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Intensive Rent and Value in Ricardo

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Ricardo's statement that the marginal capital pays no rent is at the basis of his extension of the labour theory of value to the presence of lands. That statement has been recently criticised by Fratini in the case of intensive cultivation. We defend Ricardo.s position on that point. However, the reduction of a productive system with land to a single-product system is generally impossible, and for instance the trade-off property between wages and pro.ts does not hold in general.

INTRODUCTION

Non fully cultivated lands yield a zero rent. Ricardo (1817) used that property to claim that, when cultivation is extended to a land of a lower quality, the long-term prices are determined by the industrial methods and the marginal agricultural method(s) and, therefore, production with lands is amenable to the same analytical treatment as production without lands. As a consequence, the same basic economic laws apply. In Ricardo.s views, prices are then proportional, or almost proportional, to labour values. In this paper, we reexamine Ricardo.s methodology, i.e. the reduction of production with lands to that of single-product systems without scarce resources. The question arises because of the existence of another type of rent: besides the extension of cultivation, an alternative way to increase agricultural production is to operate a more productive method on an already fully cultivated land. Intensi.cation of cultivation also gives rise to the payment of a rent (intensive rent). Ricardo stressed the theoretical unity of both types of rents independently of the specific forms they take and, therefore, the reduction to a single-product system always works. In a recent paper, Fratini (2012) casts some doubt on that assertion and argues that the intensive rent is paid by the new and more productive method as well as by the previous agricultural method, and therefore that Ricardo.s attempt to get rid of rent by taking into account the marginal method

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fails for intensive cultivation. The present note defends Ricardo.s analysis on that precise point, given Ricardo's conception of the intensi.cation process. In our views, the source of Fratini's critique lies in the substitution of Sraffa's (1960) framework for Ricardo's (Section 2). However, Fratini's remark does help us to understand one of the difficulties met by the Classical theory of rent: the counterpart of the greater generality of Sraffa's analysis is that some basic properties of single-product systems are lost in the case of production with scarce resources (Section 3). More generally, one identifies three main problems with the theory of intensive rent inspired by Ricardo and Sraffa (Section 4).

The question of lands and rents is important in Ricardo.s construction and is even central in his plea in favour of free trade. That aspect is quite distinct from the analytical possibility to get rid of rent, that Ricardo used to extend the range of validity of the labour theory of value. But since the reference to labour values is somewhat dubious even for industrial commodities, we shall not discuss that extension and shall only refer to the notion of prices of production, i.e. prices sustained by a uniform rate of profit. It does not matter whether the exogeneous distribution variable is the real wage (Ricardo) or the uniform rate of profit (Sraffa): we here follow Sraffa's formalisation and assume that the rate of pro.t is given and wages paid *post factum*. Then prices, wages and rents are determined by the operated methods up to the choice of the numeraire. The level of the real wage depending on the level of the rate of profit, the discussions relative to the extension of the properties of single-product systems in the presence of lands are centered on the trade-off property between profits and wages, not on the labour theory of value.

RICARDO ON INTENSIVE RENT

The simplest way to increase the production of corn when some land is fully cultivated is to extend cultivation on another land. Ricardo (1815, 1817) assumed that the lands can be ordered according to their fertility, as if the production of corn on a land of second quality required more of any input than on a first grade land. The order of cultivation of lands follows that natural order. Ricardo introduced the notion of intensive cultivation by noticing that it may be more profitable to invest a given amount of capital on an already cultivated land than on a new land of lower quality. Let a primitive investment of 1000 pounds produce 100 quarters of corn on land of quality 1. If an additional investment of 1000 pounds on the same land gives 85

more quarters, but only 80 quarters when invested on land 2, the farmer will intensify cultivation rather than extend it. The formalisation of a Ricardian intensive cultivation model is immediate. Consider for instance a two-commodity economy, corn being the agricultural good produced on a homogeneous land, and steel the industrial product. Let the initial agricultural method 1 be written

$$a_1 \text{ qr. corn} + b_1 \text{ t. steel} + l_1 \text{ labour} + 1 \text{ acre land} \rightarrow 100 \text{ qr. corn} \quad (1)$$

When the homogeneous land is fully cultivated, it is consistent with Ricardo's views to represent the additional method 2 as consisting in depositing a supplementary layer of capital and/or labour, from which there results an additional product

$$\Delta a \text{ qr. corn} + \Delta b \text{ t. steel} + \Delta l \text{ labour} + 1 \text{ acre land} \rightarrow 85 \text{ qr. corn} \quad (2)$$

For Ricardo, that additional investment is the marginal agricultural method 2 and it pays no rent because it is used after method 1 on the same land. Let the given industrial method be written

$$c \text{ qr. corn} + d \text{ t. steel} + e \text{ labour} \rightarrow 1 \text{ t. steel} \quad (3)$$

With labour as numeraire, prices are determined by the equalities attached to the marginal agricultural investment (2) and the industrial method (3):

$$(1 + r)(p_c \Delta a + p_s \Delta b) + \Delta l = 85 p_c \quad (4)$$

$$(1 + r)(c p_c + d p_s) + e = p_s \quad (5)$$

These equations are similar to those attached to a single-product system and have the same properties. (In particular, prices are strictly proportional to labour values either if the rate of pro.t is zero or if capital and labour are in the same proportions in both industries.) Once prices are known, the level of the rent per acre is determined as the di£erence between the value of the product and the overall cost of production of method 1, including normal profits. In Ricardo's numerical example, the value of the initial investment per acre (in physical terms: a_1; b_1 and l_1) is the same as that of the additional investment (Δa, Δb and Δl), a property from which Ricardo rightly concludes that the rent per acre amounts to 15 quarters of corn.

For an observer, a part of the homogeneous land is cultivated 'extensively' by means of method 1 alone and another part 'intensively', with more material inputs ($\Delta a \geq 0$; $\Delta b \geq 0$), more labour ($\Delta l \geq 0$) and a higher production per acre.

SRAFFA'S CRITIQUE

In the case of extension of cultivation, Sraffa (1960) criticised Ricardo for assuming that the order of cultivation is dictated by the natural fertility of soil. He argued that the decision to cultivate such or such land when the price of corn increases is only based on a cost criterion. Therefore, when demand rises, some land is cultivated before another only because the corresponding method is cheaper. It is useless, restrictive and partly misleading to assume with Ricardo that the next cultivated land requires more capital and more labour than the previous marginal land. Sraffa points out that, since prices depend on distribution, the order of cheapness and therefore the order of cultivation may vary with distribution. This phenomenon has been studied and illustrated by Montani (1975): if the industrial methods are given and the agricultural good is unique (the reason of these restrictions will become apparent in Section 4) and if each quality of land can be cultivated by means of a unique method (that hypothesis discards the possibility to intensify cultivation in order to isolate the case of extensive cultivation proper), then the order of cultivation for a given rate of profit coincides with the order of cheapness when rent is zero. That order varies when the uniform rate of profit moves and crosses a switch point.

Beyond the greater generality of the analysis, Sraffa's observation is note-worthy for two reasons. First, Sraffa is more precise on the criterion used by the farmers: when Ricardo compares the quantities of corn produced by a given amount of money, Sraffa refers uniquely to values and profits. Second, Sraffa follows Ricardo's dynamic approach, in the sense that he analyses the adaptation of a productive system to the evolution of demand. Most of the time, it suffices to adjust the activity levels of the presently operated methods, with the same prices and rents. From time to time, that adjustment is no longer possible for physical reasons and a change in the productive system is required, which goes with a 'spasmodic' shock on prices and rents. That change, however, is rather limited: it consists in introducing one new marginal method, the other operated methods being maintained.

Sraffa's critique to Ricardo is easily adapted to the intensification of cultivation. In Sraffa's views, the intensification process consists in introducing a more productive method on the same fully cultivated land. The reason why that method was not used earlier is that it was more expensive in the absence of rent. As a given level of the rent per acre weighs more on the corn produced by the less productive method, there exists a positive level of rent which uniformises the total costs

(rent included) of both methods. In Sraffa's formalisation, the productive system is represented in physical terms by methods (1), (6) and (3), the intensive agricultural method (6) being of the type

$$a_2 \text{ qr. corn} + b_2 \text{ t. steel} + l_2 \text{ labour} + 1 \text{ acre land} \rightarrow 185 \text{ qr. corn} \quad (6)$$

When demand increases, method (6) is extended at the expense of the initial method (1). As both methods are operated side by side, each on a part of the same homogeneous land, they both pay the same rent ρ per acre and the price-and-rent equations associated with these agricultural methods are written

$$(1+r)(a_1 p_c + b_1 p_s) + l_1 + \rho = 100 p_c \quad (7)$$

$$(1+r)(a_2 p_c + b_2 p_s) + l_2 + \rho = 185 p_c \quad (8)$$

What is the difference between Ricardo's and Sraffa's approaches? Ricardo refers to an additional investment (2) once method (1) has already been used on the whole soil ($\Delta a \geq 0, \Delta b \geq 0, \Delta l \geq 0$). By contrast, Sraffa refers to a method (6), the technical characteristics of which are independent of those of method (1). Fratini (2012) starts from Sraffa's formalisation, suggests that method (6) would be the marginal method and criticises the idea that it would pay no rent. Such an idea cannot be attributed to Ricardo, who had in mind the additional investment (2) and not method (6). That point being clarified, there is no contradiction between the equations (7)-(8) *à la* Sraffa and the previous equation (4) *à la* Ricardo (at least if labour values are identified with prices of production), as equation (4) is obtained by subtracting (7) from (8). The labour values to which Ricardo refers are those associated with the use of the industrial method (3) and the marginal agricultural investment (2).

Sraffa's theory of intensive rent is more general than Ricardo's. Sraffa only assumes that method (6) is initially more costly than method (1), when Ricardo presumed that it requires more capital and more labour ($\Delta a = a_2 - a_1 \geq 0, \Delta b = b_2 - b_1 \geq 0, \Delta l = l_2 - l_1 \geq 0$). As we shall see in the next Section, the problem pointed at by Fratini (2012) stems from that generalisation.

PROBLEMS WITH INTENSIVE RENT THEORY

Many papers have been written on rent theory in a post-Sraffian approach, and the topic is deemed to be involved. In our views, that apparent complexity results from a lack of a guiding principle in these studies. In this Section, we isolate a few questions which admit simple answers. Unfortunately, these answers are all negative.

1. Reduction to single production without land?

Ricardo intended to get rid of rent in the analysis of prices and distribution by reducing the study of a productive system with land to that of a productive system without land. As shown above for intensive cultivation, the price equations (4)-(5) are formally similar to those associated with a usual single-product system. The prices once determined, one can calculate the level of the rent (that two-step procedure justifies Ricardo's statement on causality: rent is high because the price of corn is high, not vice-versa). Moreover, the trade-off property between wages and profits holds. However, that property is intimately connected with Ricardo's hypothesis that the in-tensive method requires more of any physical input. Under Sraffa's general assumption, the equations which determine the prices and rents in terms of labour are (7)-(8)-(5). From a formal point of view, one can always subtract (7) from (8) in order to eliminate rent and, then, the prices are obtained as the solution to (4)-(5). However, as soon as one of the coefficients Δa, Δb or Δl is negative, the price equation (4) is not associated with a method of production. As a consequence, there are no more logical grounds to the trade-off property between profits and wages. (In more technical terms, the Perron-Frobenius properties hold no longer because of the presence of negative coefficients in the matrix.)

To illustrate the point, consider a simple corn model with homogeneous land and no industrial commodity. With corn as numeraire, symbol w holds for both the nominal and the real wage. The coexistence of two agricultural methods (a_1, l_1) and (a_2, l_2) on the same land, the .rst one producing 85 quarters per acre and the more productive method 185 quarters per acre, means that both equalities

$$(1 + r)a_1 + wl_1 + \rho = 100 \tag{9}$$

$$(1 + r)a_2 + wl_2 + \rho = 185 \tag{10}$$

hold simultaneously. Rent is eliminated by subtraction:

$$(1 + r)\Delta a + w\Delta l = 85 \tag{11}$$

If Δa and Δl are positive (Ricardo's hypothesis), the trade-off property between the rate of profit and wages follows from equality (11). But if the more intensive method substitutes labour for capital or capital for labour (Sraffa's more general hypothesis), i.e. if Δa and Δl have opposite signs, the real wage and the rate of profit are positively correlated! Clearly enough, Sraffa did not see that unexpected consequence of his extension of Ricardo's approach. If one returns to

Ricardo's original hypothesis (given and advanced real wage w), the same numerical example leads to the relationship

$$(1 + r)(\Delta a + w\Delta l) = 85 \qquad (12)$$

which again shows a trade-off property if Δa and Δl have the same sign and a positive correlation between the rate of profit and the real wage in the other case.

CHOICE OF METHODS

A long-term equilibrium with scarce resources is defined by a set of activity levels and a set of prices and rents. The activity levels of the methods are such that the operated methods meet the scarcity constraints on lands and the 'requirements for use', which are identified with an exogeneously given final demand vector. The price-and-rent vector is such that the operated methods yield the ruling rate of profit, while non-operated methods do not yield more; moreover, the rent is zero on the non fully cultivated lands. That post-Sraffian formalisation describes a state and ignores the Ricardian dynamics which are concerned by the reaction of the economic system to a change in final demand. The basic idea of those dynamics is that, when a physical scarcity is met, the price of the scarce commodity increases up to a level which sustains the introduction of a new method. That procedure defines the incoming operated method in a unique way.

Let us apply the criterion to intensive cultivation proper. Again, a simple corn model with homogeneous land is sufficient for our purpose. In normal times, two methods α and β operate jointly on that land. A limit is reached when the more productive method β eliminates method α. In the face of a still increasing demand, a new method must then be introduced. As we have just seen, the criterion used to select that incoming method is based on its profitability when the price of corn increases and de.nes it in a unique way. But there is no necessary coincidence between profitability and the productivity requirement: it is easy to build an example where the method γ which is potentially introduced on the basis of the profitability requirement is less productive than the method β it should replace. In other words, there is no reason to assume that the incoming method is simultaneously 'more expensive and more productive'. The Ricardian dynamics fail in the absence of that coincidence (Bidard, 2012).

It can be shown that this phenomenon is at the origin of the multiplicity of equilibria: multiplicity means that, for a given level of final demand and a given rate of profit, there may exist several sets of

prices and rents, each sustaining a specific set of operated methods with adequate activity levels. The multiplicity phenomenon points at a difference with the behaviour of single-product systems without land, which explains why it attracted attention when D'Agata (1983) illustrated it by means of a numerical example, but the phenomenon itself is consistent with Montani's (1972) previous analysis. Erreygers (1990, 1995) stated a uniqueness criterion by means of a geometrical analysis of the problem but did not show the connection with the Ricardian dynamics.

EXTERNAL RENT

Besides the extension or the intensi.cation of cultivation, Ricardo and Sraffa missed a third possibility to increase the net product: the response of the economic system may consist in the introduction of a corn-saving method in industry. (A contemporary example might refer to oil instead of corn as the scarce resource: when the price of oil rises because of increasing demand, the productive system reacts by operating oil-saving methods. The reaction may be strong enough to make the increase of the gross product of oil unnecessary.) In the initial state, assume that there is one operated corn method and one steel method, which determine the prices of both commodities with a zero rent. When land becomes fully cultivated and the demand for steel and corn continues to increase, the new long-state equilibrium is described as follows: homogeneous land is now fully cultivated by means of the same agricultural method, while steel is produced jointly by two methods, the new corn saving method being progressively substituted for the previous steel method. The associated price equations are written as follows. Two steel methods are operated. Their associated price equations (with obvious notations)

$$(1 + r)(a_{cs}p_c + a_{ss}p_s) + wl_s = p_s \tag{13}$$

$$(1 + r)(a'_{cs}p_c + a'_{ss}p_s) + wl'_s = p_s \tag{14}$$

determine the price-and-wage vector up to the choice of the numeraire. Once the prices are known, the price equation associated with the corn method, which is operated on the totality of the soil

$$(1 + r)(ap_c + bp_s) + wl + \rho\Lambda = p_c$$

determines the rent per acre (Saucier (1981) dubbed it 'external differential rent'). The structure of the system of equations sustains the usual two-step procedure (first the prices, next the rents). However, the prices are not prices of production and, for instance, have no

relationships with labour values when the rate of profit is zero, since the conditions of production of corn do not intervene in their calculation. More specifically, the price equations (13)-(14) are not those associated with a single-product system, for which there is a one-to-one correspondence between a commodity, its method of production and a price equation. As a consequence, the usual properties of single-product systems do not hold and, again, there are no theoretical grounds for a trade-off property between pro.ts and wages.

External rent may occur as soon as two methods can produce the same industrial good. The phenomenon may also take place in agriculture: in order to increase the net product of corn, one can use corn-saving methods in the production of another agricultural commodity. This is why the scope of post-Sraffian rent theory is limited: in order to discard the dramatic analytical consequences of external rent, it often presumes given industrial methods and a unique agricultural good. It is only under very restrictive conditions of that type that the properties of single-product systems can be extended to production with land. Sraffa's analysis was over-optimistic, for instance when he suggested that there is no difficulty to extend rent theory to several agricultural goods (similar mistake in Bidard, 2010).

CONCLUSION

A gap between Ricardo's and Sraffa's constructions on the question of the succession of methods when demand increases is that Ricardo often (though not always) adopted a physical approach which led him to presume, in the case of extensive cultivation, that lands can be classified according to intrinsic qualities. In that of intensive cultivation, he similarly considered that the more intensive method results from an additional investment. Sraffa substituted a value approach for that physical approach: the new operated method is chosen on the basis of a cost criterion when the price of corn increases. His critique of Ricardo's conception of the extension of cultivation is explicit (the order of cultivation is not a physical property) while that of the intensification process remains implicit (the incoming method does not necessarily require more physical inputs). The idea that the marginal investment pays no rent being justified within the Ricardian framework, we consider that Fratini's (2012) critique of Ricardo is based on an undue identification of Ricardo's and Sraffa's conceptions of the intensification process. But that critique applies to Sraffa's more general construction and hints at a more general difficulty with the Classical rent theory.

Beyond the above mentioned divergences, Ricardo and Sraffa indeed pursued the same theoretical goal. Ricardo intended to show that the presence of land does not alter the basic principles of the labour theory of value. His strategy was to reduce the study of a productive system with land to that of a productive system without land by considering the marginal agricultural methods. Sraffa shared a similar objective, up to the substitution of prices of production for labour values. Ricardo and Sraffa both thought they had succeeded in their project of getting rid of rent. This is why Sraffa did not mention any other significant gap between the properties of production with lands and those of single-product systems than the appearance of negative coefficients in the standard basket. He did not draw all theoretical consequences of the substitution of a value criterion for a physical criterion and, consequently, failed to see that the analysis of production with land cannot be reduced to that of single-product systems except under very specific cases. Post-Sraffian analyses of rent theory have pointed at some difficulties with rent theory but have not yet become aware of the invalidity of Ricardo's and Sraffa's global project.[1]

Note

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