

Title: Ricardo's numerical example versus Ricardian trade model: A comparison of two distinct notions of comparative advantage

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Abstract

The so-called *Ricardian* trade model of contemporary economic textbooks is not a rational reconstruction of Ricardo's famous numerical example in chapter seven of the *Principles*. It differs from the latter in terms of definition of the four numbers, relevant cost comparison, rule of specialisation, assumptions and theoretical implications. Thus, the widespread critique regarding the unrealistic assumptions of the textbook trade model does not apply to Ricardo's original proof of comparative advantage.

Keywords: comparative advantage, David Ricardo, Ricardian trade model, international trade theory, free trade

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1. Introduction

“Classic”. A book that people praise and don’t read.

Mark Twain

The so-called Ricardian model of comparative advantage, or simply Ricardian trade model, has been a main target in recent publications criticising the mainstream case for free trade.² The selection of this target by opponents of free trade is perfectly understandable. After all, this basic international trade model featuring two countries, two products and one factor of production (labour) is said to explain all by itself the virtuous of free trade and the optimal pattern of international trade. Comparative advantage has been indeed the economists’ favourite argument against protectionism during the last 150 years.

Despite the unrelenting popularity of the Ricardian trade model within the economic profession, the relatively small but growing faction of critics of this trade model does not have to fear a fierce backlash from their colleagues. After all, the majority of economists are willing to concede that it is built upon some unrealistic assumptions. Not surprisingly, the critics’ main line of attack has centred precisely on this weak spot.³ They argue that the conclusions extracted from the trade model are only valid within the narrow confines of its unrealistic assumptions. In the real world, however, the potential gains suggested by the trade model may well prove illusory. A few critics have gone as far as recommending the dismissal of the whole theory of comparative advantage, which they consider out-dated and deeply flawed.⁴

It is not my intention here to come to the rescue of the Ricardian trade model. In fact, I do largely agree with the critique directed against this trade model in recent years. My contention is rather that the critique has been unfairly extended to Ricardo, because most scholars do not distinguish accurately between the numerical example in chapter 7

² See Reinert (2007) for a particularly fierce attack on Ricardo’s theory of comparative advantage.

³ Baiman (2010) takes a different approach. He accepts the assumptions of the basic classical model, but intends to demonstrate that its free trade conclusion is logically inconsistent. He fails to do so because he erroneously believes that Ricardo assumed that the quantity of cloth and wine produced in England and Portugal are equal, and misinterprets other aspects of Ricardo’s numerical example as well.

⁴ See, for example, Schumacher (2013).

of his magnum opus *On the Principles of Political Economy and Taxation* (1817), and trade model of contemporary economic textbooks. Indeed, a majority of critics do not make any distinction at all between the two.⁵ A few others, while acknowledging some minor differences, fail to realise that Ricardo's original proof of comparative advantage does not require any of the unrealistic assumptions of the textbook trade model.⁶ A third group of scholars wrongly claim that at least a few of the criticised assumptions can also be found in the *Principles*.⁷

The ongoing practice of designating the textbook trade model as *Ricardian* stands in the way of an accurate distinction between the two.⁸ This designation has certainly misled many economists into thinking that the textbook trade model they encountered during their undergraduate studies was a sort of modern translation or rational reconstruction⁹ of the famous numerical example in the *Principles*. Once a particular meaning or interpretation of a theory has taken root in a scholar's mind, it is quite difficult to alter it afterwards. So it is not surprising at all to find out that most of them still cling to this misconception. Nobel-laureate economist George Stigler once offered the following explanation for the difficulty of correcting the widespread misinterpretation of Ricardo's labour theory of value: "The basic reason Ricardo's theory is often misinterpreted is that it was often misinterpreted in the past. If a theory once acquires an established meaning, each generation of economists bequeaths this meaning to the next, and it is almost impossible for a famous theory to get a fresh hearing" (Stigler 1958, p. 367). The very same can be affirmed with respect to Ricardo's numerical example. Only that in the case of comparative advantage, the chances of getting a fresh hearing

⁵ See Driskill (2012), Gonzalez (2006), Prash (1996), Felipe and Vernengo (2002), Reinert (2007), Skarstein (2007) and Bouare (2009), in no particular order.

⁶ See, for example, Fletcher (2011).

⁷ See Duffield (2010) and Schumacher (2013).

⁸ This longstanding tradition has remained unaltered until the very present, as a brief look into today's most popular textbooks on international economics reveals (Carbaugh 2008; Krugman et al. 2012; Feenstra & Taylor 2014; Thompson 2011 and Salvatore 2013).

⁹ Mark Blaug (2001) describes the concept of rational reconstruction as an exercise of "(...) dressing up past ideas in modern garb, often in the form of mathematical models that look just like something that might have appeared in the latest issue of the *American Economic Review* or the *Journal of Political Economy*" (p. 150).

might be even slimmer, since this concept is firmly embedded into mainstream international trade theory.

I am perfectly aware of the fact that it is always a daunting task in academia to go against an established meaning of a famous theory like comparative advantage, which is considered by many as one of the crown jewels of the economic profession (Rodrik 1998, p. 3). Looking at the growing number of critics and the many misinterpretations currently attached to it, though, it might well deserve the effort. The most famous numerical example in the economic science seems to be in desperate need of a fresh hearing.

Luckily, the present paper is not the first in recognising that the textbook trade model differs from Ricardo's numerical example.¹⁰ Well-known popularisers of the correct interpretation of the four numbers in the *Principles* like Roy Ruffin and Andrea Maneschi have already highlighted some differences regarding the terms of trade (Ruffin 2002), the calculation of the gains from trade (Maneschi 2004) and the degree of specialisation (Maneschi 2008). John Pullen (2006) also preceded this paper in making a comparison between Ricardo's statement of comparative advantage and the Ricardian trade model, which he refers to as the "modern version of the law of comparative advantage". Although I agree with Pullen's conclusion that Ricardo did not conceive the comparative-advantage proposition as an economic law that determines international specialisation and the geographical location of industries¹¹, I disagree with his interpretation of the purpose and content of the numerical example in the *Principles*. Neither of the two propositions Ricardo announced and proved there – the non-appliance of the labour theory of value in international exchanges and comparative advantage – were intended as a practical guide or a piece of commercial advice for commodity traders, as Pullen (2006, p. 60) suggests.

Notwithstanding these occasional recognitions of some differences between the textbook trade model and Ricardo's numerical example, the vast majority of economists

¹⁰ See Parrinello (1988) for an early attempt of distinguishing between Ricardo and the Ricardian trade model.

¹¹ See also Aldrich (2004).

still consider the former as an accurate rational reconstruction of the latter. Even Ruffin and Maneschi hold tenaciously to this view. Ruffin (2002) declared in his influential paper that “it is important to begin with a modern statement of Ricardo’s law of comparative advantage to fully appreciate Ricardo’s own statement” (p. 729), while Maneschi (2008) suggested that Ricardo would have explained comparative advantage quite differently had he known the standard tools and graphical techniques of neoclassical economics. Both seem to be more interested in reconciling Ricardo’s original proof of comparative advantage with modelling assumptions and analytical results of neoclassical trade theory than in highlighting the significant differences with respect to the textbook trade model.¹²

A central purpose of this paper is to demonstrate that the textbook trade model cannot be considered as an accurate rational reconstruction of Ricardo’s numerical example. In order to fundament this assertion, I will highlight some essential differences between them, putting emphasis on the distinct set of assumptions. The highlighted differences have been overlooked until now because of the enduring practice of interpreting Ricardo’s numerical example almost exclusively through the lenses of the textbook trade model. In a deliberate break with this tradition, the paper will take as point of departure what he actually wrote in the *Principles*, while putting aside as much as possible the features associated with the mainstream notion of comparative advantage. Furthermore, I will explain how the misinterpretation of the relationship between comparative advantage and the labour theory of value led to crucial reformulations of Ricardo’s original proof during the 1920s and 1930s. This novel methodological approach allows for a sharper distinction between the numerical example in the *Principles* and the textbook trade model, which is perhaps the most important accomplishment of the present paper with respect to its predecessors.

The paper is structured as follows. It starts with a brief summary of the original purpose and content of Ricardo’s numerical example. The next section is devoted to highlighting the main differences between the numerical example in the *Principles* and the textbook trade model of comparative advantage. Besides the diverging definitions of

¹² See Gehrke (2015).

the four numbers, they also feature different rules of specialisation, which in some cases suggest opposing conclusions regarding the beneficial nature of an exchange. The following section shows that three well-known assumptions of the textbook trade model are not required in Ricardo's original proof of comparative advantage. After briefly mentioning a few commonalities, the last section before the conclusions analyses the main advantages of Ricardo's numerical example over the textbook trade model.

2. An accurate interpretation of Ricardo's numerical example

Ricardo announced in chapter seven of the *Principles* that "the same rule which regulates the relative value of commodities in one country, does not regulate the relative value of the commodities exchanged between two or more countries" (Vol. 1, p. 133). Thus, he explicitly limited the validity of his labour theory of value to exchanges within national borders. A few paragraphs later, Ricardo proceeded to illustrate this proposition with a simple numerical example featuring the exchange of English cloth and Portuguese wine. In accordance with the announced proposition, he stated: "The quantity of wine that she [Portugal] shall give in exchange for the cloth of England, is not determined by the respective quantities devoted to the production of each, as it would be, if both commodities were manufactured in England, or both in Portugal" (Vol. 1, pp. 134-135).

The four numbers in the famous example should be correctly interpreted as the quantity of men working for a year required to produce some unspecified amounts of cloth and wine traded between England and Portugal.¹³ This accurate interpretation of the four numbers debunks charges of logical inconsistency and incompleteness made by scholars who misinterpreted them as quantities of labour necessary to produce a single unit of cloth and wine in the two countries.¹⁴

¹³ In recent years Ruffin (2002) has been quite successful in spreading the correct interpretation of the four numbers, after previous attempts were largely ignored by most scholars. Back in 1930 Sraffa already presented a table in which Ricardo's four numbers were defined as "number of men whose labour is required for one year in order to produce a given quantity of cloth and wine" (Sraffa 1930, p.541).

¹⁴ See, for example, Chipman (1965, p.479).

Moreover, Ricardo selected the four numbers quite smartly so he could also demonstrate that “this exchange might even take place, notwithstanding that the commodity imported by Portugal could be produced there with less labour than in England” (Vol. 1, p. 135). England saves the labour of 20 men working for a year by importing the wine from Portugal instead of producing it internally, while Portugal gains the labour of 10 men by importing the cloth. Therefore, each country has an interest, completely independent from the other, in the featured exchange. With an astonishingly simple numerical example, thus, Ricardo managed to prove that a country might import a certain quantity of a commodity although it could produce it internally with less amount of labour time than the exporting country, and that such an exchange would be beneficial for both trading partners. In close correspondence with what is written in the *Principles*, the term “comparative advantage” will be used as a shorthand expression for this proposition throughout the paper.

Although it is this ingeniously simple proof of comparative advantage which made the numerical example so famous afterwards, strong evidence suggests that Ricardo himself considered the proposition regarding his value theory as the main insight he wanted to illustrate with the exchange of English cloth and Portuguese wine. First, the so-called comparative-advantage section¹⁵ in the *Principles* actually starts with the value proposition, and approximately half of the section is dedicated to explain the assumption of relative capital-immobility between countries, which Ricardo identifies as the main cause for the non-appliance of the labour theory of value in international exchanges¹⁶; second, this interpretation offers a plain explanation for why Ricardo only mentioned labour-time requirements in the numerical example; third, immediately after illustrating that the relative value of commodities exchanged between two or more countries is not regulated by the respective amounts of labour time necessary for their production, Ricardo announces a rule for price-determination in international

¹⁵ According to Sraffa, (Vol. 1, Introduction, xvii), this section starts in page 133 (third paragraph) and ends in page 137 (first paragraph).

¹⁶ See also Ruffin (2002, p. 734).

transactions¹⁷; and last but not least, it would have been simply impossible for him to prove the comparative-advantage proposition in a mutually beneficial exchange without contradicting his labour theory of value.¹⁸

I have already illustrated the last affirmation in a previous paper using specific numbers.¹⁹ Since the role of the value proposition in Ricardo’s numerical example is still the subject of debate among scholars²⁰, it might be necessary here to demonstrate in a more general way – that is, for any combination of numbers – that one cannot prove the comparative-advantage proposition in a mutually beneficial exchange within the framework of the labour theory of value. For this purpose, let us reformulate Ricardo’s numerical example using parameters as labour-time requirements instead of specific numbers. England is exporting a certain amount of cloth to Portugal in exchange for a certain amount of wine. The parameters C_e , W_e , C_p and W_p indicate the number of men working for a year required to produce these unspecified amounts of cloth and wine traded in the respective countries.

	Cloth	Wine
England	C_e	W_e
Portugal	C_p	W_p

Table 1: A general formulation of Ricardo’s numerical example.

¹⁷ He stated: “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” (Vol. I, p. 137).

¹⁸ It seems that Ricardo was well aware of this, as he wrote in the paragraph immediately after the numerical example: “Thus England would give the produce of the labour of 100 men, for the produce of the labour of 80. Such an exchange could not take place between the individuals of the same country. The labour of 100 Englishmen cannot be given for that of 80 Englishmen, but the produce of the labour of 100 Englishmen may be given for the produce of the labour of 80 Portuguese, 60 Russians, or 120 East Indians. The difference in this respect, between a single country and many, is easily accounted for, by considering the difficulty with which capital moves from one country to another, to seek a more profitable employment, and the activity with which it invariably passes from one province to another in the same country” (Vol. 1, pp. 135-136).

¹⁹ See Morales Meoqui (2011, pp.754-755).

²⁰ See, for example, Faccarello (2015, pp. 762-764).

For England to be interested in importing a certain quantity of wine from Portugal in exchange for some quantity of cloth, the exchange has to satisfy the classical rule for specialisation. This rule stipulates that the amount of labour time embodied in the quantity of cloth exported (C_e) has to be less than the amount of labour time required for the internal production of the imported quantity of wine (W_e), or $C_e < W_e$. For Portugal to also gain from this exchange, the condition $W_p < C_p$ has to be fulfilled. For the featured international exchange to continue over a prolonged period of time, the classical rule of specialisation has to be fulfilled in both countries simultaneously.

If the labour theory of value would regulate the relative value of these commodities, the amount of labour time embodied in the respective quantities of cloth and wine traded would have to be the same, or $C_e = W_p$. Making the corresponding substitutions in the two inequalities mentioned in the above paragraph, we obtain $W_p < W_e$ and $C_e < C_p$.

In order to prove the proposition that Portugal would import a certain quantity of cloth from England despite the fact that it could produce the cloth internally with less amount of labour time, however, it must be that $C_p < C_e$. Therefore, if both countries were to gain from this exchange, Ricardo could not have proven the comparative-advantage proposition without contradicting his value theory. Thus, the proposition about the non-appliance of the labour theory of value in international trade is indeed crucial for the logical construction of Ricardo's numerical example.

Contrary to what many believe nowadays, Ricardo's insights do not refute the notion that a foreign commodity has to be cheaper than a domestic commodity of similar quality in order to get imported. This intuitive notion remains valid, as Ricardo himself stated: "The motive which determines us to import a commodity, is the discovery of its relative cheapness abroad: it is the comparison of its price abroad with its price at home" (Vol. I, p. 170). The confusion in this respect may have originated because most explanations of comparative advantage in today's economic textbooks completely omit to mention Ricardo's proposition about the non-appliance of the labour theory of value in international exchanges. If the law of value would regulate international exchanges, the English cloth embodying the labour time of 100 men would have to have a higher exchange value and presumably also superior money costs of production than the

Portuguese cloth, which contains the labour of only 90 men. In that case, however, the pricier English cloth would not be exported to Portugal. Since the law of value does not apply to exchanges between countries, though, one cannot presume that higher labour-time requirements necessarily imply superior money costs of production.

This brief summary of the purpose and content of Ricardo's numerical example follows rather closely what is written in the *Principles*. Notwithstanding, some aspects of this resume may sound quite unfamiliar to those who have learned the concept of comparative advantage from contemporary economic textbooks instead of the original source. The significant differences between Ricardo's numerical example and the textbook trade model are due to the fact that the current formulation of the latter is mostly the result of a debate among economists about the content and validity of the theory of comparative advantage during the 1920s and 1930s. This debate was very much influenced by crucial misinterpretations of the numerical example in the *Principles*, which led the participants to propose significant alterations to Ricardo's original proof of comparative advantage, as the following section will show.

3. Three mayor differences between Ricardo's numerical example and the Ricardian trade model

3.1. Diverging definitions of the four numbers

The most obvious difference between Ricardo's numerical example and the typical textbook trade model is of course the definition of the four numbers. They are defined in the textbook trade model as the quantities of labour required for producing a single unit of cloth and wine in the respective countries. During the 1920s and 1930s many influential economists erroneously believed that this definition of the four numbers also corresponded to the famous example in the *Principles*.²¹

²¹ Gottfried von Haberler (1936), for example, begins his analysis of the theory of comparative cost by asserting the following: "In chapter VII of his *Principles* he [Ricardo] gives the following celebrated example: In England a unit of cloth costs 100 and a unit of wine 120 units of labour; in Portugal a unit of cloth costs 90 and a unit of wine 80 units of labour" (p. 128). Jacob Viner (1937, p. 445) presents a table containing the same four numbers, described as the amounts of "labor required for producing a unit" of cloth and wine in UK and Portugal. This misinterpretation of Ricardo's numbers proved to be quite enduring, since Samuel Holander (1979) defined Ricardo's numbers more than forty years later as follows: "Input per unit of cloth and wine

Taking unit labour-time requirements as basis for the numerical proof of comparative advantage, has an immediate implication: one has to assume that they remain constant irrespective of the amounts of commodities produced. Otherwise, it would be impossible to calculate the respective quantities of labour time embodied in the commodities exchanged, since countries usually trade more than a single unit of any commodity in a typical trade bundle. Without this calculation, though, one cannot estimate the gains from trade in order to ascertain whether a country should import a certain quantity of a commodity rather than produce it internally.

As a consequence of the longstanding and widespread misinterpretation of the four numbers in the *Principles*, the assumption of constant unit labour-time requirements ended up being wrongly attributed to Ricardo. As I have already argued in previous occasions²², though, this unrealistic assumption is completely alien to Ricardo's economic theory. In fact, he explicitly indicated in the *Principles* that the alterations in the quantity of labour necessary to produce commodities often occur on a daily basis. This is precisely why he considered the great variations in the relative value of commodities to be produced mostly – although not exclusively – by the greater or less quantity of labour which may be required from time to time to produce them (Ricardo, Vol. 1, pp. 36-37).

3.2. Different rules of specialisation

In the numerical example in the *Principles* it is absolutely clear which numbers Ricardo compared in order to determine whether the featured exchange of cloth and wine is in the best interest of each of the participating countries. For that purpose, he made an internal comparison of labour-time requirements, comparing the quantity of labour embodied in the commodities that a country has to export in order to pay for the imported commodities, and the estimated quantity of labour required to produce the imports internally. Whenever the former is less than the latter, the exchange would be beneficial for the country. This is why he proclaimed England's interest in exporting

respectively — in terms of labour for one year — are supposed to be 100 and 120 in England; and 90 and 80 in Portugal” (p. 462).

²² See Morales Meoqui (2011, pp. 757-759; and 2014, pp. 24-25).

cloth and importing wine before even mentioning Portugal's labour-time requirements (Vol. 1, p. 135).

Ricardo did not invent the above rule of specialisation. It was repeatedly used for determining the beneficial nature of a barter trade well before the publication of the *Principles*, and continued to be used for this purpose after 1817 as well. In order to highlight its prominent role throughout the heyday of classical political economy, I have proposed to call it the *classical rule of specialisation*. This rule, though, is less conclusive for determining the beneficial nature of a barter trade when the four numbers are defined as unit labour-time requirements, and the exchange rate between cloth and wine is not specified, as it is often the case in textbook trade models. The mere fact that in England it may require less quantity of labour to produce a single unit of cloth than a bottle of wine is hardly a sufficient criterion for making the cloth at home rather than importing it, unless one also assumes that the exchange ratio between the two commodities is always 1:1.²³

Therefore, the misinterpretation of Ricardo's numbers made it necessary to find a new way of determining a country's comparative advantage. Echoing Haberler (1930, p. 352) and others, Viner argued that one should not compare costs but "(...) *ratios between costs*, and it is unessential whether the cost ratios which are compared are the ratios between the costs of producing different commodities within the same countries, or the ratios between the costs of producing the same commodities in different countries" (Viner 1932, p. 357). Thus, the comparison of cost ratios led to a legitimization of the external cost comparison, although Ricardo regarded the latter as irrelevant for determining the beneficial nature of a barter trade between countries.²⁴

From that moment on until the very present, the comparison of cost ratios has been the predominant method for determining the comparative advantage of a country in the

²³ Viner (1932, p. 363) indeed believed that Ricardo set the exchange ratio at one cloth for one wine.

²⁴ See Ricardo (Vol. 2, p. 383).

economic literature.²⁵ Under this method England has to know Portugal's labour-time requirements in order to find out its own comparative advantage, and vice versa. This is also expressed quite clearly in the corresponding rule of specialisation derived from the comparison of cost ratios. According to this rule, each country "exports the good in which it has the smallest absolute disadvantage or the largest absolute advantage" (Ruffin 2005, p. 718). Likewise, Felipe and Vernengo (2002, p. 51) stated: "The first nation should specialize in the production and export of the commodity in which its absolute disadvantage is smallest (this is the commodity in which it has a comparative advantage) and import the commodity in which its absolute disadvantage is greater (this is the commodity of its comparative disadvantage)." Like in the case of other exclusive features of the textbook trade model, this rule of specialisation ended up being wrongly attributed to Ricardo.²⁶

At first sight, it seems that the textbook rule does not contradict the classical rule of specialisation used by Ricardo in the numerical example. Indeed, if one applies the textbook rule of specialisation to the four numbers in the *Principles*, it would also recommend that Portugal should produce the wine and England the cloth traded, since the former has a greater advantage in the production of wine – a 40 men advantage in wine compared to only 10 men in cloth –, whereas the latter has a smaller disadvantage in cloth. In this particular case, thus, the textbook rule would make the same recommendation as the classical rule of specialisation. With a slightly variation in the quantity of labour required to produce cloth or wine in the respective countries, though, it is quite easy to show that each rule of specialisation leads to a different conclusion with respect to the beneficial nature of the exchange of English cloth for Portuguese wine.

²⁵ According to Maneschi (2008), "the fact that $80/120 < 90/100$ shows that Portugal has a comparative advantage in wine and hence will exchange wine for cloth when trade begins" (p. 1168).

²⁶ According to Reinert (2007), "Ricardo attempted to prove that it could still be mutually beneficial for both countries to specialise and trade if each country specialised where it was relatively most efficient (or less inefficient) compared to the other country" (Appendix 1).

In order to illustrate this, let us suppose that England discovers a process of making wine that reduces the quantity of men working for a year required to produce the amount of wine traded from 120 men to just 95 men. Portugal's labour-time requirements remain the same, as it is shown in table 2.

	Cloth	Wine
England	100	95
Portugal	90	80

Table 2: A modified version of Ricardo's numerical example

According to these numbers, Portugal can still produce both the cloth and wine traded with less quantity of labour than England, and continues to be interested in the export of wine to this country, irrespective of whether one applies the classical rule of specialisation ($90 - 80 = 10$) or the comparison of cost ratios suggested by the textbook trade model ($80/95 < 90/100$). England's disadvantage is still smaller in the production of cloth, but is it in her interest to import the wine from Portugal, as the textbook rule of specialisation suggests? Ricardo would surely disagree, because England could save the labour of 5 men by starting to produce the wine internally.

I decided to modify England's labour-time requirements for producing wine because Ricardo himself wrote about this possibility in the *Principles*.²⁷ If one increases to quantity of labour required to produce the wine in Portugal to 95 men while leaving the other three original numbers in the *Principles* unchanged, the country would still have a greater advantage in the production of wine ($120 - 95 = 25$ men) compared to cloth ($100 - 90 = 10$ men) with respect to England. The comparison of cost ratios would also show that $95/120 < 90/100$, so according to the textbook rule Portugal should import the cloth from England. According to the classical rule of specialisation, however, this exchange would not be in Portugal's interest, because she could save the labour of 5 men by starting to produce the cloth internally instead of importing it from England.

²⁷ See Ricardo (Vol. 1, p. 137). Thus, the legitimate critique regarding the static approach of the textbook trade model of comparative advantage cannot be extended to Ricardo. As a matter of fact, his notion of comparative advantage can be easily integrated into Smith's dynamic framework of international trade (Morales Meoqui, 2014).

As has been shown above, thus, the rule of specialisation championed by the textbook trade model may recommend a different pattern of specialisation than the classical rule used by Ricardo in the numerical example. The importance of this new finding cannot be overstated. It means that the notion of comparative advantage currently propagated by the textbook trade model is different from Ricardo's.

Moreover, this finding deals a deathblow to the widespread belief that the textbook trade model is merely a modern version of the original numerical example. In order to counter this finding, though, defenders of this view may refer to a well-known footnote in the *Principles* which states:

It will appear then, that a country possessing very considerable advantages in machinery and skill, and which may therefore be enabled to manufacture commodities with much less labour than her neighbours, may, in return for such commodities, import a portion of the corn required for its consumption, even if its land were more fertile, and corn could be grown with less labour than in the country from which it was imported. Two men can both make shoes and hats, and one is superior to the other in both employments; but in making hats, he can only exceed his competitor by one-fifth or 20 per cent., and in making shoes he can excel him by one-third or 33 per cent.;— will it not be for the interest of both, that the superior man should employ himself exclusively in making shoes, and the inferior man in making hats? (Vol. 1, p. 136n.)

The above footnote should not be considered as Ricardo's best claim for having formulated the principle of comparative advantage, as Aldrich (2004, p. 389) erroneously states. It rather owes its popularity to the fact that it is one of the few passages of the *Principles* that can be cited in order to claim that the textbook notion of comparative advantage is similar to Ricardo's. This is precisely why some prominent supporters of this notion tend to overstate its importance.²⁸ The alleged link between the footnote and the textbook trade model is not in the first sentence, as Pullen (2006, p. 66) indicates, but in the second sentence, starting with "Two man can...", and where Ricardo appears to suggest that one should specialise in the production of the commodity in which one

²⁸ Ruffin (2002), for example, calls it a "tremendous footnote" (p. 740).

enjoys the greatest productivity advantage. Let us try to answer Ricardo's rhetorical question with the help of a numerical example.

	1 hat	1 pair of shoes
Adam	4 hours	2 hours
David	5 hours	3 hours

Table 3: A numerical example based on Ricardo's footnote

According to the numbers in table 3, Adam has a 20 % ($1-4/5$) productivity advantage over David in making hats, and a 33 % ($1-2/3$) productivity advantage in making shoes. Should Adam specialise in the production of shoes then? One cannot really answer this question without knowing the relative value of hats and shoes. If Adam still requires two hours for producing a second pair of shoes, and has to give more than two pairs of shoes in order to obtain one hat, he would be saving some labour time by making the hat instead of buying it from David.

Besides this footnote, there is not a single passage in the *Principles* that suggests that Ricardo pretended to abandon the classical rule of specialisation in favour of a new rule for international specialisation. If this were indeed his intention, then why would he relegate such an important announcement to a mere footnote? Ricardo believed that domestic and international exchanges are regulated by different value rules – not different rules of specialisation.

The original purpose of the footnote seems to be a different one. Ricardo probably anticipated that it would be quite difficult to convince some of his readers that it is indeed in Portugal's interest to import cloth although she could produce it with less quantity of labour than England. Thus, he wanted to indicate that one could already find traces of this proposition in the *Wealth of Nations*. Indeed, the first sentence of the footnote seems to refer to a paragraph (WN, I.i.4, p. 16) where Smith talks about the possibility that England might import some amount of corn from Poland despite having a productivity advantage over the latter in the production of corn. Smith explains this counterintuitive fact by pointing out that the productivity advantage of England over Poland is greater in manufactures than in agriculture, because the nature of agricultural production does not admit the same degree of subdivisions of labour than

manufacturing. Therefore, Polish corn might compete in quality and cheapness with the corn from England or France, but Poland cannot aspire to compete with English or French manufactures, at least if the manufactures suit the soil, climate, and situation of the richer countries. The second sentence of Ricardo's footnote refers to Smith's example of the shoemaker and the tailor (WN, IV.ii.11, pp. 456-457), as Sraffa already indicated in his edition of the *Principles*.

Ironically, the very same footnote which is so highly regarded by those who cling to the idea that the notion of comparative advantage propagated by economic textbooks is similar to Ricardo's, contains another significant difference between the two. The textbook trade model implies of course complete specialisation by each trading partner according to its comparative advantage. Yet Ricardo explicitly refers in the footnote to partial specialisation. Even if a country were much more advanced in manufacturing than its neighbours, it might still satisfy part of its national demand for corn by internal production. In the following page Ricardo hints again to partial specialisation when he states: "Now suppose England to discover a process for making wine, so that it should become her interest rather to grow it than import it; she would naturally divert *a portion* of her capital from the foreign trade to the home trade; she would cease to manufacture cloth for exportation, and would grow wine for herself" (Vol. I., p. 137; cursive added).

Complete international specialisation is indeed a very unlikely outcome of free trade, since it means that a country would end up completely specialised in the production and exportation of a single type of commodity, for example cloth. According to the classical rule of specialisation, a country would specialise in the production of cloth if by exporting this commodity it could procure all the other commodities demanded by its residents at lower labour-time costs than by producing them internally. Therefore, complete international specialisation is a very unlikely outcome of free trade under any realistic circumstances.

3.3. Comparative advantage determined by opportunity costs

Despite the importance that Ricardo attributed to the non-appliance of the labour theory of value in international exchanges in the original numerical example, there is usually no reference to this proposition in the typical textbook trade model. The reason for this glaring omission is worth analysing here briefly.

During the 1920s several scholars claimed that Ricardo's theory of comparative advantage had to be rejected because of its alleged reliance on the labour theory of value, which they considered out-dated.²⁹ As an indication of this presumed dependency, they refer to the fact that Ricardo stated the costs in his numerical example as units of labour-time. In this context, Austrian economist Gottfried von Haberler tried to tackle the critique – which he considered to be valid – by substituting Ricardo's labour-time requirements with opportunity costs. According to Haberler's reformulation, a country is said to have a comparative advantage in the commodity whose production entails lower opportunity costs.³⁰

Bearing the accurate interpretation of Ricardo's numerical example from the previous section in mind, it is clear now that all the participants in this odd debate – both Haberler as well as the critics – were wrong. The actual relationship between comparative advantage and the labour theory of value is in fact the complete opposite of what they presumed. Ricardo formulated his numerical example in order to illustrate that his value theory is not valid for international exchanges. As I have shown before, under the postulates of the labour theory of value it is actually impossible to prove the comparative-advantage proposition if the featured exchange had to be also mutually beneficial. Therefore, Baldwin (1982) and Bernhofen (2005) have wrongly portrayed Haberler as the economist who freed the theory of comparative advantage from its association with the labour theory of value. Haberler's alleged accomplishment was in fact a flawed response to an unfounded critique towards the original proof of comparative advantage.

Over time, the specific reason and context that led to the reformulation of Ricardo's four numbers in terms of opportunity costs was of course forgotten. And since the reformulated numerical example continued to be named after Ricardo, it was almost inevitable that the determination of comparative advantage based on opportunity costs

²⁹ See, for example, Knight (1924) and Mason (1926).

³⁰ Bernhofen (2005) states: "Haberler's new idea was to reformulate the theory of comparative advantage such that the value of good X is measured in terms of the forgone units of the production of good Y rather than the labor units that are necessary to produce good X, as in the Ricardian formulation" (pp. 997-998).

ended up being associated with him.³¹ Among the many misconceptions surrounding the famous numerical example today, this erroneous association is particularly ludicrous. It overlooks the fact that the opportunity costs approach was originally developed by Austrian economist Friedrich von Wieser as part of his marginal theory of value. Wieser explicitly conceived his value theory as an opposing view and main alternative to Ricardo's labour theory of value. It seems quite ironic and utterly disrespectful to the legacy of one of the most influential thinkers in the history of economic thought, that nowadays he is mostly remembered for an international trade model that features a rival notion to his own theory of value.

4. Three Diverging Assumptions

Since Ricardo's numerical proof of comparative advantage is based on a different logical construction and theoretical foundation than the textbook trade model, it does not require most of the assumptions of the latter. Unfortunately, this fact is often overseen by those who do not distinguish properly between the two. As a consequence, Ricardo is often accused of using unrealistic assumptions that belong rather exclusively to the textbook trade model. Since it is impossible to find unequivocal textual evidence for the use of these assumptions in the *Principles*, it has been often suggested that Ricardo made them rather implicitly.³² The truth is that he simply did not need them. In the previous section I have already mentioned that Ricardo neither assumed constant unit labour-time requirements, nor did he argue that a country would end up completely specialised in a particular commodity. In this section I will refer briefly to three additional assumptions of the textbook trade model which are wrongly attributed to Ricardo. Since the list of assumptions of the textbook trade model is quite long, it is not possible to analyse here every single one of them. Instead, I will concentrate on the most popular ones.

³¹ See, for example, Schumacher (2013).

³² Viner's following remark is typical for this unfounded imputation: "Ricardo's illustration implies a number of important assumptions which, in conformity with his usual practice, he never expressly states" (Viner 1932, p. 362).

4.1. *Zero transportation costs*

It is widely acknowledged, for example, that the textbook trade model assumes zero transportation costs.³³ This is indeed a necessary assumption if one takes unit labour-time requirements as basis for the numerical proof of comparative advantage, and further assumes that they remain constant. Taking transportation costs into account would infringe this assumption, since the cost of carriage per unit usually decreases the more commodities are transported in a single lot. To assume that the transportation costs per unit also remain constant would defy the most elementary notion of reality.

Ricardo's numerical example is not affected by these kinds of problems, since he did not make the above assumption. In fact, the cost of carriage between England and Portugal can be easily integrated into the original numerical example without any of the complications that Viner (1932, p. 373ff.) referred to, since transportation costs are usually included in the respective values of the commodities exchanged in a barter trade. This is probably the reason why Ricardo did not bother to explicitly mention the cost of carriage.

4.2. *Full-employment of the factors of production*

Another well-known assumption of the textbook trade model refers to the full-employment of the factors of production. This assumption, for example, would preclude the existence of unemployed labour.³⁴ It was introduced by Haberler's reformulation of the four numbers as opportunity costs, since it is an essential part of this approach. It is not required, though, in Ricardo's proof of comparative advantage. Even if there were 10 Portuguese men unemployed, it would make no sense from an economic point of view to produce the cloth in Portugal with the labour of 90 men if it can be procured from England with the exportation of wine that requires the labour of only 80 men. Instead of employing the 10 Portuguese men in the production of cloth, Portugal could increase the amount of goods and services available for consumption by deploying them in other occupations.

³³ See, for example, Reinert (2007).

³⁴ See, for example, Felipe & Vernengo (2002, pp. 54-55).

The same can be said of course about the 20 men's labour saved in England. In fact, more than one-hundred years before Ricardo published the *Principles*, the English journalist Henry Martyn³⁵ had already argued in his *Considerations on the East-India Trade* (1701) that it is not wise to produce with the labour of many what can be procured from abroad with the hands of a few. To refute the mercantilists' argument that England was losing employment opportunities by importing cloth from India, Martyn formulated theoretical examples in which he applied the classical rule of specialisation in order to show that no productive employment would be lost by this exchange.

For the purpose of demonstrating the absurdity of the claim, let us suppose for a moment that Ricardo assumed that there were no English and Portuguese labourers unemployed at the moment of the exchange. If this were the case, then he should have noticed that neither England nor Portugal would have had enough labourers available in order to produce internally the amounts of cloth and wine traded, so they had no other option but to procure them from abroad.

The claim that Ricardo assumed full-employment of capital is equally ludicrous, taking into account his definition of the term "capital" in the *Principles*. For Ricardo, "capital is that part of the wealth of a country which is employed in production, and consists of food, clothing, tools, raw materials, machinery, &c. necessary to give effect to labour" (Vol. 1, p. 95). In correspondence with this definition, commodities can only turn into capital when they are employed in the production process. This means of course that he would not consider them as capital as long as they remain idle. Therefore, the statement that Ricardo always considered capital to be "fully employed" is both formally correct but completely redundant. It is rather a perfect example for a neoclassical assumption that makes no sense whatsoever in classical political economy.

4.3. *Perfect internal mobility of the factors of production*

Ricardo's numerical example does not require another well-known assumption of the textbook trade model: that of perfect internal mobility of the factors of production. Like

³⁵ MacLeod (1983) convincingly proved that Henry Martyn was the author of the anonymous pamphlet.

the previous one, this assumption was also introduced by Haberler's redefinition of the four numbers as opportunity costs. In order to give some legitimacy to such an unrealistic assumption, though, it has often been attributed to Smith or Ricardo. A careful consultation of the *Wealth of Nations* and the *Principles* proves that neither of them ever assumed perfect internal mobility of capital and labour. On the contrary, they were quite concerned about the negative consequences of any sudden short-term adjustment in international trade. Both recognise that in that case capital owners may have sunk (irrecoverable) costs and workers may find it hard to get new jobs at equivalent pay. Thus, they advocated in favour of granting protection on a temporary basis in order to spread the expected negative impact on certain groups over a longer period of time. Ricardo stated these views quite clearly in chapter XIX of the *Principles* titled "On Sudden Changes in the Channels of Trade".

Despite their concern about the negative impact that any sudden change in the general conditions of trade might have on some capital owners and workers, both Smith and Ricardo remain staunch supporters of free trade. After all, capital owners may retrieve most of their capital from the affected sectors, and many displaced workers might find employment elsewhere. To assume perfect internal immobility of the factors of production, that is, all capital is lost and every displaced worker remains unemployed forever, would be as unrealistic as the opposite assumption of perfect mobility.

5. A few commonalities between Ricardo's numerical example and the textbook trade model

Given the significant differences between Ricardo's numerical example and the textbook trade model highlighted so far, one might wonder at this point if there are any common features at all. There are indeed a few. It goes without saying, for example, that both offer a numerical proof for the proposition that a country might import some quantity of a commodity even though it could produce it internally with less amount of labour time than the exporting country. It is also true that both only refer to labour time requirements. Finally, both Ricardo's numerical example and the textbook trade model assume at least some degree of international capital immobility. But even among these common features one can find significant nuances between the two.

It has been often criticised that the textbook trade model only takes one factor of production – labour – into account. This critique, though, does not apply to Ricardo. There are in fact plenty of references to capital in the paragraphs surrounding the numerical example in the *Principles*. Ricardo even explains the non-validity of the labour theory of value in international exchanges by the relative immobility of capital between countries. Since the main purpose of the numerical example was precisely to illustrate this value proposition, it made perfectly sense for him to only compare the labour-time requirements in the respective countries. The formulation of an international trade model with two commodities, two countries and labour as the sole factor of production is Haberler's invention – not Ricardo's (Gehrke 2015).

Unlike the textbook trade model, Ricardo does not assume perfect international factor immobility. He merely refers to the "(...) difficulty with which capital moves from one country to another, to seek a more profitable employment, and the activity with which it invariably passes from one province to another in the same country" (Vol. I, pp. 135-136). His assumption that capital is less mobile across country borders than within these borders seems to be quite reasonable even nowadays.

Moreover, Ricardo's current critics often forget to point out that he explicitly referred to the expected consequences of a greater international factor mobility when he stated: "It would undoubtedly be advantageous to the capitalists of England, and to the consumers in both countries, that under such circumstances, the wine and the cloth should both be made in Portugal, and therefore that the capital and labour of England employed in making cloth, should be removed to Portugal for that purpose. In that case, the relative value of these commodities would be regulated by the same principle, as if one were the produce of Yorkshire, and the other of London: and in every other case, if capital freely flowed towards those countries where it could be most profitably employed, there could be no difference in the rate of profit, and no other difference in the real or labour price of commodities, than the additional quantity of labour required to convey them to the various markets where they were to be sold" (Vol. I, p. 136).³⁶

³⁶ The last sentence also serves as evidence that Ricardo did not assume zero costs of transportation.

Ricardo believed, thus, that if capital and labour were to become internationally mobile in a similar way as they are within country borders, the relative value of the commodities produced in different countries would be regulated by the same principle as if they were produced within the same country, namely by the amount of labour time required for their production.

6. Main advantages of Ricardo's numerical example over the textbook trade model

Taking into consideration all the crucial aspects in which the typical textbook trade model departs from the original numerical example in the *Principles*, one has to conclude that the former is neither an accurate reproduction nor a rational reconstruction of the latter. Instead, the textbook trade model should be viewed as a genuine neoclassical trade model which offers an alternative way of proving the proposition that a country might import some amount of a commodity even though it could produce it internally with less quantity of labour than the exporting country.

Which of the two alternative methods for proving the above proposition should be given preference, then? Ricardo's numerical example has several advantages over the neoclassical textbook trade model. It offers, for example, a simpler way of calculating the gains from trade. Moreover, it does not rely on any of the unrealistic assumptions that have been so harshly criticised in the literature. As a response to this critique, scholars have invested a considerable amount of time and effort in trying to relax some of these assumptions. It seems to me, though, that this effort amounts to a misallocation of intellectual resources. One can easily avoid the use of any unrealistic assumption by simply following Ricardo's proof of comparative advantage.

Moreover, the textbook trade model explains the commodity composition of international trade by persistent differences in labour productivity among countries. This is indicated in the trade model by the fact that labour-time requirements per unit usually differ among countries and are assumed to remain constant. Differences in labour productivity are thus exogenously given, and presumably result from employing different production technologies.

The model's assumption of persistent technological differences among countries is problematic, to say the least. It implies either that there are socioeconomic and cultural barriers that preclude the inhabitants of developing countries from copying, assimilating or even improving the productive techniques invented in the advanced countries, or that the latter can effectively prevent the erosion of their technological advantages. Both explanations for the persistency of technological differences among countries may seem more or less plausible in the short term, but they are not particularly convincing in the long term. There are plenty of historical examples where a less developed country initially copies and later improves the production technologies of advanced countries. Japan and South Korea are two well-known examples of this catching-up process in recent economic history. China seems to be a sure bet for a similar development in the coming decades.

Moreover, a trade model which explains international exchanges only by referring to persistent technological differences, has an important limitation: it is unable to explain exchanges between economies with similar levels of economic development. This important limitation of the textbook trade model is another departure from Ricardo's theory of international trade. Following his intellectual mentor Adam Smith, Ricardo explicitly mentions in the *Principles* several sources for having a relative facility in the production of certain commodities. Like Smith, Ricardo also believed in the inherent benefits of specialisation and the division of labour. Their common approach explains the benefits of trade between countries irrespective of their relative level of economic development.³⁷

Finally, Ricardo's numerical example also excels the neoclassical textbook trade model in terms of empirical validity. As already stated, the latter predicts that countries will specialise in different economic activities based on their relative productivity differences. Proving this prediction empirically, though, imposes a key challenge. Since the neoclassical textbook trade model also implies complete specialisation, the imported commodities will not be produced in the importing country. Consequently, the key

³⁷ See Morales Meoqui (2014).

explanatory variable of this trade model – differences in labour requirements – cannot be directly observed.³⁸

In comparison, it does not require a lot of empirical research to realise that the propositions Ricardo announced and fully proved in the famous numerical example remain as valid today as they were two hundred years ago. It is an easily observable fact that in current international exchanges the relative value of commodities is not determined by the amount of labour-time required for their production. Goods produced in China with substantial quantities of labour, for example, are exchanged for European or US goods whose production requires less amount of labour-time. Contrary to the postulates of the labour theory of value, the Chinese goods are generally cheaper and have a lower relative value than the ones from Europe and the US. The latter countries import inexpensive goods from China, although they could produce them internally with less quantity of labour. Thus, Ricardo's propositions can only be considered as obsolete by those who ignore economic reality or do not understand what he intended to prove in the numerical example. While it is unquestionable that nowadays capital crosses country borders more expeditiously than during Ricardo's lifetime, the same cannot be said about labour. It seems that both capital and labour have to be internationally mobile for the labour theory of value to determine the exchange value of commodities.

7. Conclusions and Recommendations

This paper is meant as a sort of amicus brief in favour of Ricardo amid the current wave of criticism towards the textbook trade model of comparative advantage. A fresh hearing of his famous numerical example in the *Principles* highlights the significant differences with the respect to the textbook trade model, and shows that the critical points raised against the latter do not apply to the former.

The current formulation of the textbook trade model has been the result of two important misinterpretations of Ricardo's original proof of comparative advantage. The first misinterpretation consists in the definition of the four numbers as the quantities of

³⁸ See Deardorff (1984) and Costinot & Donaldson (2012).

labour required to produce a single unit of cloth and wine in England and Portugal, while the second misinterpretation concerns the alleged reliance of Ricardo's proof of comparative advantage on the labour theory of value. As a consequence of these two misinterpretations, the textbook trade model departs in significant ways – both in terms of assumptions and implications – from the numerical example in the *Principles*. Moreover, the textbook trade model proposes a rule for determining the beneficial nature of an exchange which is very different from the one used by Ricardo as well as other classical political economists. As has been shown here, in some cases the two rules may even lead to opposing conclusions about the beneficial nature of an exchange for a particular country. In this sense one can affirm that Ricardo's numerical example and textbook trade model convey diverging notions of comparative advantage.

Taking these significant points of departure into account, one has to conclude that the textbook trade model can no longer be considered as an accurate reproduction or rational reconstruction of Ricardo's numerical example. Therefore, it seems quite difficult if not impossible to arrive to an accurate understanding of the latter by looking at it through the lenses of the textbook trade model. In order to grasp the original purpose of Ricardo's numerical example, I would strongly recommend to read the primary source without prejudice.

Furthermore, it has become rather obvious now that the current designation of the textbook trade model as *Ricardian* is a misnomer. It wrongly suggests a high level of continuity, when in reality the textbook notion of comparative advantage has very little – if anything at all – in common with the original one in the *Principles*. Referring to neoclassical trade models based on the opportunity costs approach as *Ricardian* seems to me as absurd as naming the Earth-centred model of the universe after Nicolas Copernicus or Galileo Galilei. In order to avoid further misunderstandings and facilitate a clear distinction between the two alternative notions of comparative advantage in the future, scholars would have to agree on a new denomination for the textbook trade model. If it has to be associated with a particular economist, it would be certainly more

accurate to refer to it as Haberler's trade model, since he was original creator of the two countries – two commodities – on factor model or “2-2-1” model.³⁹

Ricardo's numerical example and Haberler's trade model constitute two alternative methods for proving the same proposition, namely that a country might import some quantity of a commodity even though it could produce it internally with less quantity of labour than the exporting country. Ricardo's proof of this proposition, though, is clearly superior in terms of elegance and simplicity. Moreover, it has the additional advantage that it does not rely on any of the unrealistic assumptions associated with Haberler's trade model, like constant unit labour time requirements, zero transportations costs, full-employment and perfect internal mobility of the factors of production. These assumptions limit considerably the validity of Haberler's trade model. Ricardo's two interlinked propositions, on the other hand, remain as valid today as they were two hundred years ago.

Finally, I support the critics' claim that Haberler's trade model should be removed from the central position it currently occupies within international trade theory. The expected effect of this removal on the current political and academic debate about free trade and globalisation, though, would be quite different than what the critics are hoping for. The presence of a theoretic trade model with utterly unrealistic assumptions at the core of the mainstream case free trade has given them an easy target to rally against. Consequently, its eventual removal would rather strengthen the case for free trade, bringing it more in line with the one originally formulated by Smith, Ricardo and other representatives of the classical school of economic thought.

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³⁹ Or if one prefers a catchy acronym instead, it might be called the Constant Unit Labour Costs model (CULC), in order to highlight the two most distinguishing attributes of the four numbers in the textbook trade model.

observations and discussions during the session in which this paper was presented. The usual caveats apply with regard to the remaining errors and omissions.

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