Foreign trade, international values, and gains from trade: Ricardo, Pennington, Whewell, and John Stuart Mill

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1. Introduction

This paper has two aims. Its first purpose is to spell out some implications of the "Sraffa-Ruffin reading" of Ricardo's exposition of the comparative advantage theory, according to which the "four magic numbers" in his famous numerical example refer, not to unit labour coefficients, but to the labour contents of given (unspecified) amounts of the two goods traded between England and Portugal.[1] The implications I want to emphasize concern the following points (of which the first two have already been recognized more widely):[2]

(i) In his demonstration that the trade between England and Portugal is mutually advantageous Ricardo was merely applying the "eighteenth century rule", and he could correctly determine the gains from trade accruing to each country by simply subtracting two of the four numbers from the other two.

(ii) Since Ricardo set out the comparative advantage theory without introducing any assumptions on returns, he could allow for incomplete specialization in the case of internationally traded commodities which are produced under conditions of increasing costs.

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[1] Tabuchi (2014) has shown that this reading was also suggested by the Japanese scholar Kenzo Yukizawa in a paper published in 1974 (in Japanese).

[2] The first implication was spelled out, apart from Sraffa (1930), Yukizawa (1974) and Ruffin (2002), also by Maneschi (2004, 2014). Maneschi (2008) has also drawn attention to the second implication, which (according to Tabuchi 2014) has been noted also by Yukizawa (1974).

In addition, I shall advance two further (and perhaps more contentious) claims, which I believe to follow also from the "Sraffa-Ruffin" reading of Ricardo's example:

(iii) The given terms of trade in Ricardo's example are not "half-way" between the autarky price ratios, but simply refer to a situation of balanced trade. The autarky price ratios which correspond to this trade situation are left unspecified by Ricardo, and cannot be inferred from his numerical example.

(iv) Ricardo's exposition leaves no room for a determination of international values by reciprocal demand, because the terms of trade were considered by Ricardo as being governed by the monetary production costs of the exported and imported commodities, which are liable to change with a change in the quantities traded, in a situation of balanced trade. The analysis of trade imbalances was conducted by Ricardo strictly in monetary terms and involved international gold movements as an indispensable ingredient of the adjustment processes.

By drawing attention to these implications, in section 2 of the paper, I want to show that Ricardo's exposition of foreign trade, international values, and the division of the gains from trade was quite different from that attributed to him by John Stuart Mill in his essay "Of the Laws of Interchange between Nations, and the Distribution of the Gains of Commerce among the Countries of the Commercial World" ([1844] 1967). In this essay Mill indeed attributed to Ricardo his own exposition of the comparative advantage theory, in an attempt to present his introduction of reciprocal demand analysis as basically in line with the latter's conceptualization, and as being merely an elaboration of some problems which Ricardo, 'having a science to create, had not time, or room' to address ([1844] 1967: 235). In truth, however, Mill's re-interpretation of the numerical example marked the opening step of a significant departure from Ricardo's approach to foreign trade theory, and to economic theory more generally.[3]

Accordingly, the second aim of this paper is to reconstruct the historical process of the transformation of Ricardo's conceptualization of foreign trade in such a way that a determination of international values by means of reciprocal demand analysis could be introduced into it. In section 3 it is first shown, with reference to a contribution by

[3] For a similar assessment of Mill's contribution to the development of Ricardo's theory of foreign trade see Shiozawa (2014).

William Whewell, who in 1831 provided an algebraic formulation of Ricardo's ideas on foreign trade without perceiving a need for introducing demand considerations explicitly, that the further development of Ricardo's theory of foreign trade need not necessarily have proceeded along the lines suggested by J. S. Mill. In sections 4 and 5, it is then shown that the re-formulation and further development of Ricardo's theory of foreign trade by John Stuart Mill emanated from the erroneous exposition of Ricardo's theory in the first two editions of his father's *Elements*. In section 6, it is suggested that James Pennington's contribution, which also grew out of the erroneous explication of the division of the gains from trade in James Mill's *Elements*, was an attempt to determine international values by retaining elements of Ricardo's exposition and combining them with some of the newly introduced elements in Mill's exposition. Section 7 offers some concluding remarks.

2. Ricardo's exposition of comparative advantage, international values, and the division of the gains from trade

The assumptions underlying Ricardo's example can be conveniently set out in terms of the following table (see Sraffa 1930: 541):

	Number of men whose labour is required for one year in order to produce a given quantity of	
	Cloth	*Wine*
in Portugal	90	80
in England	100	120

Given these numbers, it would be advantageous for England to export cloth in exchange for wine imported from Portugal, and for Portugal to export cloth in exchange for wine from England:

> England gives the cloth produced by 100 Englishmen in exchange for the wine produced by 80 Portuguese; and since this quantity could only have been produced by 120 Englishmen, she gains the labour of 20 Englishmen. Portugal gives the wine produced by 80 Portuguese for the cloth produced by 100 Englishmen; the production of this cloth would have required the labour of 90

> Portuguese, and therefore Portugal gains the labour of 10 Portuguese. (Sraffa 1930: 541)

The gains from trade are thus expressed in terms of the amount of labour that each country saves when it specializes according to its comparative advantage and trades with the other country, instead of remaining self-sufficient. Gains from trade accrue to each country as long as the amount of labour embodied in its exports is smaller than the amount of labour it would need to produce the commodities it imports. On the basis of Ricardo's exposition, the gains accruing to each country can be inferred from the two numbers of this country alone. The way in which Ricardo expressed the gains from trade is consistent with a long tradition of applying a simple rule which can be found also in earlier authors, denoted by Viner as the "eighteenth-century rule" for the gains from trade. It states that 'it pays to import commodities from abroad whenever they can be obtained in exchange for exports at a smaller real cost than their production at home would entail' (Viner [1937] 1975: 440).

Once it is recognized that the four numbers refer to the labour contents of given (unspecified) amounts of the two goods traded, and not to unit labour requirements, [4]

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[4] Interestingly, the anonymous author of *Considerations on the Importation of Foreign Corn* (1814), much like Ricardo, also explicated the conmparative advantage principle by starting out from *given* trade flows and *given* terms of trade for unspecified amounts of the traded goods: 'If England exchanges with Germany a piece of cotton cloth, which has been made with the labor of ten persons, for ten days, (allowance being made for the value of cotton wool imported), for a quantity of iron or wheat, which could not have been produced in England, but with the labor of double the number of persons for the same time, it must be evident, that England is more advantaged than she could have been in the application of her own double labor to its production … Also, if on the other hand, Germany could produce with ten days' labor of the ten persons, the iron or wheat she exchanges for the piece of cotton cloth, which, although made in England with the ten days' labor of the ten persons, could not have been made in Germany but with double labor and capital, or at double the price of them, Germany too is in this manner advantaged.' (Anonymous 1814: 7-9; quoted from De Vivo 2010: 100) This example obviously refers to a given trade situation with given terms of trade, in which trade occurs because each country enjoys an *absolute* advantage in one of the two commodities. Trade based on comparative advantage is then introduced in the following terms: 'Supposing England and Germany both capable of producing the iron and wheat at the same expense of labor and capital, yet if England at the same time can by superior ingenuity, convert this labor and capital to the manufacture of cotton cloth, producing a quantity of it greatly beyond what Germany may be able to produce by the similar application of its labor and capital, then must both countries still be benefited by the exchange … Germany obtains more cotton cloth than it could

it should also be clear that the autarky price ratios cannot be inferred from these numbers unless constant returns are assumed. It is possible, of course, to define the units in which cloth and wine are measured in terms of the quantities traded. Then, if England, for instance, produced wine for herself instead of importing it from Portugal, the amount of labour needed for producing "a unit of wine" at home would be 120 men for year. However, with non-constant returns in cloth production, the amount of labour needed for producing "a unit of cloth" in England cannot be inferred from Ricardo's numbers (it is *not* equal to 100 men for a year, because the total quantity of cloth produced in England changes when England ceases to export cloth to Portugal). And it is clear enough that Ricardo was not supposing constant returns, because he allowed for incomplete specialization when he wrote that 'a country … may … import *a portion* of the corn required for its consumption' ([1821] 1951: 136 n; emphasis added).

Let us turn, then, to the question whether Ricardo had any rule for the determination of international values. Beginning with John Stuart Mill, interpreters of Ricardo's theory of foreign trade have either suggested that the problem of the determination of international values was not tackled by him at all, or that it was tackled only unsatisfactorily, in the context of his exposition of the specie-flow mechanism. It is interesting to note, therefore, that the specie-flow mechanism is explicated by Ricardo in chapter 7 of the *Principles*, *not* in terms of an adjustment process leading up to a situation of balanced trade, but rather in terms of a process leading away from it, towards a situation in which international trade flows have ceased entirely. The starting point of Ricardo's analysis is the situation of balanced trade depicted in his famous numerical example, which he supposes to be disturbed by the discovery of a process for making wine in England ([1821] 1951: 137). The end result of the wine-making method being introduced in England is that she 'would grow wine for herself' and 'cease to manufacture cloth for exportation', although

> cloth would continue for some time to be exported from this country, because its price would continue to be higher in Portugal than here; but money instead of wine would be given in exchange for it, till the accumulation of money here, and its diminution abroad, should so operate on the relative value of cloth in the two countries, that it would cease to be profitable to export it. ([1821] 1951: 137)

> have fabricated for itself, by means of the same labor and capital employed in the fabrication of the cotton cloth.' (Anonymous 1814: 7-9; quoted from De Vivo 2010: 100)

The specie-flow mechanism is thus invoked by Ricardo in the analysis of a process that leads from a trade equilibrium to autarky – and not the other way around.[5] Ricardo illustrated this process by starting out from an initial trade situation of balanced trade with *given* money prices:

> Thus, suppose before the improvement in making wine in England, the price of wine here were 50*l.* per pipe and the price of a certain quantity of cloth were 45*l.*, whilst in Portugal the price of the same quantity of wine was 45*l.* and that of the same quantity of cloth 50*l.*; wine would be exported from Portugal with a profit of 5*l.* and cloth from England with a profit of the same amount. ([1821] 1951: 138)

Note that the given money prices are specified "per pipe" (of wine) and for "a certain quantity" (of cloth), that is, in units which are different from those in which the labour contents of the exports and imports are specified. These prices are then shown to be altered by the changes in the value of gold in the two countries, which emanate from the fact that for a time the (still) profitable importation of English cloth into Portugal is accompanied by the (newly) profitable importation of Portuguese gold into England:

> But the diminution of money in one country, and its increase in another, do not operate on the price of one commodity only, but on the prices of all, and therefore the price of wine and cloth will both be raised in England, and both lowered in Portugal. The price of cloth, from being 45*l.* in one country and 50*l.* in the other, would probably fall to 49*l.* or 48*l.* in Portugal, and rise to 46*l.* or 47*l.* in England, and not afford a sufficient profit after paying a premium for a bill to induce any merchant to import that commodity. ([1821] 1951: 139-40)

Accordingly, the *post*-improvement autarky price of "a certain quantity" of cloth is stated to be 49*l.* or 48*l.* in Portugal and 46*l.* or 47*l.* in England, and the *post*-improvement autarky price of "a pipe" of wine can be inferred as being 43*l.* or 44*l.* in Portugal and 46*l.* or 47*l.* in England. Note, however, that these are the autarky prices corresponding to the *post*-improvement situation; the *pre*-improvement autarky prices cannot be inferred from the information provided by Ricardo.

If Ricardo envisaged a determination of international prices without recourse to reciprocal demands, the question arises how demand changes can be absorbed

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5   Ricardo also pointed out that in consequence of the introduction of the improved production method in England the direction of trade could even be reversed, with England exporting wine and Portugal exporting cloth, 'if the improvement in making wine were of a very important description' ([1821] 1951: 137-8).

without altering the terms of trade. A compelling answer, which was first proposed by Negishi ([1996] 2000: 98), is that changes in demands are absorbed by corresponding changes in supplies, and do not induce any price changes *unless production costs change as a result of changes in the quantities produced*. This is the basic principle of Ricardo's classical approach to the determination of long-period prices:

> It is the cost of production which must ultimately regulate the price of commodities, and not, as has often been said, the proportion between the supply and demand: the proportion between supply and demand may, indeed, for a time, affect the market value of a commodity, until it is supplied in greater or less abundance, according as the demand may have increased or diminished; but this effect will be only of a temporary duration. ([1821] 1951: 382)

For Ricardo, this principle remains intact also in open economies with international trade in commodities. For example, if corn is imported into England from France, its price in England, Ricardo contends, is governed by its natural price in France,[6] 'and it would remain at this price, whether England consumed a hundred thousand, or a million of quarters' ([1821] 1951: 374-5). But this does not mean that the natural price in France is unaffected by the "strength" of the English demand for corn:

> If the demand of England were for the latter quantity, it is probable that, owing to the necessity under which France would be, of having recourse to land of a worse quality, to furnish this large supply, the natural price would rise in France; and this would of course affect also the price of corn in England. *All I contend for is, that it is the natural price of commodities in the exporting country, which ultimately regulates the prices at which they shall be sold, if they are not the objects of monopoly, in the importing country.* ([1821] 1951: 375; emphasis added)

With international trade in commodities which are produced under non-constant costs, foreign demand can alter the production costs and thus the natural prices, because it alters the total quantities supplied. Therefore, the terms of trade are *not* independent of demand, but the influence of changes in foreign demand is by way of directly affecting the long-period supply prices. Once this is understood, it is also possible to see that the charge commonly leveled at Ricardo of having failed to specify

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6   Ricardo refers to 'the natural price, viz. that price which is necessary to its production, and without which it could not be cultivated' in France; he also refers to it as 'the price at which it could be furnished to the English market, and afford the usual and ordinary profits of stock in France' ([1821] 1951: 374).

the limits of the terms of trade is unfounded. In my reading, the following passage contains a reasonably precise statement on those limits:

> Cloth cannot be imported into Portugal, unless it sell there for more gold than it cost in the country from which it was imported; and wine cannot be imported into England, unless it will sell for more there than it cost in Portugal. If the trade were purely a trade of barter, it could only continue whilst England could make cloth so cheap as to obtain a greater quantity of wine with a given quantity of labour, by manufacturing cloth than by growing vines; and also whilst the industry of Portugal were attended by the reverse effects. ([1821] 1951: 137)

This statement, which has generally been read as a vague and insufficiently precise statement on the limits of the terms of trade, is in fact fully satisfactory in view of the premises underlying Ricardo's analysis. With non-constant returns in the production of the traded commodities, a change in the amounts traded will alter the quantities that have to be supplied, and thus their production costs. Accordingly, the limits are not given and constant, independently of the terms of trade and the corresponding quantities traded, but subject to change with changing terms of trade, since the total amounts traded are liable to change with changing terms of trade.

To sum up, let us briefly contrast Ricardo's exposition with that of John Stuart Mill, which will be described in greater detail below. The procedure adopted by J. S. Mill, which came to be established as the standard procedure in international trade theory, is to first infer the pattern of trade by interpreting Ricardo's four numbers as unit labour coefficients, to derive the two countries' autarky price ratios from them, and then to provide arguments why the international exchange ratio must usually lie between them. The next step then is to show how, after the opening of trade proceeding from an autarky situation, the trade equilibrium is established, and to determine the corresponding terms of trade, using reciprocal demand analysis. This line of argument is then repeated in terms of money prices, and the adjustment process from the autarky situation towards the position of balanced trade is shown to entail gold flows between the two countries as long as the trade flows are not balanced.

As we have seen above, Ricardo's exposition in chapter 7 of the *Principles* is quite different, and can indeed be said to be exactly the reverse of the above: Ricardo starts out from a situation of balanced trade with given terms of trade and then describes the associated division of the gains from trade in barter terms. The barter analysis is employed only in demonstrating the existence of gains from trade and their division;

it plays no role in Ricardo's analysis of adjustment processes, which is conducted strictly in monetary terms. In this analysis Ricardo also starts out from a situation of balanced trade with given money prices and then analyzes the adjustment processes which lead to a no-trade situation, following an improvement in production methods, which are shown to entail gold flows between the two countries as long as the trade flows are not balanced. The terms of trade are taken to be determined by the natural prices in the exporting countries, which in turn reflect the influence of monetary changes and of changes in production costs arising from the adaption of the quantities supplied to those demanded.

3. Whewell's exposition of Ricardo's theory of foreign trade

The Cambridge polymath William Whewell is known among trade theorists for his mathematical analysis of J. S. Mill's theory of foreign trade, in a paper that was read to the Cambridge Philosophical Society in 1850 (Whewell [1850/56] 1971).[7] The importance of this paper for Mill's 1852 addition to Chap. 18 of his *Principles*, and perhaps also for Alfred Marshall's treatment of reciprocal demand analysis, was first noticed by Chipman (1965: 392-3), and has been extensively discussed.[8] However, Whewell's earlier algebraic formulation of Ricardo's theory of foreign trade in his paper of 1831, entitled "Mathematical Exposition of some of the leading Doctrines in Mr Ricardo's *Principles of Political Economy and Taxation*" ([1831] 1971), has not been given the attention it deserves. The interest in this paper derives not so much from the results obtained by Whewell, which are partly faulty, but rather from his concise statement of the "postulates" underlying Ricardo's analysis of foreign trade. In particular, Whewell clearly identified the importance of the condition of "balanced trade" in Ricardo's approach to the determination of international values.[9]

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[7] The paper was read in 1850 and first published in the Society's *Transactions* in 1856.

[8] See Appleyard and Ingram (1979a, 1979b), Chipman (1979), Gherity (1988), Creedy (1989),and Henderson (1989).

[9] In the secondary literature the identification of this condition is generally attributed to John Stuart Mill; see, for instance, Haberler's statement on the determination of the international exchange rate: 'The exact ratio is determined, given the conditions of demand, by the fact that (supposing other credits and debits to balance) the total value of each country's exports must equal the total

Whewell's analysis of Ricardo's views on foreign trade in §§ 14-19 of his 1831 paper consists of two parts. The first part (§§ 14-16) is concerned with the restoration of the balance of trade, while the second part (§§ 17-19) focuses on the determination of the rate of exchange. Whewell clearly recognized that international immobility of labour and capital implies that both the real wage rate and the rate of profits may be different in the two countries:

> The proportionality of the exchangeable value to the cost or labour of production no longer obtains, when the labour of different countries is concerned. "The produce of the labour of 100 Englishmen may" as Mr. Ricardo says, "be given for the labour of 80 Portuguese, 60 Russians, or 120 East Indians." Nor can we assume the equality of profits in different countries. The difficulty with which labour and capital travel from one country to another, is a sufficient obstacle in the way of the establishment of such a uniformity in the value of labour, and of the rate of profits. ([1831] 1971: 31)

Accordingly, the proportionality of prices to embodied labour which obtains within each country need not obtain with regard to the prices of internationally traded commodities.

Whewell then extracted the following set of "postulates" from chapter 7 of Ricardo's *Principles*:

> I. The merchant will buy a commodity at one place, and sell it at another, if by so doing he can recover the money cost with the profit usual in his own country. The consumer will buy a commodity of foreign rather than the same commodity of domestic production, if by so doing he can obtain it cheaper. This is the fundamental principle of all foreign trade.
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> II. When a country has as much gold (or any other money-metal) as is wanted to circulate her commodities; if an additional quantity of gold be imported and retained in the country, the circulation of commodities remaining the same, money prices will rise.
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> III. In the condition of equilibrium of a trading country, the annual exports and imports must be equal in money value.
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> IV. The prices supposed here are the remunerating prices in the equilibrium of demand and supply. ([1831] 1971: 33 and 35)

In addition to these four postulates, 'which I borrow from Mr. Ricardo', Whewell also found it necessary 'to make several assumptions for the sake of reducing the

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value of its imports. This important addition to the Theory of Comparative Cost was made by J. S. Mill.' (Haberler 1936: 134)

problems before us to calculation' ([1831] 1971: 32). In particular, Whewell assumed that initially the country's quantity of gold is 'exactly requisite' to circulate her commodities, and that money prices 'rise in proportion to the increased quantity of gold' ([1831] 1971: 33), that is, he assumed a specific functional relationship between changes in money prices and changes in the quantity of gold.

Whewell's first postulate, which emphasizes the role of merchants and their profit-maximizing behavior, captures very neatly Ricardo's general approach to problems in international trade. It also accords with Ricardo's focus on money prices, rather than "real costs", in his explanation of the direction and extent of trade flows. The second postulate is Whewell's rendition of the specie-flow mechanism, which he combines with his proportionality assumption in order to determine the price changes which emanate from changes in the quantity of gold:

$$p' = p\left(1 + \emptyset\,\frac{h}{g}\right),$$

where p and p' denote the price before and after the inflow of gold, g is the original quantity of gold, h the quantity imported, and $\emptyset$ some positive constant ([1831] 1971: 33-4). From the third postulate, Whewell derived the equality of the value of exports and imports:

$$\sum_{i=1}^{n} p_i x_i = \sum_{j=1}^{m} p_j^* x_j^*$$

where p_i and x_i denote the prices and quantities of the export goods, and p_j^* and x_j^* those of the imported goods ([1831] 1971: 35). Note that Whewell formulated the condition of balanced trade for imports and exports of any number of commodities, but *exclusive* of gold or money. Whewell's explication of his fourth postulate is interesting, for two reasons. On the one hand, it shows that he correctly perceived that Ricardo had focused attention on a long-period position in a trade equilibrium, where the quantities supplied are fully adapted to those demanded. On the other hand, however, he failed to notice that the rate of profit and thus also the long-period prices are affected when the imported goods are necessary commodities. Whewell observed:

Let *p* be the price at which cloth can be imported into Chili from England, with English profits. Then it is here supposed that *p* is the price at which it is there sold, though it may for a time be sold for a higher price from the demand being active, or for a lower price, the supply being excessive. The gradual extension of demand, and the fluctuations and miscalculations of supply, though causes of perpetual and powerful operation, are left out of consideration, as not effecting that condition of equilibrium to which our investigations here refer. The estimation of these alternations, indeed, appears to be a fitter employment for the practical merchant, than for the reasoning of the theoretical economist. ([1831] 1971: 36)

Note that the price of English cloth in "Chili" is supposed to be determined by two conditions. It is the price at which the cloth

(i)   can be exported 'with English profits'; i.e., the English merchant is supposed to buy cloth from British producers at its long-period price of production and to obtain normal profits on the advanced capital (production costs plus costs of carriage and transport); and

(ii)   can be sold in Chili when its supply is fully adapted to the demand for it.

In the following, Whewell then sought to analyse the adjustment process towards a situation of balanced trade, starting out from an arbitrary situation of unbalanced trade (an English trade surplus), by calculating the price changes in England which emanate from the inflow of gold, making use of his simplifying assumption of proportionality between changes in money prices and in the additional quantity of gold. However, in this calculation Whewell assumed, wrongly, that 'the prices of imported commodities are not affected by this change, for the foreigners will be content with a remunerating money price, and will be prevented by their own competition from obtaining more' ([1831] 1971: 39). To be sure, Whewell rightly insisted that the general rise of prices in England does not change the production costs and therefore the prices of imported commodities, but he overlooked that the inflow of gold in England must be attended by an outflow of gold in the foreign country, and thus by a fall in the general level of prices there, thus lowering also the production costs and the prices of England's import goods. Although clearly defective, Whewell's attempt to 'model' the adjustment process towards a situation of balanced trade on the basis of the specie-flow mechanism without bringing in

"demand" explicitly can be seen as an interesting alternative to the path pursued by John Stuart Mill.[10]

4. The error in Mill's exposition in the first two editions of the *Elements*

In order to trace the developments which led to John Stuart Mill's introduction of reciprocal demand analysis, we must briefly recapitulate the story of the introduction and correction of a curious error in James Mill's exposition of the comparative advantage theory in the first two editions of his *Elements of Political Economy* (published in 1821 and 1824, respectively). However, before we come to this, it is apposite to draw attention to Mill's earlier article "Colony", where this error is conspicuously absent.

James Mill's article "Colony" (1818)

Interestingly, in his article "Colony" for the *Encyclopedia Britannica*, written in late 1817 and published in February 1818, James Mill explained foreign trade based on comparative advantage and the division of the gains from trade by following very closely, though not entirely, Ricardo's exposition:

> Suppose that the same quantity of corn which is produced in England by the labour of 100 men, England can purchase in Poland with a quantity of cotton goods which she has produced with the labour of 90 men; it is evident that England is benefited by importing the corn and exporting the cotton goods, whatever may be the price of the cotton goods in Poland, or the cost of producing them. Suppose that the cotton goods could be produced in Poland with the labour of 85 men, that is, less than they are supposed to be produced with in England. Even that would not hinder the trade between them. Suppose that the same quantity of corn, which is raised in England with the labour of hundred men, is raised in Poland with the labour of 80; in that case, it is plain, that Poland can get with 80 men's labour, through the medium of her corn, the same quantity of cotton goods which would cost her the labour of 85 men, if she was to make them at home. Both nations, therefore, profit by this transaction; England to the extent of 10 men's labour, Poland to the extent of 5 men's labour; and the transaction, in a state of freedom, will be sure to take place between them, though England is less favourably situated than Poland with regard to both articles of production. (Mill 1818: 269)

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[10]   In a previous paper Whewell ([1829] 1971) had in fact already introduced the concept of demand elasticity in the context of a critical discussion of Ricardo's theory of agricultural improvements.

In this passage James Mill correctly stated the division of the gains from trade by starting out, like Ricardo, from given amounts of the goods traded and given terms of trade, and by simply subtracting the relevant numbers. Unlike Ricardo, however, Mill specified his example in terms of cloth and *corn*, that is, a 'necessary' commodity, whose importation must affect the money wage rate and the rate of profit in England, – a complication that Ricardo had skillfully avoided.[11]

The error in James Mill's *Elements*

In his essay "Of the Laws of Interchange between Nations" J. S. Mill stated that Ricardo had committed an error in his exposition of the comparative advantage theory, because he had 'unguardedly expressed himself as if each of the two countries making the exchange separately gained the whole of the difference between the comparative costs of the two commodities' ([1844] 1967: 235). He then illustrated "Ricardo's error" in the following terms:

> Suppose ... that 10 yards of broad cloth cost in England as much labour as 15 yards of linen, and in Germany as much as 20. If England sends 10 yards of broad cloth to Germany, and is able to exchange them for linen according to the German cost of production, she will get 20 yards of linen, ..., and will gain ... 5 yards on every 15 ... But in this case ... Germany ... derives no advantage from the trade. So, on the other hand, if Germany sends 15 yards of linen to England, and finding the relative value of the two articles determined in that country determined by the English costs of production, ... Germany now gains 5 yards ... But in this case, England would gain nothing. ([1844] 1967: 235-6)

Somewhat patronizingly, he added: 'This ... was not an error, but a mere oversight of Mr. Ricardo' ([1844] 1967: 235-6). But the curious fact is, as Sraffa (1930) has shown long ago,[12] that no such error or oversight is to be found in Ricardo. However, in the

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[11] Interestingly, George Grote, one of J. S. Mill's co-workers in the discussions of political economy, in March 1819 wrote a manuscript on "Foreign trade" of some 12 pages, which he presented to Ricardo, and which was found with the "Ricardo Papers" in 1930 (see Thweatt 1976: 232n). Although Thweatt announced its publication, the Grote manuscript has not been published. The manuscript could be interesting, because it might show how Grote explained Ricardo's theory *before* the first edition of James Mill's *Elements* came out in 1821.{CHECK: Grote Ms in "Ricardo Papers" at CUL}

[12] In the Sraffa Papers is a letter from Sraffa to Viner, dated 17 May 1932, which contains the following passage: 'I was delighted to receive the offprint of your review of Angell, both for the convenience of having it separately, and for the opportunity it has given me of reading it again after several years. Had Einandi

first edition of James Mill's *Elements* the explanation of the division of the gains from trade contained an error similar to the one J. S. Mill had attributed to Ricardo. In Section IV of Chapter III is an example similar to the one in the "Colony" article, with England and Poland exchanging cloth and corn with each other, but expressed in terms of unit labour requirements and with an erroneous attribution of the entire gains from trade to each of the two countries (1821: 85-6). In the second edition of the *Elements* this example was retained, together with the error, but in addition J. S. Mill's "classic" example for illustrating the comparative advantage theory stated in terms of broadcloth and linen exchanged between England and Germany appeared in this edition as well, containing the identical error with regard to the division of the gains from trade (1824: 118-9).[13] This error was first corrected in the third edition of the *Elements*, where it is stated that 'the result of competition would be to divide the advantage equally' between the two countries ([1826] 1844: 122).

As Sraffa (1930) has pointed out, the story of the error's detection and correction has been related by J. S. Mill himself, in the account he gave in his *Autobiography*: Between 1825 and 1828 J. S. Mill's "study group", which included inter alia George Grote, George Graham, and William Ellis, met regularly in George Grote's house to critically examine a number of philosophic and economic texts. The first text they considered in 1825 was James Mill's *Elements*, and J. S. Mill later explained that the 'theory of International Values which I afterwards published, emanated from these conversations' ([1873] 1965: 123). Initially, Mill had collaborated with George Graham on further developing Ricardo's analysis of profits and of foreign trade:

> But when my expositions of them came to be written I found I had so much overestimated my agreement with him, and he differed so much ... on International Values, that I was obliged to consider the theory as now published exclusively mine. ... I may mention that among the alterations which my father

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{*sic*} and myself had it in mind in 1929-30, we should have saved a good deal of space to the Harvard Quarterly; for you had already settled the point we were disputing about' (D3/11/74: 13). The reference is to Viner's review (1926) of Angell (1926), in which Viner had already shown that Ricardo had not committed the error attributed to him by J. S. Mill.

[13] Mill's "cloth-linen example" with England and Germany as trading partners was subsequently adopted also by J. S. Mill in his essay of 1844 and in Chap. 18 of his *Principles*, and then by many authors, including Marshall ([1879/1930] 1974). Sraffa (1930: 540n) had surmised, apparently without having inspected a copy of the 2nd edition, that this example 'seems to have been first inserted in the correction of the 3rd ed. of the *Elements*'.

made in revising his *Elements* for the third edition, several were founded on criticisms elicited by these Conversations; and in particular he modified his opinions (though not to the extent of our new speculations) on both the points to which I have adverted. ([1873] 1965: 125)

We know, then, that the error in the first two editions of James Mill's *Elements* was detected and corrected by J. S. Mill (and his co-workers) in 1825.[14] It is still an open question, however, by whom the error was initially introduced into James Mill's 'school-book' on political economy. Thweatt (1987) has argued that the erroneous attribution of the gains from trade was in fact introduced not by James, but by the young John Stuart Mill. Although the evidence he presented in support of this conjecture is not fully conclusive, it seems rather plausible, and certainly cannot be dismissed out of hand.[15] Thweatt, however, was unaware of the "Sraffa-Ruffin" reading of Ricardo's example and therefore failed to see the wider implications of his findings.[16] If his conjecture can be confirmed, it would mean that J. S. Mill's introduction of reciprocal demand analysis into Ricardo's theory of foreign trade has emanated from his own misunderstandings of latter's exposition. Or, to put it differently: Before reciprocal demand could be introduced into the classical theory of international values, Mill first had to make room for it by re-interpreting Ricardo's

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[14] Viner ([1937] 1975: 446) noted that the error had been corrected also in a paper by Ellis, published in 1825: 'Another co-worker of J. S. Mill's, William Ellis ["Exportation of Machinery", Westminster Review III (1825), 388-9], early in the same year, had presented an arithmetical illustration similar to those used by James Mill, and had concluded therefrom that the gain would be equally divided between the two countries. It seems, therefore, that the error was detected at about the same time by several members of the group.'

[15] Thweatt provides circumstantial evidence to show 'that the initial draft of the *Elements* was written by John, not his father', 'that it was John who checked the manuscript in 1821, just prior to publication', and 'that it was the young John, not James Mill, who revised the chapter on "Foreign Trade" … when a second edition of the *Elements* was prepared' in 1824 (1987: 36-8). The evidence assembled by Thweatt, together with the fact that James Mill's explanation of the division of the gains from trade in his "Colony" article did not contain the error of the first two editions of the *Elements*, makes it very likely that it was indeed J. S. Mill who introduced the error in the first place.

[16] In addition, Thweatt's 1987 paper was directed mainly towards rehabilitating James Mill: By showing that the errors had been introduced not by James but rather by John Stuart Mill, Thweatt sought to support his rather idiosyncratic hypothesis, which he had advanced in a previous paper (Thweatt 1986), that James Mill (and not Torrens or Ricardo) was the true originator of the comparative advantage theory.

numerical example in terms of unit labour coefficients. This made it possible for him to depict the autarky price ratios as the limiting ratios of the international exchange ratio, and to introduce an analysis of the determination of the terms of trade by means of reciprocal demand.

5. John Stuart Mill's essay *"Of the Laws of Interchange between Nations"*

In his essay of 1844 J. S. Mill presented his novel approach to the determination of international values as merely filling a gap in Ricardo's exposition of the theory of foreign trade, which the latter had consciously and deliberately left unfilled. However, a close reading of the text reveals some cracks in the harmonious image Mill sought to convey of the relationship between his own and Ricardo's analysis.

The essay opens with an exuberant eulogy on Ricardo's contributions to international trade theory. After having expounded the principle of comparative advantage, Mill then observed that Ricardo had shown 'that the truth of the propositions now recapitulated is not affected by the introduction of money as a medium of exchange; the precious metals always tending to distribute themselves in such a manner throughout the commercial world, that every country shall import all that it would have imported, and export all that it would have exported, if exchanges had taken place … by barter' ([1844] 1967: 234). The departure from Ricardo's mode of exposition in analyzing trade imbalances and processes of adjustment in strictly monetary terms is then motivated with the following remark:

> To this branch of the subject we shall, in the sequel of this essay, return. At present it will be more convenient that we should continue to suppose, that exchanges take place by the direct trucking of one commodity against another. ([1844] 1967: 235)

Mill then put forward the (false) contention that Ricardo had omitted to determine 'in what proportion the increase of the produce, arising from the saving of labour, is divided between the two countries', and explained his omission by suggesting that Ricardo, 'having a science to create, had not time, or room, to occupy himself with much more than the leading principles' ([1844] 1967: 235). This is followed by an exposition in terms of the cloth-linen example showing that the entire gain would be wrongly attributed to each party separately when it is supposed that each country can trade at the other country's autarky price ratio, and by attributing this error to

Ricardo. It is then noted that the level of the international price ratio determines immediately also the distribution of the gains: 'If we knew what this level would be, we should know in what proportion the two countries would share the advantage of trade' ([1844] 1967: 236). After having explained that international immobility of labour and capital prevents the equalization of wage and profit rates across countries, Mill asserted:

> The principle, that value is proportional to cost of production, being consequently inapplicable, we must revert to a principle anterior to that of cost of production, and from which this last flows as a consequence,- namely the principle of demand and supply. ([1844] 1967: 237)[17]

Mill evidently was aware that he was not merely refining the classical approach to price determination, but was in fact introducing a completely new element into it:

> In order to apply this principle {of supply and demand}, with any advantage, to the solution of the question which now occupies us, the principle itself, and the idea attached to the term demand, must be conceived with a precision, which the loose manner in which the words are used generally prevents. (Mill [1844] 1967: 237)

What Mill had in mind was, of course, the introduction of an inverse relationship between commodity prices and quantities demanded, and of an endogenous determination of the latter:

> It is well known that the quantity of any commodity which can be disposed of, varies with the price. The higher the price, the fewer will be the purchasers, and the smaller the quantity sold. The lower the price, the greater will in general be the number of purchasers, and the greater the quantity disposed of. ... Whatever be the commodity – *the supply in any market being given*, there is some price at which the whole of the supply exactly will find purchasers, and no more. That, whatever it be, is the price at which, by the effect of competition, the commodity will be sold. (Mill [1844] 1967: 237-8; emphasis added)

Note that in this analysis the (total) quantities supplied are taken as given, it is the quantities demanded only which are supposed to vary with price:

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[17]   In Chap. 18 of his *Principles* Mill explicitly denied that international values are determined by cost of production: 'The values of commodities ... produced in the same country ... depend (temporary fluctuations apart) upon their cost of production. But the value of a commodity brought from a distant place, especially from a foreign country, does not depend on its cost of production in the place from whence it comes.' ([1848] 1965: 595)

> This, then, is what we mean when we say that price, or exchangeable value, depends on demand and supply. We should express the principle more accurately, if we were to say, the price so regulates itself that the demand shall be exactly sufficient to carry off the supply. (Mill [1844] 1967: 238)

As Chipman has rightly observed, 'it was implicit in {Mill's} discussion that an intermediate price ratio would necessitate complete specialization, *entailing a fixed supply of each good*; the problem was then whether there would exist a price ratio for which "the demand shall be exactly sufficient to carry off the supply"' (1965: 483; emphasis added). It should be stressed also that Mill's analysis was based on the assumption of constant returns in the production of cloth and linen, although Mill did not make this explicit and was probably not aware of it.[18]

That the adjustment to a situation of balanced trade was supposed to be achieved by variations in the quantities demanded alone becomes evident in Mill's explanation of 'an extreme case, in which the whole of the advantage resulting from the interchange, would be reaped by one party' ([1844] 1967: 240). According to Mill, such a case could arise when demand was supposed *not* to vary with price at all. To illustrate this, Mill started again from his example 'that 10 yards of broad cloth cost in England as much labour as 15 yards of linen, and in Germany as much as 20' ([1844] 1967: 235). By supposing that Germany's demand for cloth is fixed, and letting 'this fixed quantity be 1000 times 10 yards', the establishment of a balanced trade requires, according to Mill, that 'the demand of England for linen was reduced by the rise of its value, to the quantity which one thousand times ten yards of cloth would purchase. It might be, that to produce this diminution of the demand, a less fall would not suffice, than one which would make 10 yards of cloth exchange for 15 yards of linen. Germany would then gain the whole of the advantage, and England would be exactly as she was before the trade commenced' ([1844] 1967: 240). It is implicit in Mill's argument, of course, that specialization in England might be incomplete.[19]

What Mill had achieved by means of his reciprocal demand analysis was to have established the importance of "demand" (or "preferences") in determining international values: "Demand" matters (and within the limits set by the autarky price ratios it is indeed demand alone which matters), and this – paradoxically –

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[18]   'Production is tacitly assumed to be under conditions of constant real cost' (Viner [1937] 1975: 538). For a similar statement, see Chipman (1965: 483).

[19]   See Chipman (1965: 483).

precisely in a situation where the commodities are supposed to be produced under conditions of constant costs:

> It may be considered, therefore, as established, that when two countries trade together in two commodities, the exchangeable value of these commodities relatively to each other *will adjust itself to the inclinations and circumstances of consumers* on both sides, in such manner that the quantities required by each country, of the article which it imports from its neighbour, shall be exactly sufficient to pay for one another. ([1844] 1967: 240; emphasis added)

Before moving on to Mill's exposition of the specie-flow mechanism, it remains to note that in the essay of 1844 Mill's novel approach to the determination of international values did not really carry him very far, because he was not yet disposed to introduce any specific functional relationships between prices and quantities demanded:[20]

> As the inclinations and circumstances of consumers cannot be reduced to any rule, so neither can the proportions in which the two commodities will be interchanged. ... The advantage will probably be divided equally, oftener than in any unequal ratio that can be named; though the division will be much oftener, on the whole, unequal than equal. [1844] 1967: 240-1)

In short: Unless one is prepared to reduce the "inclinations and circumstances" of consumers to determinate rules, international values remain indeterminate and almost "anything goes" with regard to the distribution of the trade gains. All that can be said is 'that the limits within which the variation is confined are the ratio between their costs of production in the one country, and the ratio between their costs of production in the other' (Mill [1844] 1967: 240).

Next, Mill set out to examine 'whether the same law of interchange, which we have shown to apply upon the supposition of barter, holds good after the introduction of money' ([1844] 1967: 241). Supposing arbitrarily given money prices in the two countries, Mill explained in terms of the specie-flow mechanism how an export surplus or deficit must lead to further changes in the value of money in the two countries until the account balances:

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[20]   He did so, however, in the 1852 addition to chapter 18 of his *Principles*, probably by drawing inspiration from Whewell's contribution of 1850; see Chipman (1965: 484-93).

> We have thus arrived at precisely the same conclusion, in supposing the employment of money, which we found to hold under the supposition of barter. ([1844] 1967: 242).

Finally, it only remains to note that Mill showed some awareness that the analysis of the adjustment processes in real terms based on reciprocal demand is implicit in the monetary analysis. Since the quantities demanded react more or less strongly to price changes, and because greater or smaller price changes are associated with greater or smaller changes in the value of money, the extent of the gold flows between the countries gives some indication of the distribution of the trade gains:

> The greater the efflux of money required to restore the equilibrium, the greater will be the gain of Germany; both by the fall of cloth, and by the rise of her general prices. The less the efflux of money requisite, the greater will be the gain of England. ([1844] 1967: 243)

6. James Pennington's *Letter to Kirkman Finlay* (1840)

As is well-known, the error in the first two editions of James Mill's *Elements* was also noticed by James Pennington in his *Letter to Kirkman Finlay* ([1840] 1963). It is not clear when the ideas contained in this essay were first stated by Pennington, but there are various hints that this might have been already in 1825, when J. S. Mill also began to work out his novel ideas on international trade.[21] At any rate, Pennington not only recognized Mill's error in attributing the entire gains from trade to both countries separately, but he also 'seems to have been the first', says Viner, 'explicitly to point out in print that the comparative costs set maximum and minimum rates for the terms of trade, and that within these limits the operation of reciprocal demand could fix the terms of trade at any point' ([1937] 1975: 447). Accordingly, Pennington has

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[21]   Pennington tells us in the "Advertisement" on the back of the title-page that the new part of the *Letter*, which comprises his deliberations on foreign trade, was written in the early part of 1839. However, Torrens refers to 'a very curious and elaborate Critique by Mr. Pennington' already in the Advertisement of the fourth edition of his *Essay on the External Corn Trade* ([1829] 1972), dated 'February 3rd, 1827', and Richard Sayers, who re-edited Pennington's *Letter to Kirkman Finlay*, noted that although J. S. Mill is generally credited with having introduced the theory of reciprocal demand, 'it is not unlikely that he [John Stuart Mill] and Pennington (both members of the Political Economy Club) had heard each other speak on the point' (Sayers in Pennington [1840] 1963: xxxii). Moreover, when Pennington published his *Letter* in 1840 he was apparently unaware that the error had already been corrected in the third edition of Mill's *Elements*, published in 1826.

been considered as an early proponent of some of the salient ideas of J. S. Mill's essay of 1844.

However, a careful reading of Pennington's *Letter* shows that he not only pointed out - correctly - that Mill's explanation (in Section IV of Chap. III) of the division of the gains from trade *in barter terms* was erroneous, but he also stated – wrongly – that Mill had committed 'the same error' in his illustration (in Section XV of Chap. III) of the process which leads up to an equilibrium of balanced trade *in monetary terms*. After quoting in full the relevant passage in the second edition of Mill's *Elements*,[22] Pennington observed:

> In this Mr. Mill has fallen into the same error as in the former case. There is no better reason for concluding that, under the circumstances supposed, the price

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[22]   The passage reads: 'Suppose the circumstances to be such in Poland, that, if she produced corn and cloth for herself, four quarters of corn would have the same value as ten yards of cloth; of course, if she had the use of money, the price of four quarters of corn and ten yards of cloth would be the same. In England, according to the supposition, the price of four quarters of corn and that of twenty yards of cloth would be the same. ... Let us, then, suppose that, in the two countries, the price of corn is equal. If it is, the price of a yard of cloth must, in Poland, be twice as great as it is in England. In these circumstances, what will happen is obvious: the cloth, which is cheap in England, will go to Poland, where it is dear; and there it will be sold for gold, because there can be no counter importation of corn, which, by supposition, is already as cheap in England as in Poland. By the importation, in this manner, of English cloth into Poland, gold goes out of Poland, and comes into England. The consequence is, that gold becomes more plentiful in England, less plentiful in Poland. From this first consequence a second ensues, that prices gradually rise in England, fall in Poland: the price of corn, for example, and, along with it, the price of cloth, rise in England, fall in Poland. If, when we suppose the traffic to begin, the price of corn in each country is 1*l.* per quarter, the price of cloth being, by consequence, in Poland 8*s.*, in England 4*s.* per yard, the supposed exchange of cloth for gold will gradually, in England, raise the price of corn above, in Poland sink it below, 1*l.* per quarter: raise the price of cloth in England above 4*s.* per yard, sink it below 8*s.* per yard in Poland. In this manner, the price of corn in the two countries gradually receives from equality, the price of cloth gradually approaches it. At a certain point in this progress, corn becomes so dear in England, and cheap in Poland, that the difference in price will pay for the cost of carriage. At that moment a motive arises for the importation of corn into England; and prices regulate themselves in such a manner, that in England corn is dearer than in Poland, by the expense of carrying corn; cloth is dearer in Poland than in England, by the expense of carrying cloth, from the one country to the other. At this point, the value of the cloth imported into the one country, and that of the corn imported into the other, balance one another. The exchange is then at par, and gold ceases to pass.' (Mill 1824: 38-9; quoted in Pennington [1840] 1963: 37-9)

of cloth in England will rise only a little above 4*s*. per yard, and thus enable Poland to obtain nearly twenty yards of cloth for four quarters of corn, than for concluding that cloth will fetch nearly 8*s*. per yard in Poland, and thus enable England to obtain nearly eight quarters of corn for twenty yards of cloth. Poland can afford to give, in the way of barter, eight quarters of corn for twenty yards of cloth. The result would probably be, that the terms of the interchange would fluctuate between these extremes, and that money prices would adjust themselves accordingly. ([1840] 1963: 39)

But Mill's explication of the process that leads from autarky to balanced trade is indeed fully correct: Pennington had apparently failed to notice that Mill's statement that English cloth can be sold in Poland at 8*s*. per yard (that is, at the autarky money price in Poland) is not referring to the situation of balanced trade, but rather to the situation immediately after the opening of trade.

Viner's statement quoted above seems to suggest that Pennington pursued the same line of reasoning as J. S. Mill in trying to find a rule for determining the terms of trade. However, this is not true, because Pennington, unlike Mill, did not set out his argument in barter terms and did not introduce any functional relations between prices and quantities demanded. He rather sought to analyze the problem of the determination of the terms of trade by first restating Mill's example in monetary terms:

> The case may be more commodiously and more concisely stated as follows. England can produce four yards of cloth at the same cost of labour at which she can produce one quarter of corn: Poland can produce only two[23] yards of cloth at the same cost of labour as that at which she can produce one quarter of corn. Before the traffic between the two countries begins, the price of corn in England is 60*s*. per quarter, in Poland 40*s*. per quarter. The price of cloth in England is 15*s*. per yard, in Poland 20*s*. per yard. ([1840] 1963: 40).

Pennington then proceeded to argue that, starting out from a no-trade situation with the above money prices prevailing in the two countries, the entire gains from trade cannot possibly go to both countries simultaneously:

> Under these circumstances, the people in England say, "Open the trade with Poland, and we shall be able to buy corn at 40*s*. per quarter, and to sell our cloth at 20*s*. per yard." The people of Poland say, "Open the trade with England, and we shall be able to sell our corn at 60*s*. per quarter, and to buy cloth at 15*s*. per yard." It is obvious that both parties cannot be right in their anticipations, and

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[23] In the specification of his numerical example Pennington obviously committed an error, because he has 'three' instead of 'two' here; see also Thweatt (1987: 42, note 5).

the question is, at what point the barter of cloth for corn, and the prices accommodated to that barter, will settle on the opening of trade. ([1840] 1963: 40)

Pennington suggested that the answer to this question must depend on the "strength of demand" existing in each of the two countries for the other country's product:

> I apprehend that the point will depend on this circumstance, namely, whether the demand in England for corn is so strong as to raise the price of corn in Poland from 40*s*. to 60*s*. per quarter; or the demand in Poland for cloth so strong as to raise the price of cloth in England from 15*s*. to 20*s*. per yard. … The probability is, that the barter point would shift and vary between the extremes above mentioned. ([1840] 1963: 40-1)

Although the "strength of demand" is here introduced as an argument into the determination of international values, this is not done in barter terms, but in monetary terms. In the following, Pennington reverted even more closely to Ricardo's mode of exposition in his argument: The quantity of corn demanded by England is taken as given and the quantity supplied is supposed to be fully adapted to it. According to Pennington, a uniform international price of corn could then be brought about only through changes in the distribution of the precious metals:

> If, under the circumstances which I have supposed, we should habitually import three millions of quarters of grain yearly, we might so far fall back upon land of superior fertility as to produce corn at home, with that capital which pays no rent, at 56*s*. per quarter; and that the corn exporting countries would so far advance upon inferior soils, as to increase the money cost of growing corn abroad 4*s*. per quarter. There would still be a difference of 12*s*. between the foreign and the home price. How is that difference to be extinguished?
>
> It appears to me, that if a perfectly free trade in corn were established the difference in question could be extinguished only by a new distribution of the precious metals … the foreign price of corn must rise to the English price, or the English price must fall to the foreign price, or the two prices must meet at some intermediate point. If the importing price should rise to the price at which the English corn can be grown … then the money wages of labour, and of all commodities in the corn exporting country, must rise in the same proportion. But such a rise of general prices cannot take place without an increase in the quantity of money. ([1840] 1963: 47-8)

To sum up, Pennington had noticed Mill's error in the second edition of the *Elements* (1824) and in his attempt to rectify it he sought to bring together the new elements introduced in Mill's exposition with some of the elements in Ricardo's exposition. From the former, he took over the specification of the numerical example in terms of labour requirements per unit of output (or, alternatively, in output quantities per unit of labour), which allowed him to point out that the limiting ratios are given by the

autarky price ratios. On the other hand, however, in using the cloth-corn rather the cloth-linen example, he did not suppose commodities to be produced under conditions of constant costs. Moreover, Ricardo's exposition induced him to set out his analysis in monetary terms and to give a role to the specie-flow mechanism in the establishment of a position of balanced trade. Finally, unlike J. S. Mill, Pennington did not introduce any functional relations between prices and quantities demanded and did not envisage a determination of the equilibrium terms of trade in pure barter terms.

7. Concluding remarks

In his overall assessment of the classical theory of foreign trade, which he tended to associate first and foremost with Ricardo, Jacob Viner has stressed the priority of the analysis in monetary terms, and characterized the role of the analysis in barter terms as follows:

> For all the classical writers it was common doctrine … that under free trade, and in the absence of transportation costs, prices of identical internationally-traded commodities would be uniform in all countries when expressed in the same currency. It was also common doctrine that the prices of commodities produced within a country would be, or would tend to be, proportional to their money costs of production, that differences in supply prices would be the immediate determinant of the course of trade, and, therefore, that differences in money costs of production determined the course of trade. They extended their analysis to real costs not as a substitute for analysis in terms of money costs, but in order to show that, although trade was immediately governed by price and money-cost differences, these differences in prices and money-costs reflected differences in real costs and were therefore significant for welfare appraisals. The real-cost analysis was intended, therefore, to give significance to the analysis in pecuniary terms, and not to replace it. ([1937] 1975: 483)

With John Stuart Mill's determination of international values by means of reciprocal demand, real-cost analysis indeed began to replace the analysis in pecuniary terms. What had both induced and enabled Mill's introduction of his demand analysis into the determination of international values was precisely the misreading of Ricardo's numerical example in terms of unit labour coefficients, which entailed the assumption of constant production costs and given autarky price ratios, in the first two editions of his father's *Elements*.

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