

*Why did Ricardo believe that a Quantitative Growth
Theory is 'Vain and Delusive'?*

David R. Andrews

Hamilton College

dandrews@hamilton.edu

September 2001

1. Introduction

Recent years have witnessed an upsurge in interest in the classical theory of growth. Yet David Ricardo, a central member of the classical school, rejected the theory of growth as we know it today. Keynes makes this clear in The General Theory of Employment, Interest and Money. His principle object of criticism is what he calls the "classical school," by which he means that school which "adopted and perfected the Ricardian economics" (Keynes, 1973, p. 3).¹ His main point of difference from this "Ricardian tradition" is that it is "primarily concerned with the distribution of a given volume of employed resources between different uses." Keynes attributes this attitude to Ricardo himself, who, according to Keynes, "expressly repudiated any interest in the amount of the national dividend, as distinct from its distribution" (Keynes, 1973, p. 4). Or again: "Ricardo expressly disclaimed any attempt to deal with the amount of the national dividend as a whole" (Keynes, 1973, p. 5).²

Despite its repetition, Keynes's characterization fails to capture Ricardo's position fully. It is not the case, as Keynes implies, that Ricardo's rejection of the quantity of output as an appropriate field for investigation stemmed simply from a lack of "interest" or "concern". In fact Ricardo rejected the study of the magnitude of aggregate output because he thought that it was theoretically problematic. The letter from Ricardo to Malthus that Keynes cites as support for his own interpretation of Ricardo makes this clear:

Political Economy you think is an enquiry into the nature and causes of wealth - I think it should rather be called an enquiry into the laws which determine the division of the produce of industry amongst the classes who concur in its formation. No law can be laid down respecting quantity, but a tolerably correct one can be laid down respecting proportions. Every day I am more satisfied that the former enquiry is vain and delusive, and the latter only the true objects of the science (letter of 9 October 1820, cited by Keynes, 1973, p. 4, emphasis added; Ricardo, 1952, VIII, pp. 278- 279).

Although Keynes trivializes Ricardo's position as a lack of interest, Ricardo characterizes his own position in terms of scientific validity: "no law can be laid down respecting quantity." Ricardo rejects as "vain and delusive" the very study that Keynes presents as an innovation, viz., the study of the factors which determine the magnitude of aggregate output. Keynes does not even attempt to refute Ricardo's position, but instead asserts that his own theory is a generalization of the classical school (Keynes, 1973, p. 3).³

A comparison between the rhetoric of Ricardo's rejection of a theory of the quantity of output with his repudiation of interest in short-term effects intensifies the impact of the former. In January 1817, Ricardo wrote to Malthus that:

you have always in your mind the immediate and temporary effects of particular changes - whereas I put these immediate and temporary effects quite aside, and fix my

whole attention on the permanent state of things which will result from them (Ricardo, 1952, VII, p. 120).

But in this instance Ricardo does not reject Malthus's position as mistaken. On the contrary, Ricardo continues on by acknowledging some legitimacy in Malthus's approach: "Perhaps you estimate these temporary effects too highly, whilst I am too much disposed to undervalue them. To manage the subject quite right they should be carefully distinguished and mentioned, and the due effects ascribed to each" (Ricardo, 1952, VII, p. 120). Ricardo's conciliatory attitude toward Malthus's emphasis on the short-period, that is, contrasts sharply with his attitude toward Malthus's emphasis on the theory of output, which he rejects as unscientific.

Although this letter has been widely quoted, the extensive literature on Ricardo and Keynes includes no attempt to either confirm or refute this assertion by Ricardo. Jacob Hollander suggests that Ricardo's assertion "might be regarded as a belated justification rather than as preliminary design " (Hollander, 1910, p. 132), but offers no insight into its meaning or evidence for his interpretation. Samuel Hollander, in his massive tome on Ricardo, urges that the passage be taken with considerable qualification (Hollander, 1979, p. 660), but makes no attempt to explain the reasons for, or the logic behind, Ricardo's remarkable claim.

This does not imply that Ricardo failed to recognize something like growth in the economy. Like Smith, he distinguished between "states of society" that are "stationary," "retrograde," or progressive" (Ricardo, 1951, I, pp. 176-177; cf. Smith, 1976, p. 99). These designations are complex and cannot be reduced to changes in a scalar

magnitude. Economic "progress" plays an important role in his theory: the central problem of political economy, for Ricardo, is to determine the manner in which progress affects the relative shares of output which accrue to the various classes of society.

Ricardo's claim occurs in the middle of a discussion of the measure of value. The rhetorical location is not incidental: Ricardo's analysis of the measure of value does lead to the conclusion that the theory of the level of output is futile. He finds that while it is possible to adequately measure value in a manner that is appropriate for a theory of distribution, it is impossible to adequately measure value in a manner appropriate for a theory of aggregate output.

The difficulty in measuring the value of output is based on the same principle that gives rise to Sraffa's critique of the measurement of capital. In Production of Commodities by means of Commodities, Sraffa's central criticism of capital theory concerned the measure, not the determination of value: "The reversals in the direction of the movement of relative prices, in the face of unchanged methods of production, cannot be reconciled with any notion of capital as a measurable quantity independent of distribution and prices" (Sraffa, 1960, p. 38). This criticism is presented as a parenthetical implication of a more general principle concerning measurement. Since the larger context has nothing particularly to do with capital or the marginal theory of value and distribution, it is not surprising that the more general principle has implications beyond the marginal theory. More generally, Sraffa's treatment of measurement implies that one cannot measure any heterogeneous collection of commodities as a scalar independently of distribution.⁴ That is to say, both the measurement of

the magnitude of aggregate output and the measurement of aggregate capital are particular applications of the same general principle. As J.R. Hicks wrote, in a slightly different context:

I have myself come to the problem of capital measurement as part of the general problem of measuring economic aggregates *in real terms* . . . The measurement of capital and the measurement of product are at bottom two aspects of the same problem; what has been learned about the one matter must be relevant to what has to be learned about the other (Hicks, 1961, p. 18)

Much attention has been focused on the case of capital because of its significance in the pre-Sraffian theory of value and distribution.⁵ In contemporary economics, however, the problem of the measure of value has migrated from the microeconomic question of the determination of relative values to the macroeconomic question of the determination of the level of total real output. Ricardo's rejection of the possibility of theorizing the level of total real output should therefore be of considerable interest today. In contemporary economics, total "real" output is typically measured by adjusting total nominal output with a price-index. This procedure expresses a theory of the measurement of the value of a collection of heterogeneous commodities, and, as such, it is subject to the same criticism that was developed by Ricardo and applied by Sraffa to capital.

This paper first examines the context of Ricardo's remark. Next it considers the problem of measurement as it appears in Ricardo. There are several accounts of this, but none which emphasizes the points which it is necessary to emphasize here.⁶ Ricardo argues that while there can be

no invariable measure of value, the quantity of labour necessary to produce a commodity can adequately serve as a measure for some purposes, but not for measuring total output. Next I consider the significance of the results derived in Production of Commodities in the context of the problem of measurement as it arises in Sraffa's Ricardo. Sraffa's analysis addresses issues which led Ricardo to reject the possibility of finding or constructing an invariable measure of value. With this framework in place, I then argue that the problem raised by Ricardo, analyzed by Sraffa, and debated in Cambridge, has the same structure as the problem that the price-index is intended to solve, and that the price-index is unable to solve it successfully for the same reasons that were analyzed by Ricardo and Sraffa. Finally, I consider Sraffa's response to the argument made by Hicks and others that while it is impossible to find an invariable measure of value, it is possible to find an adequate measure.

2. Ricardo's Remark in Context

Ricardo's assertion that political economy should be concerned with distribution, not with growth, occurs in the context of a discussion with Malthus on the theory of value. They agreed that they had different understandings of value: "It is quite true as you observe that we do not mean the same thing in speaking of value" (letter of 25 September 1820, Ricardo, 1952, VIII, p. 261).

Ricardo proposed that, in order to resolve this difference, they first agree on a measure of value: "we ought first agree what a standard ought to be, and then examine which approaches to an invariable standard the one you propose, or that which I propose." (letter of 4 September

1820, Ricardo, 1952, VIII, p. 229). They differed fundamentally on this issue, a difference that they were never able to resolve. Ricardo argued, in his Principles of Political Economy and Taxation, that the value of a commodity is best measured by the quantity of labour employed in its production. Malthus argued, in his 1820 Principles of Political Economy, that the value of a commodity is measured by the quantity of labour which the commodity can command.

Malthus suggested that they should decide which definition of is superior based on the usefulness of the two definitions: "the question should be tried by the relative utility of the two definitions in an inquiry into the nature and causes of the wealth" (letter of 25 September 1820, Ricardo, 1952, VIII, p. 261; emphasis in original).

This is the point at which Ricardo asserts the impossibility of constructing a quantitative theory of growth, as he disputes Malthus's conception of the nature of the inquiry:

Political Economy you think is an enquiry into the nature and causes of wealth - I think it should rather be called an enquiry into the laws which determine the division of the produce of industry amongst the classes who concur in its formation. No law can be laid down respecting quantity, but a tolerably correct one can be laid down respecting proportions. Every day I am more satisfied that the former enquiry is vain and delusive, and the latter only the true objects of the science (letter of 9 October 1820, Ricardo, 1952, VIII, pp. 278- 279).

Ricardo does not explain his view in detail, but rather proceeds to respond to Malthus's criticism of his standard of value:

You say that my proposition "that with few exceptions the quantity of labour employed on commodities determines the rate at which they will exchange for each other, is not well founded" I acknowledge that it is not rigidly true, but I say that it is the nearest approximation to truth, as a rule for measuring relative value, of any I have ever heard (letter of 9 October 1820, Ricardo, 1952, VIII, p. 279).

Next Ricardo explains why he believes his own view to be superior:

it is supply which regulates value - and supply is itself controlled by comparative cost of production. Cost of production, in money, means the value of labour, as well as profits. Now if my commodity be of equal value with yours its cost of production must be the same. But cost of production is with some deviations in proportion to labour employed. My commodity and your commodity are both worth £1000 - they will therefore probably have the same quantity of labour realized in each (letter of 9 October 1820, Ricardo, 1952, VIII, p. 279).

It is noteworthy that Ricardo does not argue that the quantity of labour is equal to the cost of production or equal to the value of the product. The quantity of labour is a useful measure because it is in proportion to the cost of production, which "controls" supply, which "regulates" value.

Ricardo does add one qualification to his belief in the power of his theory, and it is an important qualification: "But the doctrine is less liable to objections when employed not to measure the whole absolute value of the commodities compared, but the variations which from time to time take place in relative value" (letter of 9 October

1820, Ricardo, 1952, VIII, p. 279). That is, since the quantity of labour employed in production is not equal to the quantity of value, but rather "controls" and "regulates" the quantity of value, the quantity of labour employed in production will be less adequate as a measure of total "absolute" value than as a measure of changes in "relative" value. This is important for the issue at hand because the growth of output involves measurement of the "whole absolute value" while the proportions of output which accrue to the various classes are necessarily "relative".

3. Aggregation in Ricardo

The problem of measuring value occupied an important place in Ricardo's thought over a period of many years. His concern with the distribution of shares of total output among landlords, capitalists and workers required him to address the problem of aggregating quantities of output. Ricardo recognized that money prices are inadequate in the discussion of aggregate magnitudes because of their notorious variability: "The principles of Political Economy cannot be explained by the changes which take place in nominal price. Every one who attempts to explain those principles should adopt the best measure of real value that he can obtain, for that purpose" (Ricardo, 1951, II, p. 67).

In order to aggregate heterogeneous commodities adequately, Ricardo required a standard in terms of which all commodities could be expressed invariably:

The only qualities necessary to make a measure of value a perfect one are, that it should itself have value, and that that value should be itself invariable, in the same manner

as in a perfect measure of length should be neither liable to be increased or diminished; or in a measure of weight that it should have weight and that such weight should be constant (Ricardo, 1951, IV, p. 361).

Ricardo concludes that there can be no such measure. It is easy to find objects possessing value, but impossible to find objects with invariable value: "Of such a measure it is impossible to be possessed because there is no commodity which is not itself exposed to the same variations as the things, the value of which is to be ascertained" (Ricardo, 1951, I, pp. 43-44). Ricardo gives two reasons for variations in value which preclude the possibility of an invariable standard. First, there may be changes in methods of production: "there is [no commodity] which is not subject to require more or less labour for its production" (Ricardo, 1951, I, p. 44). Any commodity that might be chosen as standard might itself vary in value as a result of improvements or difficulties in the conditions of production. This position is based on Ricardo's view that the "real value" of a commodity is based on the quantity of labour embodied in its production:

I may be asked what I mean by the word value, and by what criterion I would judge whether a commodity had or had not changed its value. I answer, I know of no other criterion of a thing being dear or cheap but by the sacrifices of labour made to obtain it. Every thing is originally purchased by labour (Ricardo, 1951, IV, p. 397).

As the quantity of labour required to produce a commodity changes as the result of changes in the conditions of production, the value of the commodity varies, disqualifying it as an invariable standard.

The second reason Ricardo offers to show that there cannot be an invariable standard of value arises out of his criticism of Adam Smith. Smith argued that an increase in wages would lead to an increase in the prices of all commodities.⁷ Against this view, Ricardo argued that an increase in wages would raise the price of many commodities, but it would also lower the price of many commodities: "not only was it false that a rise of wages would raise the price of every commodity . . . but on the contrary, it caused the price of many commodities to fall" (Sraffa, 1951, p. xxxv). This conclusion is based on the "'curious effect which the rise of wages produces on the price of those commodities which are chiefly obtained by the aid of machinery and fixed capital'" (Sraffa, 1951, xxxv, citing Ricardo, 1952, VII, p. 82).⁸ The basis for the "curious effect" lies in the dissimilar conditions of productions of various commodities:

In one trade very little capital may be employed as circulating capital, that is to say in the support of labour - it may be principally invested in machinery, implements, buildings, &c. capital of a comparatively fixed and durable character. In another trade the same amount of capital may be used, but it may be chiefly employed in the support of labour, and very little may be invested in implements, machines and buildings. A rise in the wages of labour cannot fail to affect unequally commodities produced under such different circumstances" (Ricardo, 1951, I, p. 32).

Specifically, the relevant difference is in the varying proportions of fixed capital involved in the production of different commodities; if different commodities require different proportions of labour to fixed

capital, then an increase in wages will tend to reduce the price of the commodities requiring the lower proportion of labour relative to the commodity associated with the higher proportion of labour:⁹

The degree of alteration in the relative value of goods, on account of a rise or fall of labour, would depend on the proportion which the fixed capital bore to the whole capital employed. All commodities which are produced by very valuable machinery, or in very valuable buildings . . . would fall in relative value, while all those which were chiefly produced by labour . . . would rise in relative value (Ricardo, 1951, I, p. 35).¹⁰

Ricardo believed that the magnitude of this effect would tend to be greatly restricted:

The reader, however, should remark, that this cause of the variation of commodities is comparatively slight in its effects. With such a rise of wages as should occasion a fall of one per cent. in profits, goods produced under the circumstances I have supposed, vary in relative value only one percent; . . . The greatest effects which could be produced on the relative prices of these goods from a rise of wages, could not exceed 6 or 7 per cent.; for profits could not, probably admit of a greater general and permanent depression than to that amount (Ricardo, 1951, I, p. 36)

Despite Ricardo's belief that the implications of this "curious effect" of changes in wages on the system of relative prices were quantitatively slight, he believed that it presented another reason why the value of any commodity chosen as standard would not remain

invariable. Even if a commodity could be found that always required the same quantity of labour in its production, and therefore overcame the first problem,

still it would not be a perfect standard or invariable measure of value, because . . . it would be subject to relative variations from a rise or fall of wages, on account of the different proportions of fixed capital which might be necessary to produce it, and to produce those other commodities whose alteration of value we wish to ascertain (Ricardo, 1951, I, p. 44).

That is, regardless of the standard chosen to measure the value of two commodities, a change in distribution could alter the relative prices such that the value of the first might be greater than the value of the second before a change in distribution and less than the value of the second after the change. It is therefore impossible to say which has greater value without knowing the distribution of income.

But not only do individual relative values shift when the distribution of income changes, the value of any aggregate of commodities, such as net output, is necessarily altered: "the size of [the total] product appears to change when the division changes" (Sraffa, 1951, p. xlviii).¹¹ The arbitrariness of the mechanism which determines whether the price will go up or down in the face of a change in distribution, resulting from the complexity of the pattern of proportions of labour to means of production, implies that there is no generally predictable net effect on the magnitude of the aggregate: it might increase or it might decrease. It therefore becomes impossible to tell if an observed change in the aggregate measured in terms of any

standard is due to changes in the aggregate or merely to changes in distribution:

Even though nothing has occurred to change the magnitude of the aggregate, there may be apparent changes due solely to the change in measurement, owing to the fact that measurement is in terms of value and relative values have been altered as a result of a change in the division between wages and profits (Sraffa, 1951, p. xlviiii).

Sraffa isolates the contradiction to which this leads: "in the extreme case where the aggregate is composed of the same commodities in the same quantities and yet its magnitude will appear to have changed as measured in value" (Sraffa, 1951, p. xlviiii). That is to say, with the level and composition of physical output constant, a change in distribution of income causes relative values to rise and fall in such a pattern that the magnitude of the aggregate measured in value terms changes. This is the fundamental contradiction: measured in terms of relative values, the magnitude of the aggregate appears to have changed, while by construction the magnitude of the aggregate does not change in real terms (where real refers to the actual physical quantities).

Ricardo wished to have a measure that under the circumstances of the extreme case would show no change in the real output considered as a single magnitude. This would require an "invariable measure of value" which would reflect what Ricardo called "absolute value". This latter term refers to the value of a commodity construed as a scalar magnitude that is independent of the distribution of income. In such absolute terms, an aggregate of commodities could also be measured independently of the distribution of income.

Ricardo's conclusion that there can be no such perfect or invariable measure of value did not lead him to give up on the possibility of measuring value completely. He came to believe that labour could serve as an adequate, albeit imperfect, measure of relative value, but not of the absolute value of total output: "the doctrine [of labour as the measure of value] is less liable to objections when employed not to measure the whole absolute value of the commodities compared, but the variations which from time to time take place in relative values" (Ricardo, 1952, VIII, p. 279). That is, labour could serve reliably as the basis for measuring the changes in the value of some commodities (or aggregates of commodities) relative to the value of other commodities (or aggregates of commodities); but labour could not serve as a measure of the magnitude of total output. This conclusion therefore allows Ricardo to carry out an analysis of distribution, i.e., to measure and compare the values of distributive shares relative to each other as these vary over time; but this does not allow for the measurement of total output as an absolute scalar magnitude.

The impossibility of identifying an invariable standard of absolute value, therefore, raises an enormous problem for the attempt to establish scientific principles which determine the total quantity of real output. For any principle that might be posited hypothetically, it would be impossible to reliably compare the theoretically prescribed quantity of output with an empirically observed quantity of output. For any attempt to conduct such a comparison, the question of the measure of value must be addressed. Without an invariable standard of value, the precise magnitude of an observed quantity of output depends on the proportions of labour and fixed capital throughout the economy as well

as the distribution of income. It would be impossible to determine whether any discrepancy or correspondence between the theoretically prescribed magnitude of output and the empirically observed magnitude were the result of the validity or invalidity of the posited principles or the result of the particular proportions and distribution.

Ricardo was part of a tradition for which the ability to compare theoretical results with observed results is absolutely crucial. This tradition can be traced at least to Francis Bacon through Hobbes, Locke, and Hume to James Mill and the utilitarians, with whom Ricardo was closely associated:

To limit speculation and to make it fruitful by forcing it to deal with facts; to trace all its evidence to experience or the observation of facts; and to insist upon its verification by comparison with facts, is the main and surely the legitimate purpose of the Utilitarians as of all their philosophical congeners . . . The great ambition of the Benthamites had been to apply scientific methods to all the problems of legislation, jurisprudence, economics, ethics, and philosophy" (Stephen, 1900, III, pp. 78-9).

Hence the impossibility of finding or constructing an adequate standard in terms of which total output might be expressed justifies Ricardo's claim that the project of establishing the principles which determine total output is "vain and delusive" in contrast with proper scientific objectives.

4. Production of Commodities

The argument presented in the previous section that it is impossible to adequately measure the magnitude of aggregate real output as a scalar independent of distribution applies, mutatis mutandis, to the measurement of capital. In both cases the problem is to describe a quantity of heterogeneous outputs as a homogeneous scalar.¹² Sraffa's analysis in his Production of Commodities by means of Commodities can be understood as an analysis of the Ricardo's second reason for the impossibility of an invariable standard based on the "curious effect" discovered by Ricardo in his criticism of Smith.¹³ Sraffa does not address the first reason given by Ricardo, that commodities are all subject to variations in value, perhaps because it depends on the labour theory of value, which is no longer widely accepted.

In his investigation Sraffa reaches conclusions which are very similar to those of Ricardo. Sraffa finds, as did Ricardo, that the key to the pattern of price movements resulting from a change in the distribution of income "lies in the inequality of the proportions in which labour and means of production are employed in the various industries" (Sraffa, 1960, p. 12).¹⁴ Sraffa confirms Ricardo's conclusion that an increase in wages might cause the prices of different commodities to move in opposite directions because of their different proportions of labour to means of production. Sraffa demonstrates that the changes depend not only, as Ricardo thought, on the proportions of labour to means of production employed in the production of a particular commodity, but also on the proportion of labour to means of production employed in the production of the relevant means of production:

the relative price-movements of two products comes to depend, not only on the 'proportions' of labour to means of

production by which they are respectively produced, but also on the 'proportions' by which those means have themselves been produced, and also on the 'proportions' by which the means of production of those means of production have been produced, and so on. The result is that the relative price of two products may move, with the fall of wages, in the opposite direction to what we might have expected on the basis of their respective 'proportions' (Sraffa, 1960, p. 15).

This raises the possibility of greater complexity in the price-movements than Ricardo had foreseen. While Ricardo saw prices rising or falling, Sraffa concludes that the price "may rise or it may fall, or it may even alternate in rising or falling" (Sraffa, 1960, p. 14). Sraffa's "reduction to dated quantities of labour" led him to conclude that there may be "complicated patterns of price-movements with several ups and downs" (Sraffa, 1960, p. 37).

Sraffa also addressed the restrictions on price movements as distribution changes. In the case of single-product industries, Sraffa finds that "if as a result of a rise in the rate of profits the price falls, its rate of fall cannot exceed the rate of fall of the wage" (Sraffa, 1960, p. 38). This is consistent with Ricardo's view that the effects on prices of changes in distribution will be relatively minor. In the more general case of multiple-product industries, however, Sraffa concludes that this restriction no longer applies, so that given an increase in profits and corresponding fall in wages, it is possible "that the price of a product may fall faster than the wage" (Sraffa, 1960, p. 61).

Just as Ricardo concluded that the "curious effect" precluded the possibility of an invariable standard with which to measure aggregate output, it is these complicated patterns of price movements which, for Sraffa, make it impossible to measure capital invariably: "The reversals in the direction of the movement of relative prices, in the face of unchanged methods of production, cannot be reconciled with any notion of capital as a measurable quantity independent of distribution and prices" (Sraffa, 1960, p. 38).¹⁵

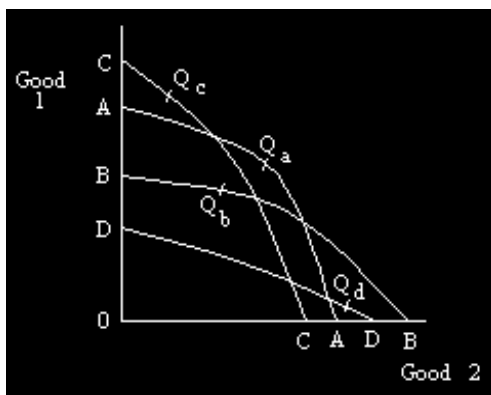
Sraffa's standard commodity does not solve the problem because it cannot serve as an invariable standard in the sense required by Ricardo. It is true that the value of the standard commodity does not change as the distribution of income changes, but the values of other commodities still change even when measured in terms of the standard commodity.¹⁶

5. Measurement in Statistics and in Theory

In his paper "Measuring Capital and other Economic Aggregates," presented in 1958 in Corfu and published in 1961, J.R. Hicks expresses a widely held view, namely, that while it is impossible to find or construct a perfect measure of value, the problem is therefore one of finding the best measure available. Sraffa, in his intervention in the discussion at Corfu (Sraffa, 1961), argues that this position is unacceptable. In order to present Sraffa's argument, let us first consider the position taken by Hicks.

Hicks agreed that there is no invariable standard available in terms of which capital might be measured, but his argument is quite different from Ricardo's. For Hicks, a bundle of heterogeneous commodities A is greater than bundle B if the resources required to

produce bundle A can be used to produce bundle B, but the resources required to produce bundle B are insufficient to produce bundle A. Robert Solow summarized Hicks's paper using production possibility curves (Lutz and Hague, 1961, p. 300):



In this case, Q_A is larger than Q_B . What Solow called "the standard paradox" (Lutz and Hague, 1961, p. 300) is reached when Q_A is compared with Q_C . In this case it is not possible to compare the magnitudes of the two bundles in the sense that bundle A is not producible with the resources required to produce bundle C and bundle C is not producible with the resources required to produce bundle A.

Nevertheless, Hicks argues that if there is sufficient substitutability within the system, then the comparison can be made well if not perfectly. From this he concludes that "it seems that we must just have faith (or hope) that enough substitutability for the purpose does in practice exist. I believe that this is what economists do, without fully realizing it, when they attempt to measure capital" (Hicks, 1961, p. 26). That is, although measurement will not work perfectly in every case, the empirical world is constructed such that

the best available measures will typically work satisfactorily, with only negligible errors.

Sraffa argued that this response is inadequate: "if one cannot get the measures required by the theorists' definitions, this is a criticism of the theory, which the theorists cannot escape by saying that they hope their theory does not often fail" (Sraffa, 1961, p. 306). He argues that Hicks confuses measurement in statistics with measurement in theory. Statistical measures are "only approximate and provide a suitable field for work in solving index number problems. The theoretical measures require absolute precision. Any imperfections in these measures are not merely upsetting, but knock down the whole theoretical basis" (Sraffa, 1961, p. 305). The logic of this position is perfectly conventional. Statisticians are forced by lack of data to approximate, and to employ techniques to construct inexact measures such as proxies and index numbers for estimating magnitudes that are not directly measurable. In this case it is unrealistic to expect or demand extreme precision. Sraffa implies that Hicks's position might be appropriate if the problem were one of statistical measurement. Hicks allows that there is no satisfactory way to measure capital, but he is nevertheless hopeful that the resulting errors will not be too great.

Theory, on the other hand, is subject to more rigorous standards of logic. In theory, arguments with logical errors are inadmissible. If a theoretical argument contains even a single logical flaw it is invalid. According to Sraffa the problem in measuring capital is a problem of theory: "The work of J.B. Clark, Boehm-Bawerk and others was intended to produce pure definitions of capital, as required by their theories, not as a guide to actual measurement" (Sraffa, 1961, p. 305). In theory it

is fallacious to hope or have faith that logical flaws will not be too serious because they do not happen frequently. If capital cannot be defined in a manner that is consistent with the marginal theory, then there is no such magnitude "capital" to be measured.¹⁷

The same argument applies to the measurement of real aggregate output insofar as that quantity is construed as a scalar. If the quantity of real output as a scalar cannot be defined theoretically, this points to a problem with any theory which requires that concept. It will be futile to hope that the method chosen to measure real output as a scalar will not be too seriously misleading. The theoretical and logical problem of definition must be solved before the problem of approximation can even be reasonably attempted.

6. Implications for Modern Growth Theory

In contemporary growth theory, classical and modern, the problem of aggregating real output is conventionally addressed with a price-index. In this sense the price-index serves the same purpose with respect to measurement that the theory of value played for Ricardo, that is, to aggregate a diverse collection of commodities into a uniform substance. The price-index is therefore not simply a tool, but also serves as a theory of value for the measurement of aggregate output, which might be called the price-index theory of value.

The price-index, however, is subject to exactly the same problems that Ricardo encountered in his search for an invariable standard of value. A price-index is simply a measure of changes in the price of a composite commodity. The composite commodity associated with the relevant price-index is the standard in which real output is expressed.

Sraffa's analysis shows that a composite commodity may be subject to the same complicated patterns of price variations as a single commodity as the result of changes in the distribution of income. If relative prices remained constant and all prices changed uniformly, then any commodity or composite commodity would serve equally well as a standard of value. The reason for using a composite commodity is presumably the hope that the changes in relative prices will somehow cancel each other out. Ricardo's analysis, as developed by Sraffa, shows that a change in distribution may cause prices to change in such complicated ways that there is no reason to think that such changes would tend to cancel each other out. As Ricardo argued against the possibility of using "the mass of commodities" as a standard of value: "If it be admitted that one commodity may alter in absolute value, it must be admitted that 2, 3, 100, a million may do so, and how shall I be able with certainty to say whether the one or the million had varied" (Ricardo, 1951, IV, p. 401).

Sraffa's analysis also suggests that different price-indexes, associated with different composite commodities, may move in different directions in response to changes in distribution, so long as they are produced with different proportions of labour to means of production. This is problematic for the theoretical construction of real output because it means that different measures of real output, none of which is theoretically superior to the others, may yield different theoretical results.

The problem of the price-index can be seen in the extreme case constructed by Sraffa with respect to the "curious effect" discovered by Ricardo. Given a constant quantity of diverse physical output, an increase in wages tends to change prices so that "the aggregate is

composed of the same commodities in the same quantities and yet its magnitude will appear to have changed as measured in value" (Sraffa, 1951, p. xlviiii). In this case, there will be (perhaps complicated) changes in relative prices and therefore changes in the price-index as well as in aggregate nominal output; therefore, real output as measured by adjusting nominal output with the price-index will tend to change. Thus we run into a contradiction equivalent to that encountered by Ricardo: "real" output as measured in terms of a price-index changes while "real" output in physical terms remains constant (by construction).

There is, however, an important difference between the problem of measuring capital and the problem of measuring real output. The inability to measure capital independently of distribution implies a circularity in the marginal theory of value and distribution. I am not arguing that the inability to measure real output independently of distribution leads to any comparable circularity. The impossibility of measuring aggregate "real" output invariably is nevertheless a serious problem for a theory of the determination of the size of aggregate output construed as a scalar. The possibility of complicated price changes as the distribution of income changes means that the magnitude of aggregate output might change in complicated ways as distribution changes. The problem this possibility points to is that given a change in total "real" output as measured using a price-index it would become difficult to distinguish between that part of the change due to changes in the actual physical output and that part of the change due to changes in distribution. This renders untestable any proposition of the form: X causes aggregate real output to increase (or decrease). It even becomes

possible that an increase in physical output accompanied by a change in distribution would appear as a decline in "real" output as measured using a price-index. Here again the intuitive notion that "real" refers to actual physical output is violated.

This does not imply that movements of a general price-index provide no information. On the contrary, as Keynes says, such movements are "not without meaning and not without interest" (Keynes, 1973, p. 40). If prices rise and people's income remains constant, this is a serious and meaningful event. As Keynes says, the "proper place" for such concepts "lies within the field of historical and statistical description" (Keynes, 1973, p. 40). The point is that as a theoretical tool, the price-index theory of value is inadequate to the task it is designed to accomplish, that is, to serve as a standard of value in terms of which nominal values can be adequately converted into "real" magnitudes.

7. Conclusion

Given any two collections of commodities, α and β , quantitative comparison may be made under the following conditions in the absence of a measure of value. If both sets are composed entirely of units of the same commodity, then it is possible to say which is greater and by precisely how much. If the two sets are composed of the same diverse commodities in exactly the same proportions, it is again possible to say which is greater and by precisely how much. If the two sets are composed of the same diverse commodities, not in the same proportions, but such that one set is completely contained within the other, it is possible to say which is greater, but not by precisely how much. If the two sets are

not composed of the same commodities, or if they are composed of the same diverse commodities such that neither is contained within the other, then it is not even possible to say which is greater. The need for a measure of value appears because the first two cases are so highly specialized as to be unrealistic and the third cannot claim very wide generality. Unfortunately, no suitable measure is available which can reliably solve the problem that arises in the last case.

As I have argued, the problem of measuring capital that led to the famous controversy is a special case of a more general problem of aggregation that is equally insoluble. Sraffa's analysis in Production of Commodities is not restricted in any way to the measurement of capital; and the roots of the problem first appeared in Ricardo's thought in the context of measuring total output and independently of any concern with measuring capital. It is not generally possible to aggregate any collection of heterogeneous commodities in such a manner that can be represented as a scalar which is independent of distribution.

It follows that the now common attempt to measure "real" output by adjusting nominal output using a price-index is just as fallacious as the attempt to measure a quantity of capital. Curious as it may seem, the size of the pie depends on how it is sliced.

With respect to any analysis of an economic system over time, the quantity of total output is not a viable object of study for political economy. Sraffa's analysis and the fact that in the famous letter to Malthus, quoted by Keynes and cited above, this conclusion is connected to the problem of measuring total output suggest that Ricardo had a firm theoretical foundation for it. Indeed, in this passage Ricardo does not

say that the focus on the determination of the quantity of output is wrong or secondary, rather he says that it is "vain and delusive" (Ricardo, 1952, VIII, p. 279).¹⁸ That is to say, focusing on the determination of the quantity of output as a whole is not simply undesirable, it is theoretically useless.

Ricardo understood his work as an attempt to treat political economy on a scientific basis. For Ricardo, a hallmark of a scientific approach was the insistence that theory be judged based on appeal to fact. In order to compare theoretical results concerning aggregates of commodities with observed results concerning aggregates of commodities, it is necessary to be able to reliably measure the value of the aggregates. Ricardo believed that because of the impossibility of finding an invariable standard of value, it is impossible to measure aggregates of output in a manner adequate for the establishment of the principle which determine the quantity of aggregate output. Sraffa has shown that Ricardo's analysis of this point can be clarified using the level of formality which is conventional today.

Endnotes

¹ Garegnani (1983) argues that Ricardo should not be included in what Keynes calls the "classical" school. This paper addresses Keynes's characterization of Ricardo rather than his definition of "classical".

² This reading also surfaces in Keynes's comparison between Ricardo and Malthus: "Ricardo is investigating the theory of the *distribution* of the product in conditions of equilibrium and Malthus is concerned with what determines the *volume* of output day by day in the real world" (Keynes, 1972, p. 97; emphasis in original). Cf. Ricardo, 1951, I, p. 5: "To determine the laws which regulate . . . distribution, is the principle problem in Political Economy."

³ Similarly, Eatwell and Milgate (1983) propose to synthesize Keynes and Ricardo without addressing this difference.

⁴ The measurement of real output or capital as a vector is not subject to the criticism presented here.

⁵ The measurement of land and labour is not entirely unproblematic, but land and labour are not subject to the same problems that apply to the measurement of aggregates of commodities. Land has natural units, e.g., acres; labor has conventionally been reduced (by Ricardo, Keynes and Sraffa) to uniformity by assuming that differences in wages reflect differences in productivity.

⁶ See, for example, Garegnani, 1984.

⁷ Smith, 1979, p. 510.

⁸ For discussion of this "curious effect" see Campanelli, 1996; Meek, 1973, pp. 103-5; St. Clair 1957, pp. 33-35; S. Hollander, 1979, pp. 200-1.

⁹ Cf. Sraffa's discussion of surplus and deficit industries in the third chapter of Sraffa, 1960.

¹⁰ Ricardo found that the varying durability of capital has an equivalent effect of prices as a result of a change in distribution: It appears, too, that in proportion to the durability of capital employed in any kind of production, the relative prices of those commodities on which such durable capital is employed, will vary inversely as wages; they will fall as wages rise, and rise as wages fall; and, on the contrary, those which are produced chiefly by labour with less fixed capital, or with fixed capital or a less durable character than the medium in which price is estimated, will rise as wages rise, and fall as wages fall (Ricardo, 1951, I, p. 43)

¹¹ The exception to this occurs in the case in which the aggregate is composed entirely of Sraffa's standard commodity.

¹² The similarity of the problems of measuring capital and output has been remarked upon by Ricardo (1952, IX, pp. 359-360), Sraffa (1951, p. xlix), and Hicks (1961, p. 18).

¹³ This is not to say that the various models of the book, or the distinction between basics and non-basics, for example, are not interesting in themselves. It is only to point out that in the structure and context of Sraffa's text, the investigation of the effects of changes in distribution on prices is central. Various models and constructs, such as the standard commodity, are used to facilitate this investigation, but in Production of Commodities these are means and not ends. This argument is made in more detail in Andrews, 1996.

¹⁴ Ricardo's "fixed capital" and "circulating capital" correspond to Sraffa's "means of production" and wages. The crucial point is that there are two different kinds of income, wages and profits, which must be paid in different proportions in different industries; therefore when the distribution of income between wages and profits changes, the relative prices of the commodities produced in the different industries must change.

¹⁵ The complicated character of the patterns of price changes which result from a change in distribution provide the basis for reswitching, the possibility that a method of production might be most profitable at two different rates of profit while another method might be most profitable at intermediate rates. The question which of two methods of production is most profitable depends on the value of the inputs relative to the value of outputs for each process. With the distribution of income changing, the value of each input and each output changes in a complicated fashion and may possibly reverse itself, so that the total value of means of production used in any process and the value of the output produced by that process both change. The possible complexity of the changes in value implies that the question of which process is more profitable is equally complex and may involve reversals as the distribution of income changes.

¹⁶ See N.-P. Ong 1983, Salvadori and Kurz, 1993.

¹⁷ Keynes drew the same distinction between "the field of historical and statistical description" in which approximation is appropriate and "causal analysis" for which "perfect precision" is required (Keynes, 1973, p. 40).

¹⁸ It has been argued that in classical political economy the question of the level of output and the question of the price of output were to be treated separately (Eatwell and Milgate, 1983, p. 6). The conclusion reached here, on the other hand, supports the view that, at least for Ricardo, the quantity of output, considered as a scalar, is not a question that can adequately be addressed at all.

Bibliography

- Andrews, D. (1996). Nothing is Hidden: a Wittgensteinian interpretation of Sraffa. Cambridge Journal of Economics 20(6): 763-777.
- Campanelli, G. (1996). "Ricardo's "Curious Effect": A Mathematical Formulation." History of Political Economy 28(4): 691-701.
- Eatwell, J. and M. Milgate (1983). Introduction to Keynes's Economics and the Theory of Value and Distribution. J. Eatwell and M. Milgate, editors. New York, Oxford University Press: 1-17.
- Garegnani, P. (1983). Notes on Consumption, Investment and Effective Demand. Keynes's Economics and the Theory of Value and Distribution. J. Eatwell and M. Milgate. New York, Oxford University Press.
- Garegnani, P. (1984). Value and Distribution in the Classical Economists and Marx. Oxford Economic Papers 36:291-325.
- Hicks, J. R. (1961). Measuring Capital and other Economic Aggregates. In The Theory of Capital. F. A. Lutz and D. C. Hague. London, Macmillan: 18-31.
- Hollander, J. H. (1910). David Ricardo: A Centenary Estimate. Baltimore, Johns Hopkins University Press.
- Hollander, S. (1979). The Economics of David Ricardo. Toronto and Buffalo, University of Toronto Press.
- Keynes, J.M. (1972). Essays in Biography, reprinted in the Collected Writings of J.M. Keynes, Vol. X, ed. D. Moggridge, Cambridge, Cambridge UP.
- Keynes J.M. (1973). The General Theory of Employment Interest and Money, reprinted in The Collected Writings of J.M. Keynes, Vol. VII. London, Macmillan.

- Lutz, F. A. and D. C. Hague, Eds. (1961). The Theory of Capital. London, Macmillan.
- Malthus, T.R. (1820) The Principles of Political Economy.
- Meek, R. (1973). Studies in the Labour Theory of Value. London, Lawrence and Wishart.
- Ong, N.-P. (1983). "Ricardo's Invariable Measure of Value and Sraffa's 'Standard Commodity.'" History of Political Economy 15(2): 207-227.
- St. Clair, O. (1957). A Key to Ricardo. New York, Kelley and Millman.
- Ricardo, D. (1951-1973). The Works and Correspondence of David Ricardo. Edited by Piero Sraffa. Various volumes. Cambridge, Cambridge University Press.
- Roncaglia, A. (1978). Sraffa and the Theory of Prices. Chichester, John Wiley & Sons.
- Salvadori, N. and H. Kurz (1993). The 'Standard commodity' and Ricardo's Search for an 'Invariable Standard of Value'. The Dynamics of the Wealth of Nations: Growth, distribution and structural change: Essays in honor of Luigi Pasinetti. M. Baranzini and G. C. Harcourt. New York, St. Martin's Press: 95-123.
- Smith, A. (1979). An Inquiry into the Nature and Causes of the Wealth of Nations. Oxford, Clarendon Press.
- Solow, R. (1961). Introduction of Hick's Paper. In The Theory of Capital. F. A. Lutz and D. C. Hague. London, Macmillan.
- Sraffa, P. (1951). Introduction. Principles of Political Economy and Taxation. D. Ricardo. Cambridge, Cambridge University Press.

Sraffa, P. (1960). Production of Commodities by means of Commodities: Prelude to a Critique of Economic Theory. Cambridge, Cambridge University Press.

Sraffa, P. (1961). Intervention in the Debate. In The Theory of Capital. F. A. Lutz and D. C. Hague. London, Macmillan.

Stephen, L. (1900). The English Utilitarians. London, Duckworth.