RICARDO ON AGRICULTURAL IMPROVEMENTS: A NOTE

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ABSTRACT

This note discusses the numerical examples of land saving and capital saving agricultural improvements Ricardo provided in the chapter on the rent of land in the Principles. *Especially his illustration of the second kind of improvements met with fierce criticism. It is argued that Ricardo was not wrong in any substantive sense and that he could only be criticized for having changed the definition of rent as regards the timing of its payment from post to ante factum.*

I   INTRODUCTION

Ricardo's discussion of different forms of technical progress and their implications for the distribution of the product between workers, capitalists and landlords in Chapter 2 of the *Principles* (Ricardo, [1817] 1951) attracted the attention of major economists, including John Stuart Mill, Marx, Marshall and Wicksell. However, the numerical examples he put forward to illustrate what we may, for short, call 'land saving' and 'capital (*alias* labour) saving' technical progress generally met with fierce criticism. According to Edwin Cannan, Ricardo 'is absolutely and almost obviously wrong' with regard to the second kind of improvements and his reasoning is said to end 'in complete and hopeless failure' ([1893] 1967, pp. 259–60). Essentially the same criticism was reiterated some fifty years later by Harry G. Johnson who called Ricardo's second numerical example 'erroneous' (Johnson, 1948, p. 792).[1]

In this note we shall argue that Ricardo was not wrong in any substantive sense. He could only be criticized for having changed the definition of rent, which implied a change as regards the timing of its payment from *post* to *ante factum*, when proceeding from one numerical example to the next; alas, without explicitly noting, nor perhaps even noticing, the implication. We shall begin, in Section II, with a summary account of Ricardo's argument. Section III then provides an interpretation of Ricardo's two numerical examples in which each of them emerges as fully correct.

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[1] Cannan's criticism of Ricardo's second example was also shared by Mark Blaug ([1967] 1997, p. 113), Denis O'Brien (1975, pp. 128–9) and Paul A. Samuelson (1977, p. 521).

II   Two Kinds of Agricultural Improvements

In Chapter 2 of the *Principles* Ricardo elaborated the concept of differential rent and then pointed out 'the effects of the natural progress of wealth and population on rent, in a country in which the land is of variously productive powers' (1951, p. 78), on the assumption that there is no technical progress. It is only in a second step that he addressed the problem of the impact of improvements in agriculture on distribution. He wrote:

> But improvements in agriculture are of two kinds: those which increase the productive powers of the land, and those which enable us, by improving our machinery, to obtain its produce with less labour. They both lead to a fall in the price of raw produce; they both affect rent, but they do not affect it equally (*ibid.*, p. 80).

He thus distinguished between what may be called 'land saving' and 'capital saving' progress. Both kinds are invariably characterised by what he considered to be 'the essential quality of an improvement', that is, 'to diminish the quantity of labour before required to produce a commodity' (*ibid.*).

Land saving improvements

Ricardo mentioned as examples of the land saving kind a more skilful rotation of crops and a better choice of manure, and concluded: 'These improvements absolutely enable us to obtain the same produce from a smaller quantity of land' (*ibid.*). He illustrated this kind of improvement in terms of the following numerical example:

> If, for example, the successive portions of capital yielded 100, 90, 80, 70; whilst I employed four portions, my rent would be 60, or the difference between

70 and 100 = 30		100
70 and 90 = 20		90
70 and 80 = 10	whilst the produce	80
= 60	would be 340	70
		340

> and while I employed these portions, the rent would remain the same, although the produce of each should have an equal augmentation. If, instead of 100, 90, 80, 70, the produce should be increased to 125, 115, 105, 95, the rent would still be 60, or the difference between

95 and 125 = 30		125
95 and 115 = 20	whilst the produce	115
95 and 105 = 10	would be increased	105
	to 440	95
60		440

But with such an increase of produce, without an increase of demand, there could be no motive for employing so much capital on the land; one portion would be withdrawn, and consequently the last portion of capital would yield 105 instead of 95, and rent would fall to 30, or the difference between

105 and 125 = 20	whilst the produce will be	125
105 and 115 = 10	still adequate to the wants	115
	of the population, for it would be 345 quarters, or	105
30		345

the demand being only for 340 quarters (*ibid.*, pp. 81–2).

The example is skilfully constructed and has been approved of by most commentators. The third portion of capital, which is the marginal portion in the post-improvement situation, will not be fully needed in order to match effectual demand, which is taken to be unaltered.[2] What matters *here* according to Ricardo is the preservation of the *differences* between the different amounts of *output*, reckoned in terms of corn, generated by the *same* amounts of *capital*, irrespective of how the latter is measured.

Capital saving improvements

About capital saving improvements Ricardo wrote:

But there are improvements which may lower the relative value of produce without lowering the *corn rent*, though they will lower the *money rent of land*. Such improvements do not increase the productive powers of the land; but they enable us to obtain its produce with less labour. They are rather directed to the formation of the capital applied to the land, than to the cultivation of the land itself. ... Less capital, which is the same thing as less labour, will be employed on the land; but to obtain the same produce, less land cannot be cultivated.

He continued:

Whether improvements of this kind, however, affect *corn rent*, must depend on the question, whether the difference between the produce obtained by the employment of different portions of capital be increased, stationary, or diminished. If four portions of capital, 50, 60, 70, 80, be employed on the land, giving each the same results, and any improvement in the formation of such capital should enable me to withdraw 5 from each, so that they should be 45, 55, 65, and 75, no alteration would take place in the *corn rent*; but if the

[2] John Stuart Mill in his numerical illustration of land saving improvements (see Mill, [1848] 1987, pp. 717–18) by inadvertence constructed an example in which the post-improvement marginal land is fully employed. In this case competition amongst landlords need not suffice to make the rent on this quality of land vanish: it is possible that the marginal land yields its proprietors a positive rent (although this is not necessarily the case). Ricardo avoided the trap into which Mill fell.

improvements were such as to enable me to make the whole saving on that portion of capital, which is least productively employed, *corn rent* would immediately fall, *because the difference between the capital most productive, and the capital least productive, would be diminished*; *and it is this difference which constitutes rent* (*ibid.*, pp. 82–3; emphases added).

Apparently, with the emphasis on corn rent Ricardo in this example reckoned capital in terms of corn. Let us call the four different portions of capital considered capitals 1, 2, 3 and 4, respectively, where the employments are ranked in decreasing order of productivity. Capital 4 is obviously that portion of capital which does not pay a rent to the owner of land. The message Ricardo intended to convey in terms of the above numerical example is plain and simple: rent is a *differential* rent; both before and after the improvement capital 1 pays a corn rent of 30 (= 80 − 50 = 75 − 45), capital 2 of 20 (= 80 − 60 = 75 − 55), and capital 3 of 10 (= 80 − 70 = 75 − 65). Total output is the same before and after the improvement and so is total corn rent which amounts to 60 (= 30+20+10), whereas total capital reckoned in terms of corn has fallen from 260 (= 80+70+60+50) to 240 (= 75+65+55+45). What matters *now* according to Ricardo is the preservation of the *differences* between the different amounts of *capital*, reckoned in terms of corn, needed to generate the *same* amounts of *output*.

III INTERPRETING THE TWO EXAMPLES

It needs to be clarified that each of the two examples can be interpreted in such a way that it emerges as a fully correct illustration of the respective case under consideration. However, the two interpretations are based on different definitions of rent which involve different assumptions as regards the timing of the payment of rent. In fact, in order to be coherent, in the first example one has to assume that rent is paid *post factum*, whereas in the second example it has to be taken as paid *ante factum*. A simple mathematical formulation can render this clear.

If equal amounts of capital K are employed and obtain decreasing amounts of product X_j ($j = 1, 2, \ldots, n$; $X_1 > X_2 > \ldots > X_n$) (reflecting the scarcity of the land(s)), and if the corresponding rents Q_j are paid *post factum*, then the following equations must hold

$$(1 + r)K + Q_j = X_j. \qquad j = 1, 2, \ldots, n$$

With the marginal portion of capital n paying no rent, $Q_n = 0$, and therefore:

$$(1 + r)K = X_n$$

$$r = \frac{X_n}{K} - 1$$

$$Q_j = X_j - X_n,$$

exactly as in Ricardo's first example.

In contradistinction, if additional amounts of product of equal size X are obtained by increasing amounts of capital K_j ($j = 1, 2, \ldots, n$;

$K_1 < K_2 < \ldots < K_n$) (again reflecting the scarcity of land(s)), and if the corresponding rents Q_j are paid *ante factum*, then the following equations must hold:

$$(1+r)K_j + (1+r)Q_j = X. \qquad j = 1, 2, \ldots, n$$

With $Q_n = 0$, then:

$$(1+r)K_n = X$$

$$r = \frac{X}{K_n} - 1$$

$$Q_j = K_n - K_j,$$

exactly as in Ricardo's second example.

Of course, the reader generally expects an author to be consistent and not to change some basic definition in the course of the development of an argument. Therefore, it should come as no surprise that most critics interpreted both numerical examples in terms of the definition of rent Ricardo put forward at the beginning of the Chapter 'On Rent'. He stressed: 'rent is *always* the *difference between the produce* obtained by the employment of two equal quantities of capital and labour' (Ricardo, 1951, p. 71; emphases added). This definition implies that rent is paid *post factum*. Contrary to his claim, Ricardo did not, however, 'always' define rent in this way, for in his second numerical example he explicitly took it as being constituted by 'the *difference between the capital* most productive, and the capital least productive' (*ibid.*, pp. 82–3; emphasis added) – a definition which implies *ante factum* payment of rent.

We can only speculate why Ricardo in the second example did not employ his usual definition of rent. Perhaps he was not conscious of the fact that the two definitions are not equivalent. Perhaps he was fascinated by the idea of a symmetry between differences in inputs (capital) producing the same output, on the one hand, and differences in outputs (product) produced by the same inputs, on the other, as the basis of differential rent. Perhaps he thought that changing the definition of rent was not all that important and could be justified in terms of the simplicity of the second example. As he pointed out in the context of some other numerical examples:

> In all these calculations I have been desirous only to elucidate the principle, and it is scarcely necessary to observe, that *my whole basis is assumed at random, and merely for the purpose of exemplification*. The results though different in degree, would have been the same in principle, however accurately I might have stated the [details]. My object has been to simplify the subject . . . (1951, pp. 121–22; emphasis added).

Be that as it may, while Ricardo's change of the definition of rent is unfortunate, this does not imply that his analysis is useless or even wrong, as some of his critics maintained. The fact that Ricardo was able to provide a satisfactory illustration of the case of land saving improvements in which rent is

paid *post factum* may suggest that an example can also easily be constructed on the same premiss in the case of capital saving improvements. Indeed, a simple modification of his first example does the job. In that example, the 'portion of capital' Ricardo speaks of is not further specified, say, in terms of a given amount of corn (or money). Let us then assume that a 'portion of capital' equals 50 units of corn before the improvement and 45 units after the improvement, taking all other magnitudes mentioned in the example relating to the pre-improvement situation as unchanged. Hence the improvement increases the rate of profits, which is always determined with regard to the employment of that portion of capital that pays no rent to the owner of land, from 2/5 to 5/9. At the same time the improvement leaves total corn rent unchanged, as required by Ricardo, and decreases 'money' rent (that is, the rent in terms of the labour bestowed on it) as a consequence of the reduction of the price of corn in terms of labour by ten per cent.[3]

We may conclude by saying that Edwin Cannan's criticism cited at the beginning of this note, while not without some justification, is certainly 'over the top' and cannot be sustained.

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[3] Ricardo considered gold (money) to be an invariable measure of value that is always produced by means of the same quantity of (direct and indirect) labour per ounce. A reduction in the amount of labour needed to produce a bushel of corn on marginal land therefore implied a proportional reduction in the money price of corn.