of wages, in the opposite direction to what we might have expected on the basis of their respective 'proportions'; besides, the prices of their respective means of production may move in such a way as to reverse the order of the two products as to higher or lower proportions; and further complications arise," (15). This is because the impact of a change in wages on the cost of a product does not depend only on the input configuration of the industry in question but also on the input configurations of the industries that produce its inputs and the input configurations of the industries that produce their inputs in turn; and so on. The reader should note that throughout this analysis Sraffa allows no role for time or causal relations. When he argues that prices must change to redress the divergence in the rates of profits arising due to changes in wages, he does not resort to the classical

long-period argument that price movements are brought about by capital mobility and changes in supply. In his analysis the size and composition of the net output does not change. These relations are purely mathematical, or logically necessary. It would be a mistake to think that Sraffa expects the real world to solve his equations.

As we have seen above a change in wages has a very complicated relation with prices. However, at this stage one can argue that wages and the rate of profits are inversely related. This is because no price can fall (or rise) at a higher rate than the fall (or rise) in wages measured by any arbitrary numeraire. For if a product could do so, it could only be due to some of its means of production falling (rising) at a still higher rate. But this could not be applied to the product that fell (or rose) at the highest rate, which will be less than the rate of fall (or rise) in the wage rate. Thus, no price can fall (or rise) at a rate higher than the wages and so rate of profits and wages must be inversely related. This relation, however, in general, will be non-linear. This is because a change in wages affects all prices, including the commodity chosen as numeraire. Thus, the relation between the rate of profits and wages is contaminated by the changes in the size of the measuring rod itself. In other words, a change in the size of a piece of a pie apparently changes the size of the pie itself. This was a problem Sraffa (1951) had discovered Ricardo to be concerned with till the end of his life.

Sraffa's solution to this problem was to construct a composite commodity that will be unaffected by changes in the wages or the rate of profits. He called this commodity the Standard commodity, which, in a way, is embedded in any given system. Any given system can be mathematically rearranged in such a way that the proportions of its outputs are the same as the proportions of its aggregate inputs. This he called the *Standard system*. The Standard commodity is made up of all the basic commodities of the system combined in such proportions²⁰. In the Standard system a physical ratio of net output (or the *Standard net product*) to the aggregate means of production can be ascertained, since the ratio is made up of the same commodities arranged in the same proportions. This ratio, which is independent of prices, Sraffa calls the *Standard ratio*. The *Standard ratio* is, of course, equal to the maximum rate of profits of the given system, i.e., it is equal to the rate of profits in the system when the wage is equal to zero. In any given *Standard system* the rate of profits can always be ascertained without any recourse to prices by deducting any positive proportion of the *Standard net product* as wage share and taking the ratio of the residual *Standard net product* and the aggregate inputs, since the proportion of a fraction of the *Standard net product* must be the same as the *Standard net product*. Thus, in the case of the *Standard system* the wage rate and the rate of profits must be inversely and proportionately related to each other. In this case a change in wages would leave all the prices unchanged, since prices only change to redress the disproportionality arising in the rates of profits. Now if the *Standard commodity* is taken as the numeraire for the given system and it measures the wages, the rate of profits in the real system must be the same as to the rate of profits of the *Standard system* since the *Standard system* is made up of the same equations of production as the real system. Thus, for any given system the relationship, $r = R(1-w)$, must hold, where r is the rate of profits, R is the maximum rate of profits, and w is the wage rate expressed in terms of the Standard commodity. The above given equation gives the structural relationship between the methods of production (represented by R) and the two distributional variables, r and w . Prices must adjust in such a way that the above relations hold.

Furthermore, Sraffa shows that the *Standard system* and the Standard commodity so derived from any given system are unique to the system. Thus any change in the method of production of a basic commodity would result not only in a change in the value of R but also in a change in the measuring rod that measures the wages and thus the rate of profits. The upshot of the analysis is that there is no logical basis of comparing the values in the two systems²¹.

Further on, Sraffa, in Part Two of his book, yet again complicates the system by introducing joint production. In the case of joint production, he shows that one cannot even assert a rise or a fall in wages measured in any arbitrarily chosen numeraire for a given system. For, what could be a fall in the wage in terms of one numeraire may turn out to be a rise in terms of some other numeraire. This is because in the case of joint products a fall in the wage may lead to an even higher rate of fall in the price of a commodity as long as its joint product is either rising or not falling sufficiently such that the rate of fall of the joint product in aggregate is less than the rate of fall in wages. However, once this possibility is introduced for joint products it cannot be denied for even singly produced commodity either, provided it employs one of such joint products as its means of production. This implies that a 10 per cent fall in wages measured by a numeraire commodity “x” may lead to a 15 per cent fall in the price of “y”. Therefore, if “y” were used as numeraire then the same fall in wages measured by “x” would amount to a 5 per cent rise in wages measured by “y”. That is, as Sraffa put it “the rule that the fall of the wage in *any* standard involves a rise in the rate of profits must now admit of an exception” (61). Interestingly such an “exception” cannot be relegated only to such cases as production of mutton and wool. Sraffa introduces fixed capital as the most general case in the genre of joint production. This not only liberates his system from the notion of time even in the case of fixed capital, it also solves the traditional problem of how to account for depreciation by rendering the notion of depreciation irrelevant.

Thus, the Standard commodity must be used, either directly or indirectly, for measuring the changes in wages for a meaningful analysis²². Given that a Standard commodity is unique to the given system, there is no logical way of comparing wages and thus the prices of commodities, once methods of production have changed—as the later Wittgenstein had argued, words don’t carry their meaning across language games. This completes the thesis that no functional relations can be established between changes in the methods of production and wages, since there is no medium by which wages can be compared across two different methods of production.

It is surprising that in his highly influential critique of Sraffa’s book, Hahn (1982) completely ignores Part Two of the book that deals with the case of joint production. In his attempt to neutralise Sraffa’s claim that his propositions are designed to “serve as the basis for a critique of [the marginal theory of value and distribution]” Hahn claims that “there is no correct neo-Ricardian proposition which is not contained in the set of propositions which can be generated by orthodoxy” (353). Hahn, however, has to impose a crucial assumption of constant returns to scale on Sraffa’s system to make good his claim²³. As we have seen, Sraffa had explicitly rejected the admittance of any notion of returns to scale on his system. And our interpretation so far concurs with Sraffa’s position. Hahn (1982), on the other hand, argues that “I have been at a loss to understand him [Sraffa] here. For the claim reduces everything we have discussed so far to just a fancy way of presenting accounts *ex post*. If there is enough

time for equal rates of profit to be established then there is also enough time for producers to decide which technique to use” (359).

Admittedly Hahn is accepting the centre of gravitation argument as part of Sraffa’s baggage. Garegnani (1990a) has countered Hahn by suggesting that Sraffa’s outputs are *ex ante* equilibrium outputs; thus his theory of prices is independent of the adjustment of outputs toward equilibrium²⁴. This, however, is not convincing. Garegnani argues that, following the classical economists, Sraffa’s theory is built on two separate logical steps. At the first step, the theory determines the real wage, the techniques of production, and the size and composition of total output. The first two variables are primarily determined by the socio-historical context and the third variable is determined by the given ‘effectual demand’, which is also largely determined by the socio-historical context, i.e., the techniques and the distribution of income, and the gravitational mechanism. The determination of value and the rate of profits are then conducted at the second logical step by taking the above three variables as *given*. Sraffa, however, conducts his analysis by changing the distribution of income. It cannot be legitimately maintained that such changes in income distribution will not have any effect on ‘effectual demand’. Thus, given the size and composition of the output in Sraffa’s system, this must result in disequilibrium. And the equilibrium can be restored through the gravitational mechanism without a change in the techniques of production only if constant returns are assumed. Since, as we have argued above, Sraffa’s system is like a snap-shot of a real system at a point in time, his equations are indeed a way of presenting accounts *ex post*, fancy or not.

Recently Samuelson (2000) has also come out with a strongly-worded indictment of Sraffa on the issue of constant returns to scale. As he states, “In cautioning (p.v) against readers ‘mistaking spurious “margins” for the genuine article’, the author [Sraffa] seems to overlook that much of his first 78 pages themselves do involve shifts in the ‘scale of an industry’—as, for example, in working with specified *standard* market baskets of productions, or in supposing that demand and taste shifts do not alter real prices in a no-joint-production world, and as, for example, in Chapter I’s crucial sole footnote” (116). He then goes on to conclude, “In sum, if a Sraffian denies constant returns to scale, the one-hundred-page 1960 classic evaporates into a few paragraphs of vapid chit-chat” (123)²⁵.

Such strong disagreement by leading authorities of the neoclassical economics with such a careful author like Sraffa²⁶ points to the crucial difference in their approaches to the problem. The neoclassicals think that any meaningful economic theory must be a *predictive* theory (i.e., a causal theory) otherwise it is meaningless or mere chit-chat. As we have argued above, Sraffa’s ‘prelude to a critique of economic theory’ is not supposed to be an alternative theory that comes up with different predictions from the orthodoxy. It is designed to show that the *basis* on which the predictive theories of the orthodoxy stand is simply non-existent. Burmeister (1975) makes this point amply clear when he writes,

Now consider a new situation with a different size and composition of output denoted by subscripts two. We may again calculate Sraffa’s Standard Commodity in this new situation and his corresponding “real wages,” (*sic*) w_2^s , as well as, the new maximum profit rate r_2^* . It remains true, by virtue of (1), that

$$r_2 = r_2^* (1 - w_2^s).$$

But in general *nothing* more can be said unless the two different situations are generated from a constant returns to scale technology! Thus, if Sraffa's "real wages" (*sic*) remain constant in both situations with $w_1^s = w_2^s = 50\%$, the equilibrium profit rate in the second situation may change in *any* direction (69).

But isn't this Sraffa's point precisely? In the real world a change in the composition of real output leaves the theoretician devoid of any basis for prediction, unless constant returns to scale are invoked. But the assumption of constant returns to scale is simply *arbitrary*²⁷. Sraffa's negative critique is complete.

Samuelson is simply mistaken when he interprets Sraffa's derivation of the Standard system or his statement in footnote 1 (Sraffa 1960, 5) etc. to imply an implicit assumption of constant returns to scale. Nowhere do Sraffa's mathematical manipulations of the equations imply that he expects the real system to mirror his mathematics. Sraffa's Standard system only suggests that *if* there was a system of production conforming to the Standard system, then such and such relationships between its variables must exist, and a particular relationship between this system and the real system can be established. Sraffa's Standard system is a hypothetical production system that exists on a hypothetical island contemporaneously with the real production system. It is not acquired by contemplating actual changes to the real system.

But Sraffians themselves have to take some responsibility in adding to confusion on this score. For example, after vehemently denying the existence of constant returns to scale in Sraffa's book, Harcourt and Massaro (1964) go on to state that "The inclusion of joint production in the analysis explains why Sraffa did not use the more familiar input per unit of output notation in the single commodity system. This notation has no meaning once there is joint production;" (448). This could not be true. This is because the use of "input per unit of output notation" in effect implies an assumption of constant returns to scale. Similarly, Levine (1974a) writes, "That is, commodity prices in the model [i.e. Sraffa's] are determined entirely independently of those relative weights or scalars, of the equations of production, that display the mix of total demand. These relative weights may change without changing the commodity-price set, provided, of course, that neither the techniques of production nor distributive share change" (879). This could not be true either, since a change in the composition of real outputs cannot leave Sraffa's techniques unchanged unless constant returns to scale is implied.

So much of the fuss about constant returns to scale is also due to another misinterpretation of Sraffa. That is, he was somehow interested in establishing that 'demand has no role in determining prices'. In a letter to Arun Bose, dated 9th December 1964, Sraffa wrote,

I am sorry to have kept your MS so long—and with so little result.

The fact is that your opening sentence is for me an obstacle which I am unable to get over. You write: "It is a basic proposition of the Sraffa theory that prices are determined exclusively by the physical requirements of production and the social wage-profit division with consumers demand playing a purely passive role."

Never have I said this: certainly not in the two places to which you refer in your note 2. Nothing, in my view, could be more suicidal than to make such a statement. You are asking me to put my head on the block so that the first fool who comes along can cut it off neatly.

Whatever you do, please do not represent me as saying such a thing. (PSP C32, quoted in Salvadori 1998; see Bose, 1965).

This is in full accord with our reading of Sraffa. The absence of demand in Sraffa's system is due neither to an implicit constant returns to scale assumption nor to the opinion that demand plays a "purely passive role". Sraffa's system shows that, given a rate of profits or wages (along with the assumption of a universal rate of profits across sectors), prices are determined by the given methods of production. The role of demand (of basic goods) can only be determined by analysing the effects on prices of changes in demand. But demand can affect prices only via affecting the methods of production (since demand can affect income distribution only via its affect on methods of production). Now Sraffa's analysis has shown that once the methods of production change the system loses all scientific grounds for comparing the two sets of prices. Thus, the impact of demand on prices is not passive but rather *unpredictable*. Thus, no causal functional relationship between quantity supplied and prices, or demand and prices, can be established.

An interesting aspect of Sraffa's analysis is that it is based on variables that are ideally *observable*. We do not encounter notions or concepts such as, 'disutility', 'sacrifice', and 'opportunity cost' on the side of cost or supply and 'utility' on the side of demand in Sraffa's book. This also fits well with our reading of Sraffa. A theory based on subjective notions such as, 'utility' or 'disutility' must be a causal theory since an explanation rooted in subjectivity must hypothesize a causal relation such that the subjective cause is inferred by its supposed observable effects. A rejection of mechanical causality must lead to a rejection of subjective theories²⁸.

Part three of the book contains a single and last chapter of the book entitled 'Switch in Methods of Production'. In this chapter, consistent with our reading of the book, Sraffa goes on to show that if there are choices of techniques available then a continuous rise or fall in the rate of profits (or wages) may lead to the same technique coming back several times as the most profitable one. That is, there is no causal functional relationship between the rate of profits (or wages) and 'intensity of capital' (or labour). In fact, the concept of 'aggregate capital' and thus, the concept of 'intensity of capital' are illogical. This chapter of Sraffa's book has been the most influential and talked about chapter and its results are well accepted by all the parties including the leading neoclassicals (see the symposium on 'reswitching of techniques' in the *Quarterly Journal of Economics*, 1966).

This is not the place to revisit the reswitching and capital reversal debate, except to note that Sraffa's own exposition of the reswitching propositions is mindful of the problem of numeraire or the measuring standard in the context of comparing systems with different methods of production. As Sraffa writes,

If the product is a basic one, the problem is complicated by the circumstance that each of the two alternative methods of producing it implies a distinct

economic system, with a distinct Maximum rate of profit. As a result, we seem to lack a common ground on which the comparison between the two methods can be carried out: since, according as one or the other method is used, we are in one or the other economic system, and to any given rate of profits there will correspond in each system, a different wage, even though in the same standard, and a different set of relative prices; as a consequence a comparison of the prices by the two methods becomes meaningless since its result appears to depend on which commodity is chosen as standard of prices (1960, 82).

This led Sraffa to develop his reswitching propositions via a somewhat tortuous argument where two methods are supposed to be producing an identical basic goods but are distinct in their use as non-basics. The subsequent literature, however, does not pay any attention to the problem associated with the standard of measurement, which is a reflection of an inadequate appreciation or misunderstanding of Sraffa's central project in the *Production of Commodities*.

IV Concluding Remarks

In some sense we have been mainly concerned with the meaning and significance of the subtitle of Sraffa's book, '*Prelude to a Critique of Economic Theory*'. Our discussion above has tried to establish that Sraffa's central project in the *Production of Commodities* was to establish that a change in methods of production or techniques of production leaves economic theory with no *standard of measurement* with which economic variables could be compared. This cuts the ground from under the feet of all the theories that are based on causal functional relations between prices and choice of techniques and income distribution and choice of techniques, such as, the neo-classical theory in general. Sraffa's propositions show that the *value problematic* is essentially a static problematic, and the concept of value has meaning only within the context of a given methods of production. Once the methods of production change the theorist loses all scientific grounds for comparing the values in the two systems. This has a close resemblance with the later Wittgenstein's philosophy of language, where the meaning of a word can be ascertained only within the context of its *use*. However, there is no standard for comparing the meanings of the same word in two different contexts or language games. Sraffa's influence on Wittgenstein or their mutual influence on each other appears to be on this most crucial point of their respective theories.

Our interpretation of Sraffa's book places it in the genre of critical rather than constructive contributions. The reader may wonder if Sraffa was so fundamentally opposed to causal theories in economics, then what kind of theories would he support? I would venture to suggest that the nature of Sraffa's work aimed at changing the fundamental problematic for economic theory. A parallel between the neo-classical theory and Wittgenstein's *Tractatus* can be drawn for illustration purpose. The neo-classical economics works out a theory of *ideal* market (the perfectly competitive market) based on the atomistic decision making agents similar to Wittgenstein's theory of *ideal* language based on his notion of 'simples' in the *Tractatus*. And as the ordinary language of everyday life is understood as distortion of the ideal language in the framework of the *Tractatus*, the neo-classical economics understands the real economy of everyday life as distortion of the ideal market. The Sraffa critique, however, suggests that the *ideal* is a chimera and a theoretical

confusion. The theory must be built from the observation of what exists. There is no ideal beyond what is ordinarily existing. Thus, the theory should be about *how* it works rather than what is the essence or ultimate cause of it. For example, in the case of a theory of value, the theory should not look for the *cause* of value either in labour or sacrifice or utility. It should rather describe how value is implicated in a given system of production and distribution.

Endnotes

- 1 In one of the earliest reviews of the book, Sir Roy Harrod wrote, “The publication of this book is a notable event. ... A reviewer would be presumptuous if he supposed that he could give a final assessment of the value of its net product, or even single out what may prove to be its most lasting contributions. Before that result could be achieved, much prolonged consideration and reconsideration would be required” (1961, 783).
- 2 Ian Steedman’s (1977) Sraffa-based critique of Marx gave rise to yet another controversy. The Marxist response to Steedman, however, did not lead to much intellectual stimulation.
- 3 A. Roncaglia (1978), John Davis (1988, 1999), David Andrews (1996), and Sandemose (2001) are a few exceptions.
- 4 The reader should keep in mind that Wittgenstein was known to be ruthlessly honest about his opinion of fellow intellectual friends. He is reported to have once said about his teacher and life long friend G.E. Moore that ‘he [Moore] shows you how far a man can go who has absolutely no intelligence whatsoever.’ And after the first few weeks during the ‘Second Coming to Cambridge’, he confined his relationship with Keynes to strictly business matters; whereas in May 1946 when Sraffa decided to cut off communications with Wittgenstein on philosophical matters, he is reported to have pleaded with him to continue their weekly conversations by saying, ‘I’ll talk anything!’ (see Monk, 1990).
- 5 Following Hume, by ‘mechanical causality’ I mean two relations of *contiguity* and *succession* as essential characteristics of cause and effect. It should be differentiated from internal or logical relations.
- 6 Sraffa’s unpublished notes are housed in the Wren Library at Trinity College, Cambridge. It is open to the public for consultation. However, one is not allowed to quote from such papers without the permission of its literary executor P. Garegnani. In this paper I refer to Sraffa’s unpublished papers as PSP and provide the file numbers to help the reader look for supporting evidence.
- 7 In his ‘Revisionist findings on Sraffa’ Samuelson (1990) writes, “One yearns to know more about Sraffa’s precise influences on Wittgenstein”.
- 8 In the ‘Preface’ of the *Tractatus* Wittgenstein writes, “The whole sense of the book might be summed up in the following words: what can be said at all can be said clearly, and what we cannot talk about we must pass over in silence” (1974)[1921]. It seems to me that this statement has two aspects and both of them

point to the limitation of language. One is the distinction between *saying* and *showing*, and the other is the distinction between *talk* and *silence*. The first is concerned with the problem of language and logic, whereas the second is concerned with ethics, aesthetics, and mystic. For our purpose, it is the first aspect that is more relevant.

- 9 This sounds like an echo of David Hume, who, as early as 1739, had argued that the notion of causation has no objective validity, as causal connections can never be inferred by observation. Thus, the idea of causal connections exist because of our *belief* in the groundless reason that the future will be the same as the past as there can be no demonstrative argument to prove “that those instances, of which we have had no experience, resemble those, of which we have had experience” (89).

The reader should note that Sraffa knew Hume’s work so intimately that he is now universally acknowledged to have clarified the confusion regarding the authorship of an ‘*Abstract*’ of the *Treatise*. For a long time the authorship of the *Abstract* was attributed to Adam Smith on the basis of Hume’s letter of March 4, 1740 to Francis Hutcheson in which Hume refers to a Mr. Smith without attributing the authorship to him. Later, however, it came to be understood that it was a reference to the young Adam Smith who had supposedly authored the *Abstract* on Hutcheson’s instructions. It was Sraffa, in collaboration with Keynes, who argued that the author of the *Abstract* was none other than David Hume himself and that the Mr. Smith of Hume’s letter was not Adam Smith but rather a Mr. John Smith, Francis Hutcheson’s Dublin publisher. See Hume (1938) [1740], J.M. Keynes and P. Sraffa (Eds.).

- 10 I concur with Roncaglia (1978, 21-2) where he uses the metaphor of a snap-shot for Sraffa’s system. Actually this metaphor is Sraffa’s own. See PSP D3/12/7 dated 15/7/28 for supporting comments on this issue.
- 11 Another point of commonality between the classical method and the *Production of Commodities* acknowledged by Sraffa is “to regard production as a circular process in which the same kind of commodities appear both among the means of production and among the products—rather than as a process beginning with ‘factors of production’ and ending with consumption goods” (From the back jacket of the book).
- 12 “The theory of Economy thus treated presents a close analogy to the science of Statical Mechanics, and the Laws of Exchange are found to resemble the laws of Equilibrium of a lever as determined by the principle of virtual velocities. The nature of Wealth and Value is explained by the consideration of indefinitely small amounts of pleasure and pain, just as the Theory of Statics is made to rest upon the equality of indefinitely small amounts of energy” (Jevons 1957 [1871], vii).
- 13 The mathematical notation, $y = f(x)$, only represents a mapping and not a causal relation. The reading of $y = f(x)$ as y is *caused* by x is an additional theoretical statement, which lies outside of mathematics.

- 14 A non-basic can appear as an input in the production of non-basics but is not directly or indirectly an input in the production of all the commodities in the system.
- 15 See PSP, D3/12/7, dated August 22, 1931 for an interesting discussion on this subject by Sraffa.
- 16 See Kurz (1998) and Kurz and Salvadori (2000) for recent restatements of this opinion.
- 17 The reader can verify from Sraffa's Lectures of 1928-31 among his unpublished papers that he criticised Marshall's supply curves or functions on the ground that a change in supply that causes a change in marginal and average costs may not be reversible. Thus, Marshall's supply curves may be good "descriptive" or "historical" curves but not curves depicting functional relations. Joan Robinson (1978), who had attended Sraffa's lectures, reiterated this point much later. And, of course, Garegnani (1990a) himself, in the context of demand curves, argues that an increase in quantity demanded due to a fall in price may not be reversible given that it could change the taste. Why does not the same logic apply to the movements of outputs in the context of 'centre of gravitation'?
- 18 Massimo Pivetti (1990) has also argued in a similar vein. He, however, tries to develop a theory of the rate of profits on the basis of the rate of interest and gets too entangled with the notion of causation and time.
- 19 The determination of equality or inequality of proportions can be made by measuring means of production by taking their values at any wage, since when proportions are the same then changes in wages have no impact on the prices and thus on the proportions so measured. From this it follows that if the proportions are not equal at one wage they will not be equal at any wage.
- 20 No non-basic commodity can feature in the composition of the Standard commodity because non-basics do not appear as inputs in the system.
- 21 Burmeister (1974, 1975) has argued that "Sraffa's measure of the 'real wage' is economically flawed. Sraffa's unique consumption basket weights c_1, \dots, c_n are determined from the technology alone; they are weights derived from the right hand characteristic vector associated with Frobenius root of the production technique matrix. These weights are not related in *any* way to human needs or preferences, and there is absolutely no economic reason why they should be relevant for defining any 'real wage' (Thus, for example, Sraffa's Standard Commodity may be such that he must assign a relatively large weight in his consumption basket to a commodity such as, pig iron which is *never* consumed by humans!)" (1975, 68, f.n.1). This clearly is a misinterpretation. The Standard commodity, as Sraffa clearly states, is only a "medium in which wages are estimated" (22). Workers are not expected or required to *consume* the Standard commodity or a fraction of the Standard Net Product. The Standard commodity is used as the normalisation equation for the system. Since wages are paid *post factum*, any given real wage can be estimated by the Standard commodity on the basis of the prices so derived. Thus, the wage in terms of the Standard commodity

in Sraffa's system is not the 'real wage' but rather the 'nominal wage'. That's why Sraffa drops the explicit use of the Standard commodity in his system by taking the rate of profits as given from outside. In this case wages can be derived in terms of *any* commodity (see Sraffa 1960, 32ff.). Burmeister (1974, 456), however, is right in stating that higher values of wages in terms of the Standard commodity "do not, in general, imply anything about economic welfare." This is because an ambiguous change in the real wage basket could result in a definite rise or fall in its estimate in terms of the Standard commodity but it, of course, would remain ambiguous in terms of its welfare connotation. Sraffa's use of the measure of wages in terms of the Standard commodity, however, has no such welfare connotation.

- 22 Taking the rate of profits given from outside and invoking the condition, $r = R(1-w)$, as the normalisation equation of the system amounts to an 'indirect' use of the Standard commodity as the standard of measure.
- 23 As emphasised by Garegnani at several places (see Garegnani, 1998 for the most recent statement), given constant returns, demand has influence on prices only via changes in distribution caused by it in the neoclassical context. An increase in the demand for a relatively 'labour intensive' good will lead to a relative increase in the demand for labour and thus wages, which would relatively increase the price of such goods compared to prices of goods produced by 'capital intensive' methods. The so-called 'non-substitution theorem' does not allow any such change by decree and thus renders demand irrelevant in determining prices.
- 24 See Burmeister (1968, 1974, 1975), Eatwell (1975), Levine (1974, 1975, 1977) for an earlier debate on the issue of constant returns to scale in Sraffa's analysis.
- 25 Actually Burmeister (1968, 1974, 1975) made a similar argument a long time ago. But, of course, Burmeister (1968) gives credit to his teacher Paul Samuelson for the statements and proofs of many of the results. Moreover, an influential unpublished mimeo on this issue by Samuelson has been in circulation since 1971.
- 26 As Samuelson (2000) himself writes, "His [Sraffa's] pen writes as if a lawyer were at hand to ensure that no vulnerable sentence appear" (134, f.n.7).
- 27 In the light of his Chapter XI on Land, it is most unlikely that Sraffa could implicitly assume constant returns to scale for his propositions. As a matter of fact, in relation to his early critique of Marshall's theory of prices, Sraffa explained to Keynes that "he had focused on the horizontal supply curve, not because he held that case to be most realistic but because it was almost the only case of importance which could be analysed rigorously within Marshall's framework" (Schefold 1997, 3).
- 28 In this context a close resemblance can be drawn between Sraffa and Heisenberg, as H. S. Allen (1928), who Sraffa had read, writes, "Heisenberg put forward the demand that only such quantities as are observable should be represented in the mathematical formulation of atomic theory. This led to the development of the matrix mechanics, every term in a matrix corresponding to something which is, at least ideally, observable" (891).

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