

Commodities do not produce commodities: a critical review of Sraffa's theory of production and prices

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Abstract

This paper revisits once more Sraffa's well-known book *Production of commodities by means of commodities*, and does so by digging up to its very foundations, i.e. its most basic assumptions regarding the nature of production (section 1). This leads to analyzing the definitions of the different categories of goods appearing in Sraffa's book: basic goods, subsistence goods, consumption goods and fixed capital goods. The paper shows why this classification is wrong. It explains why subsistence goods should not be considered as intermediate goods (section 2), that consumption goods are final goods which are not part of a surplus, and that there is no surplus of intermediate goods (section 3). It shows then that the way Sraffa introduces fixed capital goods through joint production does not allow for the existence of a surplus for this kind of goods (section 4), and leads to several contradictions (section 5). These contradictions entail some serious consequences for the Standard system: neither the definition of basic goods nor the notions of surplus and of Standard commodity can be upheld (section 6). It comes therefore as no surprise that the problems created by the introduction of land or other non-produced means of production cannot be resolved (section 7). As developed in section 8, all these limitations explain why Sraffa's system has remained over the years such a puzzle, on which nothing has been built: in particular the system is incompatible with a Keynesian theory of money. Finally section 9 proposes briefly an alternative view of production as a transformation process.

Keywords Sraffa, commodities, fixed capital, price theory, production theory

In 1960, when Sraffa published *Production of commodities by means of commodities*, it was perceived by a number of economists as a kind of theoretical bomb. Indeed it hit a heavy blow to the neo-classical theory of distribution, by showing that in a system with multiple heterogeneous goods it was impossible to define fixed capital as a factor of production of which the marginal productivity was determining the rate of profit. However, doing so implied keeping some assumptions corresponding to the neo-classical paradigm, as regards the very nature of production and of the goods involved in this process, in particular fixed capital. To what extent this was done unknowingly is difficult to say, but this preservation brought about a number of flaws.

After recalling briefly the background of Sraffa's approach, this paper will show how these flaws have emerged from the very beginning of the analysis, because of a blurred definition of production, consumption, and an inaccurate classification of the goods involved in these processes. On this basis, the introduction of fixed capital and of non-produced means of production, like land and natural resources, cannot but lead to various contradictions and inconsistencies, which will then be reviewed.

1. Sraffa's approach: production as a circular process

¹ I have a PhD in Economics from the University of Paris I Panthéon-Sorbonne. I retired three years ago, after a career as a country director in the French Development Agency, which involved being seconded for three years to the IMF in Washington (1982-85), and three years to the OECD in Paris (1998-2001).

In Appendix D of *Production of commodities by means of commodities*,² Sraffa connects his conception of production to the old classical economists Quesnay and Ricardo who regarded the system of production and consumption as a circular process. He even adds that this conception, which he develops in his book, is 'in striking contrast to the view presented by modern theory, of a one-way avenue that leads from factors of production to consumption goods'.

Sraffa says that his system is a generalization of that of Ricardo wherein wheat is both a factor of production and consumer good, which allows one to define a surplus, irrespective of the values or prices, and to determine the rate of profit regardless of them. In his system, what he calls the basic goods are generally playing the role of wheat, when, through the construction of the standard commodity, they appear in the same proportions in the means of production and the net product, which thus seems to validate his reasoning by generalizing the Ricardo's case to a system with multiple heterogeneous goods.

It was important to start by recalling this, because, as far as science is concerned, the field of validity of a scientific theory is generally constituted by the field delimited by its own assumptions, the first of them consisting in the definition of its concepts. It is also generally admitted that, for a theory to be considered as scientific, there is a need for consistency, both internally and externally. By this we mean that the theory's assumptions must not contradict themselves, which is the internal consistency, and that the assumptions must have a coherent link with the reality which the theory wants to describe, which is the external consistency.

Everybody will certainly acknowledge that the definition of production is a very important assumption, a fundamental one indeed, and in this regard it should normally have appeared, not in an appendix at the very end of *Production of commodities...*, but on the contrary in an introduction, at the very beginning of the book. However, and quite strangely, this is not what Sraffa does. Before starting to analyze his theses, let us state again that for Sraffa production means production of a surplus, and that to be able to compare this surplus to the means of production, there is an absolute need for the commodities to appear both in the means of production and in the surplus, which is therefore a forced corollary to his circular conception of production.

2. Production for subsistence

It is difficult to understand why Sraffa put back to the end of his book something as fundamental as his definition of production, but maybe the reason was that he did not want to put it too close to the first chapter of the book, entitled "Production for subsistence", because in this three-page chapter, there is no surplus, which seems completely contradictory to this definition of production. Indeed what Sraffa wants to show is that there can be a price system, even when there is no surplus. But can there be any production? Certainly not by Sraffa's own definition, unless we realize that the title of the chapter means that there is some kind of "individuals" or "producers" behind the scene, which barely survive (subsist), by the consumption of some of the commodities that are produced.

² Sraffa, 1960.

Saying that, however, which Sraffa implies when he writes that the system includes “the necessities for the workers”, means that on the left-hand side of the equations (like also on the right-hand side) some of the means of production are in fact consumption goods, or more precisely subsistence consumption goods, i.e. some kind of goods that are just sufficient to allow the “producers” to survive.

However this raises another difficulty, which has to do with the definition of consumption, something which does not appear in Sraffa’s book. Let us therefore give a definition, and then discuss it. This definition is borrowed from Wikipedia (French version), and indicates that:

“...consumption characterizes the act of an economic agent (consumer) that uses (final consumption) or transforms (intermediate consumption) goods and services. This use or transformation causes the immediate (non-durable goods) or progressive (durable goods) destruction of the items consumed. From a general point of view, consumption (value-destroying) opposes production (value-creating).”

This definition is both interesting and misleading. Interesting, because it establishes a distinction between the production process as an intermediate process, involving intermediate goods and services, and final consumption as a final process. But this definition is also misleading, because it tends to consider nevertheless both processes as consumption, since both would cause the destruction (whether productive or final) of the goods involved. The definition introduces however another distinction between final consumption, which “uses”, and intermediate consumption, which “transforms”.

What we would like to argue is that this distinction is not a subtle one, but a fundamental one, which should lead economists to reserve the use of the word “destruction” for only the goods which are used for final consumption. A good reason for that is in fact given by the very last sentence of this definition, pointing out that consumption, which is value-destroying, opposes production, which is value-creating. It is indeed logical that a process, like final consumption, which causes the immediate or progressive destruction, and in fact the disappearance of the consumption goods involved, be value-destroying, whereas conversely it is not at all logical that a process which is value-creating, like production, would cause the destruction of the intermediate goods involved. On the contrary, and if we want to stay connected to reality, it is easy to recognize that these goods used in the production process are not really destroyed in the sense that they would definitively disappear, because they are only transformed in the course of this process.

These explanations are not esoteric ones, and we do not want to split hairs on this question, but they are necessary in order for the concepts used to have a connection with the real world. In the real world indeed, final consumption is definitely a destruction. This is obvious for all the non-durable goods, like for instance food, for which there is simultaneity between consumption and destruction, this destruction being also a complete disappearance. But this is also the case for durable goods, even if this destruction can be a very long process for certain goods: in the end there is a complete impossibility for such a durable good to continue to be used as it was initially and during its whole life span.

On the contrary, in the case of intermediate goods, like all the raw materials, they most often disappear in the production process in their initial form, but only to reappear under another form at the end of this process, which means literally that they are not destroyed, but only

transformed. This is so because their substance is still there, incorporated in the final goods of which they have become an element or a part. Furthermore, in a value-creating process, it is logical for the value of these intermediate goods not to disappear, but to be transferred to the value of the goods in which they become incorporated.

Evidence of this can be derived from the fact that at the end of the life span of a durable consumption good it is more and more frequent that it can be dismantled and recycled, which allows for many of the raw materials, i.e. the intermediate goods, to reappear and be transformed again in new production processes, where they are reincorporated into new goods. Within the production process itself, there are often some tailings, scraps or residues from these intermediate goods, and most of the time, in particular each time that these intermediate goods are valuable, they do not disappear but are recovered to be put back in the process, rather than being wasted. Therefore the word "destruction" is clearly inappropriate to name what happens to intermediate goods in the course of the production process, since they do not disappear completely, but on the contrary can reappear either during this process or at the end of the life span of the final consumption goods in which they are incorporated. It is only their original shape or form which are partially modified (rather than destroyed), to be transformed into other ones.

All this explains that final consumption goods cannot at all be treated conceptually like intermediate goods, since these last ones are not consumed but only transformed in the production process, and as such are not the object of an "intermediate" or "productive" consumption, but of a productive transformation. Therefore final consumption goods should not in any case be put on the left-hand side of the equations of the production system, which represents what enters into the production process, even if these goods are "means of subsistence", called also sometimes "wage-goods".

Let us conclude that the analysis performed in this very first chapter of *Production of commodities by means of commodities*, devoted to "production for subsistence", is seriously flawed. Indeed there is no surplus, and therefore there should be no production, according to Sraffa's own definition of production. Even if one thinks that there is a kind of notional surplus, in the form of subsistence goods which would be both on the left and on the right-hand side of the equations, this would be contradictory to the demonstration, which has just been carried out, that consumption goods by their very nature are final goods which come out of the production process and as such can never enter into this process. This should be kept in mind when we now go further into the analysis of *Production of commodities by means of commodities*.

3. Production with a surplus

It is a little ironic in this context to observe that it is in the following chapter of *Production of commodities by means of commodities*, entitled "Production with a surplus" that Sraffa writes that the introduction of a surplus makes "the system become self-contradictory". But this is because the allotment of the surplus, which is supposed to be made by a uniform rate of profit, cannot be determined before the prices, and *vice-versa*. However Sraffa quickly resolves the difficulty by explaining that in fact both are determined simultaneously by the same mechanism.

The interesting thing in this chapter is rather that it shows that the emergence of the surplus has one effect which is the appearance, as part of this surplus, of a new class of products, “which are not used, whether as instruments of production or as articles of subsistence, in the production of others”. Sraffa names them “luxury goods”.

Building upon the demonstration performed in the previous section, it can immediately be observed that, strictly speaking, this definition of luxury goods applies in fact to all consumption goods. This follows because we have shown that the fact that a consumption good be a subsistence good does not in itself transform it into an intermediate good, which belongs to a totally different category of goods, those that can be put on both sides of the equations representing a production process. It follows from this fact that as far as final consumption goods are concerned, no surplus can be determined as a difference between the quantities of these goods which are on the right-hand side and the quantities supposed – wrongly, to be on left-hand side of the equations.

To be sure, there are some particular goods or services which can be in the same physical form, both means of production in the form of intermediate goods (circulating capital), and final consumer goods. They are mostly fluids (water, energy), or some services. But electricity itself does not produce electricity: we know that this is not its use in the production process that makes it reappear for a larger amount at the end of this process. Even in this not so usual case, the total quantity of this particular kind of goods or services produced during a period totally disappears during the same period either as intermediate consumption or as final consumption, without therefore the apparition of a surplus or net product.

In this respect, and to be more precise, even the example of wheat is misleading, because in the real world wheat in the form of seeds (as an input) is increasingly a processed product which has undergone some treatments, or even has been genetically modified etc., and therefore is different from wheat as a pure consumer product. This last one is itself eaten only after being transformed (conditioned, etc.), and this in a way which makes it a different product from wheat which has just been harvested. Let us also point out that for most agricultural products other than cereals, grains or seeds are in any case very different from harvested products.

Having arrived at this stage, and putting aside fixed capital for the time being, to adhere to Sraffa’s approach, we must understand that there is no surplus either for intermediate goods: certainly the quantities of intermediate goods used in the production of these intermediate goods themselves are smaller than the total quantities of these goods which are produced. But it is obviously because the rest of these intermediate goods are used in the production process of final consumption goods or fixed capital. Moreover, in a self-replacing state, where Sraffa repeatedly locates his theory, there cannot be any place for stockpiles of intermediate goods, which are produced in the exact quantities needed for both their own production and the production of final goods. Therefore in a given period the total quantity of each of the intermediate goods which enters the production process, and appears on the left-hand side of all the equations of the production system using this intermediate good, is exactly equal to the quantity which comes out of the system, and appears on the right-hand side of the equation of the industry producing this good in the same system.

4. The introduction of fixed capital

To begin with the definition of fixed capital, given at the beginning of Chapter X of *Production of commodities by means of commodities* (§73), Sraffa does not elaborate a lot, and limits itself to writing that:

“...we shall regard durable instruments of production as part of the annual intake of a process, on the same footing as such means of production (e.g. raw materials) as are entirely used up in the course of the year; while what is left of them at the end of the year will be treated as a portion of the annual joint product of the industry.”

There is therefore no doubt that fixed capital is considered in his book as a particular kind, or a sub-species, so-to-say, of intermediate goods, with the only difference that the life of the components of fixed capital is longer than the life of intermediate goods, which disappear (are transformed) in the production process at the same time as they transfer their value to the goods produced. Fixed capital is indeed made of “durable instruments”, or machines, which implies that their use in the production process is a progressive one which lasts up to the end of their life span, during which they progressively transfer their value, up to the end of the production process in which they enter. The only difference with circulating capital seems therefore for Sraffa only a question of time, having to do with the longer durability of their life span and therefore of their participation in a production process. If one wonders why time is so important, the only coherent explanation is that the rate of profits is defined not only as a percentage, but as a percentage per unit of time (in fact, the year).

At a conceptual level, it is however extremely confusing to restrict the differences between both types of capital to just this single element of time. Indeed, as we have already pointed out earlier, intermediate goods participate in the production process in such a way as they are effectively and entirely transformed in this process, where they can no longer be found under their initial form at the end of it, because their substance itself has been incorporated in the final goods which they have contributed to produce. In other words they enter into the process, but do not come out of it.

One must immediately recognize that this is not at all the case for fixed capital goods, which in the real world do not participate in the same way in the production process, whatever their durability and independently of the duration of this participation. Indeed fixed capital goods never disappear in the production process, where their true role is not to be incorporated in the structure of final goods, but on the contrary to participate in the transformation of the intermediate goods, which is an extremely different thing. In the real world, the tangible and visible role of fixed capital is not to transfer its value to the products, or to deserve the payment of a profit rate, but to help increase the productivity of the main actor of the production process, which is human labor.

Since the whole treatment of fixed capital by Sraffa is based on the particular question of the age of machines, as we shall see below, it is also important to note that in the real world there is no such thing as a once and for all clearly defined age of a machine, which would remain the same during its whole participation in the production process. In *Production of commodities by means of commodities*, we are clearly at a technical level, but even at this level there is no such thing as a predefined life span or age of whatever machine or piece of

equipment, since this age will depend on many factors, like the intensity of the use of the machine.

A machine working eight hours a day with a single shift obviously will not have the same life span as exactly the same one working 24 hours a day with several shifts. The quality of maintenance, which can vary from a firm to another due to multiple factors, as well as during its own life time, can also greatly alter the real life duration of an equipment. Furthermore most machines are not even used during the whole duration of their nominal life time, for the well-known reason that they quickly become obsolete. New and cheaper or more 'productive' machines are indeed produced each year and after a few years make production with older machines become no longer competitive. Hence the replacement of machines becomes indispensable, even a long time before the day when they would have been worn out. The result is that in the real economic world the composition of a collection of machines and the way they are used vary continuously.

From a theoretical point of view all this is all the more annoying in that the whole treatment of fixed capital by Sraffa, in § 76 of his book, using a method first developed by Torrens³, consists in establishing a sub-system based on as many equations as there are separate processes which correspond to the successive ages of a given machine. And 'the quantities of means of production, of labor and of the main product are equal in the several processes in accordance, with the assumption of constant efficiency during the life of the machine'. This is hardly compatible with the fact that neither the life span nor the efficiency of a machine can ever be determined at any given point of time.

Nevertheless this is not the main criticism that can be made of the treatment of capital by Sraffa. To consider it, let us recall that for each machine, there is a sub-system having as many equations as the successive ages of this machine, for age 0, 1, 2,... n , where n is the lifetime of each machine. Each of the n equations represents the joint production of good G and of a machine of age 0 to $n-1$ (on the left-hand side) and of age 1 to n (on the right hand side). This sub-system covers a whole range of years, as many as the life span of the machine. With a proper treatment, Sraffa then removes $n-1$ equations corresponding to the machines of intermediate ages to finally obtain a single equation containing only the newly-produced machine, of age 0. This equation is the following (see § 76 of the book):

$$M_0 p_{m0} \frac{r(1+r)^n}{(1+r)^n - 1} + (A_g p_a + \dots + K_g p_k) (1+r) + L_g W = G_g p_g$$

The first term represents the annual depreciation of the machine, i.e. the value supposed to be transferred by the machine to the final good G for a given year n .

However, when we come back to a whole system of production for a single given year, we therefore turn, as Sraffa does in § 83:

“from the standpoint of the life-progress of a single machine to the stand point of a complete range of n similar machines each being one year older than the preceding one, and thus forming a group such as we might find in a self-replacing system. The requirement that the life-sum of the depreciation

³ Torrens (1821) see pp. 28-29, where Torrens introduces the notion of “residue of capital”.

quotas should be constant and independent of the rate of profits is now embodied in the fact that under all circumstances such a group is maintained simply by bringing in a new machine each year.”

All this is quite coherent and means that in this self-replacing production system, we have n machines in operation (from age 0 to age $n-1$), with on the left-hand side of the n equations like the one above n different depreciations. As Sraffa clearly demonstrates also, and this demonstration is right, the price of the machines of the intermediate ages can vary with the rate of profits, but for a given rate, as it appears from Figure 6 (in § 83), the sum of these different prices is always equal to the initial value of the machine p_{m0} .

Up to now, everything might seem correct, but a problem arises when we realize that, when we come to the calculation of the production prices, we are no longer in the sub-system in which it was innocuous to make appear n different machines of age 0 to $n-1$ (the machine of age n being withdrawn from the production process). Indeed, in a self-replacing state there is one and only one machine, of age 0, which is produced in a given year, with its own equation representing the conditions of its production. In this equation the quantity of the machine M_0 of age 0 (since it is new) appears on the right-hand side. And for a good G , and/or any other good in the production process of which this machine is used, including its own, there are in total as many equations for each good as the number of years n corresponding to the life span of this machine M_0 .

Turning now to the way this whole system works, on the left-hand side of each of these equations there is a value

$$M_0 p_{m0} \frac{r(1+r)^n}{(1+r)^n - 1},$$

which represents the contribution to production or the “transfer of value” of these machines of age 0 to $n-1$ to the price of the goods that they help produce. We also know that the sum of these depreciations is $M_0 p_{m0}$. But we are now in the real system itself, where only new machines of age 0 are really produced each year, each of them with its equation of production, and no longer in the sub-system where there was joint production of the machines of various ages. This implies that there are no equations corresponding to the real production of machines from age 1 to n , because these machines have in fact been produced previously, in earlier periods. This means that on the right-hand side of all these equations these machines of age 1 to n cannot and do not appear.

The interesting thing is that, as a consequence of this situation, and for the whole production system, when we sum up all the equations in which a machine M_0 appears, we have on the left hand-side a value $M_0 p_{m0}$ corresponding to the sum of the depreciations, and on the right hand side exactly the same value $M_0 p_{m0}$ of the newly produced machine M_0 . This signifies clearly that, whatever the life span of the machines, in a self-replacing state the value of the quantity of the machines which is produced in each period corresponds exactly to the quantity which is supposed to “disappear” in the production process, where this value is supposed to be transferred to the value of the goods that they contribute to produce, to the tune of the total depreciation affecting the same machines of various ages.

The inescapable conclusion of this analysis is that there is no such thing as a surplus for the machine M , nor for any machine, since the demonstration performed so far can obviously be

generalized. Although all this can easily be understood intuitively, since in a self-replacing state there is no net production of fixed capital, but only its replacement, we have therefore analytically established a very important result: in the Sraffa system, and as long as the fixed capital is supposed to transfer its value to the goods produced, **there is no surplus of fixed capital**. This means reciprocally that, supposing that there is a surplus, it cannot include any capital good.

5. The contradictions of Sraffa's system with fixed capital

At the point where we have arrived, we cannot but observe that we face a double contradiction: indeed Sraffa defines production as a circular process (meaning that what comes out of the process also enters or rather re-enters into it) through which a surplus is created.

However, what is to some extent circular in the production process, as exposed in *Production of commodities...*, is the production of intermediate goods and fixed capital, this last one being assimilated to a particular type of intermediate good with a span of life longer than the production period, because both are supposed to enter into and come out of the same production process. This explains why they appear on both sides of the equations describing this process. But at the same time, in a self-replacing state, where the whole Sraffa system is located, and as we have already showed, there is no such thing as a surplus of either intermediate goods or fixed capital, because fixed capital is itself a kind of intermediate good, and therefore there should be no production according to Sraffa's definition.

As for consumption goods, we have already showed that these goods do not enter into the production process, but are destroyed (either instantaneously or more or less quickly, if they are durable) in the consumption process. It is clear therefore that there is no circular production process concerning consumption goods. However, since these consumption goods cannot be found on the left-hand side of the equations describing the process, but appear necessarily on the right-hand side, the difference between both sides, for consumption goods only, is necessarily made of the whole production of these consumption goods. One might possibly say that it constitutes a "surplus", although it would be an artificial one, because for the process as a whole the quantities of intermediate goods should normally be deducted from this "surplus", in order to obtain the true surplus of the system. But this is obviously impossible, because of the heterogeneity of the goods on both sides of the equations.

This brings us to a paradox: it is the Standard net product which has to be divided between wages and profits, but because what might be called a surplus, and constitutes this net product, is made only of consumption goods, then these profits should be devoted entirely to buying consumption goods! More importantly, this obviously contradicts the statement made by Sraffa (at the end of § 29), according to which "the rate of profits in the Standard system thus appears as a ratio between quantities of commodities irrespective of their price". Indeed there is no such thing as a ratio between consumption goods and intermediate goods!

Another contradiction comes from the fact that Sraffa's system is built in such a way that:

"...the ratio of the net product to the means of production would remain the same whatever variation occurred in the division of the net product between

wages and profits and whatever the consequent price changes” (see § 28 of *Production of commodities ...*).

But, even with all other parameters remaining unchanged, if the rate of profit changes from one period to another during one of the n periods corresponding to the life span of a machine, the depreciations in the value of this machine already registered during the preceding periods will naturally remain unchanged, but the amount of the depreciations that will take place in the following periods, after the change in the rate of profit, will also change. It follows that the sum of the n depreciations for a given machine will no longer be equal to the value of the machine, but will be lower or higher.

The same phenomenon would take place each time that the actual life span of a given machine would become shorter or longer than the original or nominal one. In both cases, either because of a change in the rate of profit or in the real life span of a machine, the resulting change in the overall amount of the depreciations will change the proportions in which the machine enters in the production process, and therefore the nature of the Standard system and the whole price system! This is indeed not compatible with Sraffa's system.

Before going further, let us go back to the definition of fixed capital as a kind of “long life” variety of intermediate goods, since we can now better realize that this vision is incorrect. Indeed what appeared on the left hand side of the equations, and that we did not question, has to be revisited, since it is clear that it was not the machine itself, but a purely virtual element, i.e. its depreciation, which varies, as Sraffa explains, both with the age of the machine and with the rate of profit. The only thing which does not vary, as we already pointed out, is the sum of the depreciations for the n machines of age 0 to $n-1$ in operation for a given period, which is always equal to p_{m0} but only for a given rate of profit. This virtual quantity introduces an irreducible element of heterogeneity with the other intermediate goods: although they disappear in the process in their initial form, but only to be transformed, intermediate goods enter into it as real goods, and not virtual ones.

6. The consequences for the Standard system

6.1 The notion of basic goods

An important conclusion that we can draw from these observations is that most goods are not basic goods, whose main property, as defined by Sraffa in § 6 of *Production of commodities...* is that they “...enter (whether directly or indirectly), in the production of all commodities”. Indeed, since these goods are also produced, it means that one has to find them both on the left and right-hand side of the equations defining the system of production. We have showed that consumption goods do not meet this criterion, but at this stage we must admit that it is also the case for fixed capital goods. Indeed it is not these goods themselves, but only their depreciation that enters into the production process, and this depreciation, as defined by Sraffa, is not a tangible element, which can be put on the left-hand side of the equations in a non-contradictory manner. From this we must derive that fixed capital goods have to be considered as final goods, which like consumption goods can be found on the right-hand side, but not on the left-hand side of the equations.

In fact this corresponds to the treatment applied to depreciation by Keynes, who devotes the whole appendix of Chapter 6 of the *General Theory* to the question of what he calls “user cost”. He defines the user cost “...as the reduction in the value of the equipment due to using

it as compared with not using it”, and indicates that aggregate income, equivalent to aggregate supply price, is equal to $A - U$, or “as being net of aggregate user cost”⁴. It is clear that this user cost is quite similar to what Sraffa calls “the annual charge to be paid for interest and depreciation” for a machine, and that as we have seen, unlike Keynes, he includes wrongly in the production cost.

As a result, the only goods that can be found on both sides of the equations are clearly the intermediate goods, strictly defined as goods that disappear (in the sense only of being transformed) within the production process, where they can be used in the production of any other good (final or intermediate) as well as in their own production (directly or indirectly). They are thus the only goods that can be called basics in the sense that Sraffa gives to this word. There is however no reason why there should be any surplus of these intermediate goods, which are produced for each of them in the same total quantity as the sum of the quantities used in all the various industries, as Sraffa calls them.

6.2 The notion of surplus

To be sure, some particular goods might *prima facie* be considered as basic goods, with an amount produced even greater than the amount used as an input (ignoring the differences already mentioned between their nature as an input and as an output). This is the case of some agricultural products. But it is because there is a biological mechanism of organic production which as such does not come obviously from spontaneous generation, but precisely from the transformation of elementary goods, free or not. Indeed, using Lavoisier’s formula, who has no reason to be false in economy, “nothing is lost, nothing is created, everything is transformed.” These elementary goods are the oxygen and carbon in the air, nitrogen, potassium and phosphorus in soils, among others, which thanks to the biological mechanism of photosynthesis (among other processes at work), allow to harvest some agricultural products in higher quantities than those which have been sown. But in terms of material balance, the overall process is balanced, and it cannot logically be otherwise.

The same thing is true for production in its economic sense. Even for agricultural products, apart from the part that is self-consumed by small individual producers, products sold on the market for final consumption are not formally those harvested, because they have passed through various successive stages of preparation, packaging and transportation, which make them different from those goods which have been harvested, so that for them the concept of the surplus as a difference is not appropriate. As for mineral raw materials, it is clear that there can no more be any surplus in the form of any directly consumable good for any ore whatsoever.

These observations have an important consequence on the very nature of what can be called a surplus. They do not prevent from considering that production is a circular process, at least for the goods that are part of the rightly-named “circulating capital”. In their case, one could even imagine that there is a surplus, but that would only be true for the subsystem, necessarily incomplete, which produces the circulating capital with circulating capital, since only a portion of the circulating capital is used in its own production process.

However, at the level of the production system as a whole, all the circulating capital is used: the portion that is not directly used for the production of the circulating capital itself obviously

⁴ Keynes, 1936. See Appendix on user cost in Chapter 6: The Definition of Income, Saving and Investment.

enters in the production of final goods: consumer goods and fixed capital. And this circulating capital is always fully utilized: even in the case of expanded reproduction, the circulating capital produced in excess during a period compared to that produced during the previous period is fully used in the increased production of various goods, be they intermediate or final, during this same period. Indeed production prices are actually reproduction prices, which concern only a single period, during which there cannot be any surplus of intermediate goods (assuming the absence of stockpiles).

As for final goods, since they do not enter as such in the production process, they exist only as an output of the system, and not as an input. Therefore, it is true that we might think of a difference at an individual level between the output and the input: since for each of them this input is zero, the total quantity produced might be considered as a kind of individual surplus. But if we did so we would forget to deduct all the intermediate goods that are on the left-hand side of the equation of the system, and that have actually entered, directly or indirectly, into the production process of this final good. Similarly, at the level of all of these final goods, this is not true either, because at this global level all of the intermediate goods which enter as inputs into the whole production process have to be deducted from the whole output, which is impossible due to the heterogeneity of both types of goods. As a consequence, a so-called surplus cannot be quantified, and has therefore no meaning.

6.3 The notion of Standard commodity

Sraffa devotes Chapter IV of his book to the Standard commodity, which he defines as a commodity that would not itself change in value when the distribution between wages and profit changes. He notes in § 24 that the perfect composite commodity that could play this role:

“...is one which consists of the same commodities (combined in the same proportions) as does the aggregate of its own means of production.”

In § 26 he calls the set of equations taken in the proportions of the Standard commodity, the Standard system. He continues by saying that:

“...in any actual economic system there is embedded a miniature system which can be brought to light by chipping off the unwanted parts”,

and he adds that: “...this applies as much to a system which is not in a self-replacing state as to one which is”. He then: “...takes as unit of the Standard commodity the quantity of it that would form the net product of a Standard system employing the whole annual labor of the actual system”, calling it “the Standard net product.”

Finally in § 28 Sraffa defines as the Standard ratio:

“...the rate by which the total product of the Standard system exceeds its aggregate means of production, or the ratio of the net product to the means of production of the system”, underlining that:

“... the possibility of speaking of a ratio between two collections of miscellaneous commodities without need of reducing them to a common measure of price arises of course from the circumstance that both collections

are made up in the same proportions – from their being in fact quantities of the same composite commodities.”

It is easy to see that all this demonstration can be carried out only because the very first assumptions made by Sraffa establish an *ad hoc* classification of the goods, where all the goods, apart from the luxury goods as he names them, can in effect play both roles of means of production and of final products, which entitles them to being basic goods. This is what leads him to his particular treatment of fixed capital goods. However, we have showed that this classification is wrong, and that the only goods which are simultaneously means of production and products of the system are the intermediate goods part of the circulating capital, but that there cannot be a surplus of them, because they are transformed in the process of production of the final goods.

It follows therefore that in an actual economic system where no confusion is made between the different types of goods, it is impossible to define either a Standard commodity such as Sraffa's, or a Standard system, or a Standard net product, or a Standard ratio. Moreover Sraffa tells us in § 43 that:

“...the last remaining use of the Standard net product is as a medium in terms of which the wage is expressed – and in this case there seems to be no way of replacing it.”

Consequently the fact that there is no such thing as a Standard net product implies in particular that the wage cannot be expressed in terms of this medium. Therefore the relation of proportionality $r = R(1 - w)$ between the wage and the rate of profits established by Sraffa, and at the heart of his theory, cannot exist.

7. The intractable problem of land and natural resources

An additional problem arises with the introduction of non-produced means of production, such as land and mines, in Sraffa's system, because this makes it again reach its conceptual limits. Indeed, in the same way that goods appearing only as products but not as means of production – such as consumer goods, are not basics, and cannot be part of the standard commodity, conversely land, or more specifically in this case the different land qualities, are among the means of production used to produce agricultural products, but obviously are not part of the product. They are not basic goods, but their existence implies the payment to their owners of a rent which is part of the production price.

When an agricultural product, such as wheat, is produced by several lands of different qualities (fertilities), to determine a price system including the price of this product (wheat), implies that the rent be removed from the system of equations, which would include otherwise more unknowns than equations. This in turn implies that the equation used for the production of wheat in the system of equations is that which corresponds to the land without rent, i.e. the least “fertile” land, but which yields however the average rate of profits. The rent of other more “fertile” lands, with a lower production cost per unit, can then be obtained as a differential rent. It is also clear that the least fertile land is one for which the production cost per unit of output is the highest, or conversely that which produces the lowest amount for a given production cost.

The problem, long known (and recognized by Sraffa himself), is that the determination of the least fertile land depends on the cost of production, i.e. on the price system. Fertility is not an absolute, exogenously given and intrinsic quality of the land, but a relative parameter, which itself depends on the price system. The introduction of land and generally of non-produced means of production and of their income, that constitutes rent, drives the system into a circular reasoning: to determine the price system, we must know which one of the different lands is the land without rent, i.e. the least “fertile” one, which implies to know the price system.

At a second level, the price system varies depending on the variation of the rate of profit or of the wage level. As a result, for different levels of the rate of profit and wages, we necessarily get different price systems, which leads to changes in the production cost of all goods produced with non-produced means of production, such as land or natural resources. These modifications in the price system in turn change the order of land fertility or of the ‘productivity’ of these natural resources.

Again, we see that “fertility” cannot be defined as a parameter which would be independent of distribution. The equation defining the method of production for the “marginal” land or natural resource can vary with distribution. Therefore the system of equations defining the methods of production when using the least fertile land or other non-produced ‘marginal’ resources does not remain the same when distribution changes, which implies that the corresponding Standard commodity also varies. Therefore, since the rate of profit or the level of wages are defined in terms of the Standard commodity, it is the very notion of a variation in this rate of profit or level of wages that becomes irrelevant, because it is by definition impossible to compare two different Standard commodities: it is clear that each Standard commodity consists of heterogeneous goods in different proportions, each set corresponding to a different system of equations.

It must therefore be acknowledged that Sraffa’s theory fails to provide a coherent conceptual framework which would be able to deal in a non-contradictory or non-circular manner with non-produced means of production and rent, in a way that would maintain the internal consistency of this theory.

8. Conclusions on the Sraffa system and Standard commodity

The Sraffa system is a brilliant construction, which had the great merit to dismantle the neoclassical theory of distribution for which wages and profits are determined by the marginal productivity of labor and capital at the equilibrium. It shows well that when multiple heterogeneous goods and production are introduced, wages and profits have nothing to do with any “marginal productivity”, but have to be defined as a share of a net product. It nevertheless results from the above demonstration that the system faces insurmountable problems, in fact partially recognized by Sraffa himself, especially when fixed capital and non-produced means of production are introduced in the system.

Moreover, as soon as a price system is needed to express and determine a state of distribution, and to the extent that the price system itself reflects a state of distribution, we fall into a circular reasoning: we must know the price system to measure the distribution, but one must know the distribution to determine this system. Sraffa resolves this dilemma by defining an invariable Standard of value, which is invariable with respect to distribution, and in which

distribution can therefore be expressed independently of prices. This invariable Standard is the Standard commodity, which leads to the well-known formula $r = R(1 - w)$. But this is achieved by paying a heavy theoretical price:

- The Standard commodity is in fact a composite aggregate of heterogeneous goods, which are by definition basic goods, thus appearing to the right and left of the equations giving the prices. This Standard commodity made of basic goods allows to some extent to reason, with all the limitations which have been reported, as if we were in the universe with a single good of the neoclassical theory or the Essay on Profits of Ricardo⁵, of which ‘Production of commodities...’ constitutes an attempt of generalization;
- Any change in the composition of the Standard commodity is a change of system which is unintelligible, since it is impossible to compare two different Standard commodities, i.e. to sets of different heterogeneous goods. Each Standard commodity corresponds to a period during which the methods of production cannot change : in the real world this implies that such a period must be extremely short ;
- Since production is generally a continuous process, with a continuous change in the methods of production and therefore in the Standard commodity, this prevents from considering this Standard of value as a unit of measure for money, which has to link the present to the future. This makes it impossible to introduce into this system a money with Keynesian characteristics, meaning that its elements are pure numbers without dimension, or scalars⁶;
- Therefore a change in distribution becomes unintelligible as soon as the methods of productions change by the slightest amount, since the composition of the Standard commodity changes simultaneously;
- While prices are expected to ensure the reproduction of the system, no mechanism is provided to connect the expense of wages and profits to this reproduction, unless we assume that workers like capitalists share the same set of basic goods in the same proportions, which is absurd;
- One could even say that the system cannot be strictly speaking the capitalist system, since the difference between workers and capitalists is suppressed by the fact that what they share is in fact the same Standard commodity.

9. An alternative view: production as a transformation process

What has been established in this paper is that all the problems encountered by Sraffa’s theory cannot but come from its very roots, i.e. from his initial assumption that production is a circular process, which leads Sraffa to an erroneous definition and classification of the goods which are part of this process, either as entering into it or as coming out of it. While Sraffa thinks rightly that there is no such thing as a “productivity” of capital, this is what leads him to consider fixed capital goods as if they were intermediate goods, and to put the ‘depreciation’

⁵ Ricardo, 1951.

⁶ That Keynes’s units of measure were not compatible with a Standard of value made of heterogeneous goods was shown in Flamant, 1975.

of capital on the left of his equations, which implies that fixed capital transfers its value to the products, an assumption rejected by Keynes.

Does this mean that production must therefore be regarded, as Sraffa also said to characterize the alternative view, as “a one-way avenue that leads from factors of production to consumption goods”? This paper does not fully validate this view either. It has showed indeed that production is a transformation process only for intermediate goods, and that part of these goods are used in their own production, which is indeed a circular process. However the remaining part of intermediate goods is transformed into final goods, that are either consumption goods or fixed capital goods, and for this very reason never enter again to be transformed in the production process once this transformation has occurred and is over.

It has been shown also that fixed capital, while it plays an indispensable role in the production process, by helping to transform intermediate goods, is not itself transformed in this process. It is not either a factor of production in the sense that it would have a measurable “productivity”, independent of distribution and of the price system. Therefore production can only be defined as a work process that takes place in the context of specific social relations, where wages are paid in money, and in which fixed capital plays an important role, but as a catalyst which as such is present and unchanged at the beginning as well as at the end of the production process, and increases in considerable proportions the productivity of labor.

All these flaws explain why the Sraffa’s system cannot be a solution to the Marxist problem of the transformation of values into prices of production, which has been wrongly expressed and therefore left unsolved by Marx. This is not surprising, because Marx, like Torrens and Sraffa, also thought that fixed capital transferred its value to the product.⁷

Let us conclude that, on the basis of the above analysis, commodities do not produce commodities. Labor, helped by capital as a catalyst, produces commodities. Maybe Sraffa was a little aware of that, which would help explain the enigmatic character of his subtitle to *Production of commodities...*: “Prelude to a critique of economic theory”.

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⁷ Flamant, C. (2014). provides a comprehensive analysis of these questions. Chapter 14 exposes a coherent price theory (pp.159-184).

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