

# THE DEMYSTIFICATION OF DAVID RICARDO'S FAMOUS FOUR NUMBERS

BY

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*The paper offers the first interpretation of David Ricardo's famous numerical example fully compatible with the primary source. It claims that the sole purpose of the four numbers was to illustrate that the relative value of commodities made in different countries is not determined by the respective quantities of labor devoted to their production. This exception results from unequal ordinary profit rates between countries because capital does not move across national borders as easily as it does within the same country. Likewise, the paper also debunks some entrenched myths about the numerical example. It shows that Ricardo did not leave the terms of trade indeterminate, that the purpose of the four numbers was not about measuring the gains from trade, and that Portugal had no productivity advantage over England. All of this contradicts the way scholars have interpreted Ricardo's numerical example since the mid-nineteenth century.*

## I. INTRODUCTION

“Whatever deceives men seems to produce a magical enchantment.”  
Plato

No numerical example has received more attention and aroused so much fascination within the economics profession than David Ricardo's famous four numbers about a barter trade of English cloth and Portuguese wine in chapter seven of his magnum opus

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*On the Principles of Political Economy and Taxation* (1817). This is because since the first half of the nineteenth century, economists have interpreted the four numbers as an ingenious proof for the proposition that it might be beneficial for a country to import a commodity that could have been produced locally with a lower cost of production. This counterintuitive proposition is often referred to as the *law of comparative advantage*, as it purportedly refuted the theory of absolute advantage in the cost of production commonly misattributed to Adam Smith.

Over the last three centuries, successive generations of economists have professed the utmost admiration for this interpretation of Ricardo's numerical example. The law of comparative advantage has been called "the deepest and most beautiful result in all of economics" (Findlay 1987, p. 514) and "one of the crown jewels of the economics profession" (Rodrik 1998, p. 3). Indeed, it has been "one of the few theories that economists of all the different schools understand and agree with" (Negishi 2014, p. 21). A little anecdote can further illustrate its special status within economics. The mathematician Stanislaw Ulam once teased Nobel Memorial Prize laureate Paul A. Samuelson to name a single proposition in all of the social sciences that is both true and non-trivial. Some thirty years after being challenged, Samuelson could think only of the theory of comparative advantage. He explained his selection as follows: "That it is logically true need not be argued before a mathematician; that it is not trivial is attested by the thousands of important and intelligent men who have never been able to grasp the doctrine for themselves or to believe it after it was explained to them" (Samuelson 1969, p. 9).

Samuelson's anecdote echoes the widespread belief among economists that the lack of professional training prevents non-economists from grasping the allegedly complex notion of comparative advantage. This perception has led to a condescending attitude towards critics. The popular essay titled "Ricardo's Difficult Idea: Why Intellectuals Don't Understand Comparative Advantage" by Nobel Memorial Prize laureate Paul R. Krugman (1998) is a paradigmatic example of this attitude. After equating skeptics of comparative advantage with deniers of Charles Darwin's theory of evolution through natural selection, Krugman ended his essay with the following dictum: "Ricardo's idea is truly, madly, deeply difficult. But it is also utterly true, immensely sophisticated—and extremely relevant to the modern world" (Krugman 1998, p. 35). This unwavering faith in the veracity of their own understanding of the law of comparative advantage even led some economists to claim that Ricardo's alleged statement of this law was somewhat deficient (Chipman 1965, p. 480; Thweatt 1976).

Against this background, it must have shocked many economists when Roy Ruffin (2002) acknowledged that the hitherto mainstream interpretation of the four numbers in the *Principles* as unit labor coefficients was wrong. Instead, they should indicate the number of men working for a year required to produce some unspecified amounts of cloth and wine traded between England and Portugal. What surprised me even more was the realization that Piero Sraffa (1930) and Kenzo Yukizawa (1974) had already published the correct definition several decades before Ruffin. Unfortunately, neither Sraffa's nor Yukizawa's paper got their fellow economists to correctly define Ricardo's four numbers.

But the third time is the charm, as the saying goes. The correct definition of Ricardo's four numbers, dubbed the *Sraffa-Ruffin interpretation* (Maneschi 2004, p. 441), quickly found general acceptance among economic scholars. Ruffin was successful where his

two predecessors had failed because he went out of his way to emphasize that the proposed correction had no consequences for the validity of the textbook theory of comparative advantage. He even claimed that it was important “to begin with a modern statement of Ricardo’s law of comparative advantage to fully appreciate Ricardo’s own statement” (Ruffin 2002, p. 729).

This narrow correction to the mainstream interpretation of the numerical example leaves some basic questions without satisfactory answers. It remains unclear, for instance, by which path Ricardo allegedly arrived at the law of comparative advantage, after Christian Gehrke (2015) thoroughly debunked Ruffin’s reconstruction of the discovery process (Ruffin 2002). More importantly, it is far from evident how merchants could sell the English cloth in the Portuguese market (Faccarello 2015a, p. 760) because it is still believed that its cost of production was higher than that of the Portuguese cloth (Faccarello 2015b, pp. 69–70; Shaik 2016, p. 505; Kurz 2017, p. 16). Ricardo’s four numbers are now correctly defined, but their interpretation is still flawed.

None of the above succeeded in tainting the long-standing enchantment of the economics profession with Ricardo’s numerical example. Quite the contrary. In 2017, economists around the world commemorated the 200th anniversary of the publication of the *Principles*. Rightfully, it is regarded as one of the most influential books in the history of economic thought. However, most of the praise and attention went to the “four magic numbers” (Samuelson 1969, p. 4) in the chapter titled “On Foreign Trade.”<sup>1</sup>

This magical enchantment with Ricardo’s numerical example turned out to be the result of a misinterpretation. A recently published paper (Morales Meoqui 2021) proves that the English cloth could be sold in Portugal because it had a lower cost of production than the Portuguese cloth. Moreover, it also shows that Ricardo did not formulate a new law or principle for international specialization but used the same rule as Adam Smith in the *Wealth of Nations*. These novel findings reveal that the extent of the misinterpretation of the numerical example went far beyond the incorrect definition of its four numbers. Indeed, we are dealing with one of the most significant and influential misreadings in the history of economic thought.

In this paper, I use these novel findings to formulate arguably the first interpretation of Ricardo’s numerical example that is fully compatible with the primary source. In a nutshell, it claims that the sole purpose of the four numbers was to illustrate the proposition that the relative value of commodities produced in different countries is not determined by the respective quantities of labor devoted to the production of each. This interpretation rebukes four popular myths currently associated with the numerical example: first, that Ricardo left the terms of trade indeterminate; second, that the purpose of the four numbers was to clarify the nature and proper measure of the gains from trade; third, that Portugal had a productivity advantage over England; and fourth, that the four numbers meant to prove that a less productive economy could participate in international trade but could not undersell a wealthier country in the production of every commodity. The paper’s main contribution is the thorough demystification of Ricardo’s numerical example, which allows progress towards a deeper and more accurate understanding of it.

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<sup>1</sup> See, for example, the three books edited by Ronald W. Jones and Rolf Weder (2017); Simon J. Evenett (2017); and Shigeyoshi Senga, Masatomi Fujimoto, and Taichi Tabuchi (2017). The numerical example also figures prominently in *The Elgar Companion to David Ricardo*, edited by Heinz D. Kurz and Neri Salvadori (2015).

Besides the introduction and the conclusions, the paper is structured into four main sections. The [section II](#) aims to recover the original purpose, content, and implications of Ricardo's famous numerical example, based on a close examination of the relevant passages in the *Principles*. [Section III](#) rebukes the myth that Ricardo had left the terms of trade indeterminate. The [section IV](#) questions the narrative that the purpose of the four numbers was to illustrate the gains from trade. [Section V](#) debunks the myth about Portugal's alleged productivity advantage over England as part of a critique of what I have termed "the productivity narrative" currently associated with Ricardo's numerical example.

## II. RECOVERING THE ORIGINAL PURPOSE OF RICARDO'S FAMOUS FOUR NUMBERS

Reading Ricardo's correspondence, it is easy to conclude that without the assiduous urging and encouragement of his dear friend James Mill, he probably would not have decided to publish his novel ideas on political economy in a book. Mill also gave him some practical advice on how to compose the text. He recommended to Ricardo, for example, to never set down a proposition without its immediate proof, so his readers would not have to infer it for themselves, through a number of steps, from some distant principles (vol. VI, p. 339).<sup>2</sup> In a letter to Ricardo dated November 18, 1816 (vol. VII, pp. 97–99), Mill expressed satisfaction with the result after reading the manuscript of the *Principles*. In his opinion, there was not a single proof of a proposition that was not irresistible. He also considered that the manuscript was remarkably free of Ricardo's habit of crowding too many points into one place.

So, what proposition did Ricardo aim to prove with the famous four numbers about the exchange of English cloth and Portuguese wine in the chapter "On Foreign Trade"? If one carefully reads the relevant passage in the *Principles*, the most plausible answer is the following proposition: "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. I, p. 133). Three paragraphs later, Ricardo specified the rule he had in mind: "The quantity of wine which she [Portugal] shall give in exchange for the cloth of England, is not determined by the respective quantities of labour devoted to the production of each, as it would be, if both commodities were manufactured in England, or both in Portugal" (vol. I, pp. 134–135). He made this specification just before introducing the two numbers corresponding to England in the next paragraph. It therefore seems only reasonable to conclude that the purpose of the four numbers was to illustrate this proposition, as I already pointed out previously (Morales Meoqui 2011).

As any mathematician can attest, it is common to announce the assumptions right after the proposition one wants to prove. Ricardo proceeded in this way when he referred to the "system of perfectly free commerce" (vol. I, pp. 133–134) and the difference in the

<sup>2</sup> Throughout this paper, all direct quotations of Ricardo's writings and correspondence are extracted from *The Works and Correspondence of David Ricardo*, volumes I to XI (Ricardo 1951–1973), edited by Piero Sraffa. I will refer to them usually by indicating the volume and page numbers only.

rate of profits between countries (vol. I, p. 134) immediately after announcing his proposition. He considered them to be the two explicit assumptions of his proof. Even economists with mathematical training failed to realize this because they were not sufficiently familiar with Ricardo's theory of value. Therefore, it seems necessary to briefly overview its core terms and features here.

First, it is necessary to remember that Ricardo, following Smith ([1776] 1976; hereinafter *WN*, I.vii:72–81), always distinguished between the market price and the natural price of commodities (vol. I, pp. 88–92). He also referred to the latter on various occasions as the *necessary price* or the *cost of production*. These three terms were synonymous to him (vol. I, pp. 119–120, 383; vol. II, pp. 34–35, 46–47, 219).

Second, for the market price of a commodity to coincide with its natural price, the quantities brought to market have to match the amounts demanded by those willing to pay the natural price (*WN* I.vii.11:74; and Ricardo vol. I, p. 91). However, both Smith (*WN* I.vii.17:75–76) and Ricardo (vol. I, p. 88) openly admitted that commodities are seldom produced precisely in the quantities demanded, as those quantities are constantly changing due to unpredictable factors like, for example, the caprice and taste of consumers. When the quantity demanded of a particular commodity exceeds or falls below the amount produced, its market price will be either above or below the natural price, and the profit made by the producer will be higher or lower than the ordinary rate of profit, respectively.

Third, while acknowledging that the market price of a commodity is continuously changing due to transient and accidental causes, Ricardo believed, following Smith, that it tends to conform to the natural price. This tendency of the market price to gravitate towards the natural price results from the competition among capitalists, as Ricardo explained in the following passage:

It is then the desire, which every capitalist has, of diverting his funds from a less to a more profitable employment, that prevents the market price of commodities from continuing for any length of time either much above, or much below their natural price. It is this competition which so adjusts the exchangeable value of commodities, that after paying the wages for the labour necessary to their production, and all other expenses required to put the capital employed in its original state of efficiency, the remaining value or overplus will in each trade be in proportion to the value of the capital employed.

In the seventh chap. of the *Wealth of Nations*, all that concerns this question is most ably treated. (vol. I, p. 91)

In line with the passage above, he further stated: “In speaking then of the exchangeable value of commodities, or the power of purchasing possessed by any one commodity, I mean always that power which it would possess, if not disturbed by any temporary or accidental cause, and which is its natural price” (vol. I, p. 92). Hence, it is safe to say that Ricardo's concept of the value of a commodity was that of its natural price or cost of production.<sup>3</sup>

<sup>3</sup> Likewise, Ricardo wrote in a footnote in the *Principles*: “Mr. Malthus appears to think that it is a part of my doctrine, that the cost and value of a thing should be the same;— it is, if he means by cost, ‘cost of production’ including profits. In the above passage, this is what he does not mean, and therefore he has not clearly

However, as he made clear on various occasions, this applies only to commodities that “can be increased in quantity by the exertion of human industry, and on the production of which competition operates without restraint” (vol. I, p. 12). “The exchangeable value therefore of a commodity which is at a monopoly price,” Ricardo stated, “is no where regulated by the cost of production” (vol. I, p. 250). Consequently, unrestricted competition within a country is a necessary condition for allowing every commodity to settle at its natural price.

Fourth, Ricardo believed that when two commodities have the same value (= natural price or cost of production), they require approximately the same quantity of labor for their production (vol. VIII, p. 279). This is because he thought that the relative value of commodities is nearly in proportion to the quantities of labor bestowed on them (vol. II, pp. 35, 79, 101–102). Contrary to popular belief, thus, he never believed that the exchangeable value of commodities was exactly proportioned to the labor that has been employed on them.<sup>4</sup> Such an exact proportionality was limited to the case of commodities produced without machines or with fixed capital of equal value and durability, and that also could be brought to market in the same amount of time (vol. I, p. 32). The common claim that Ricardo had a labor theory of value is therefore unfounded.

Fifth, a tariff increases the price of imported goods and thus distorts the relative prices in the internal market. The purpose and effect of the tariff are to make local production of the imported commodity appear more advantageous when, in fact, it is not. As Ricardo explained in the *Principles*, “it causes a pernicious distribution of the general funds of the society—it bribes a manufacturer to commence or continue in a comparatively less profitable employment” (vol. I, p. 314). “By forcing capital into channels where it would not otherwise flow, it diminished the whole amount of commodities produced” (vol. I, p. 316). Consequently, Ricardo referred to free trade as a crucial assumption in the numerical example to rule out the distortions to relative prices caused by tariffs and other protectionist measures.

Sixth, Ricardo stated 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” (vol. I, p. 375). This rule certainly applies to the exchange of English cloth and Portuguese wine as well. For the amounts of cloth and wine traded to be exchanged at their respective natural prices or costs of production, one must assume that the quantities produced corresponded to the amounts demanded. However, it is not necessary to assume that the whole trade between England and Portugal, which consisted of various kinds of commodities (vol. I, p. 141), was balanced, as Gehrke (2017, p. 142) claimed.

In this context, a system of perfectly free commerce would allow the residents of England and Portugal to buy commodities at a lower price whenever the cost of production of the local producers exceeds that of the foreign producers. No one ever

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understood me” (vol. I, p. 47). Ricardo always included ordinary profits in the cost of production (vol. II, p. 369; vol. IV, p. 25).

<sup>4</sup> Ricardo stated: “Mr. Malthus shews that in fact the exchangeable value of commodities is not exactly proportioned to the labour which has been employed on them, which I not only admit now, but have never denied. He proves then that quantity of labour is not a perfect measure of value; but what are its deviations from a perfect measure on account of the circumstances which he mentions?—if they are slight, as I contend they are, then we are still in possession of a measure tolerably accurate, and in my opinion more nearly approximating to truth, than any that has been yet proposed” (vol. II, p. 66).

disputed that the Portuguese wine had a lower cost of production than the English wine. What scholars failed to realize was that the cost of production of the English cloth was lower than that of the Portuguese cloth, although the latter could be made with less quantity of labor than the former. With the condensed refresher of Ricardo's value theory in mind, this is almost trivial to prove. The following summarizes a detailed proof from an earlier research article (Morales Meoqui 2021, pp. 442–443).

Since the English cloth and the Portuguese wine were exchanged in barter trade, the two lots of commodities must have the same value, natural price or cost of production. Furthermore, as the making of the cloth in Portugal would require more quantity of labor (ninety men) than the making of the wine (eighty men), the cost of production of the Portuguese cloth has to be higher than that of the wine. By applying transitivity, then, one can conclude that the Portuguese cloth has to have a higher cost of production than the English cloth.

The algebra language allows expressing the proof in a single line, where the variables  $CW_{POR}$ ,  $CC_{ENG}$ , and  $CC_{POR}$  represent the costs of production of the Portuguese wine, the English cloth, and the Portuguese cloth, respectively:

$$\text{Since } CW_{POR} = CC_{ENG} \text{ and } CC_{POR} > CW_{POR} \Rightarrow CC_{POR} > CC_{ENG}$$

Thus, the English cloth would have a lower cost of production than the Portuguese cloth, although the latter would require less labor for its production than the former. In the previous paper (Morales Meoqui 2021, pp. 443–444), I estimated that the cost of production of the Portuguese cloth was at 50.625*l.*, which is indeed higher than that of the English cloth (45*l.*).

With this proof in mind, it is easy to follow Ricardo's line of thought in the subsequent paragraphs of the *Principles*. Right after indicating Portugal's numbers, he affirmed the following:

This exchange might even take place, notwithstanding that the commodity imported by Portugal could be produced there with less labour than in England. Though she could make the cloth with the labour of 90 men, she would import it from a country where it required the labour of 100 men to produce it, because it would be advantageous to her rather to employ her capital in the production of wine, for which she would obtain more cloth from England, than she could produce by diverting a portion of her capital from the cultivation of vines to the manufacture of cloth. (vol. I, p. 135)

Here, Ricardo reiterated his previous claim that if Portugal had no commercial connection with other countries, she would have to transfer a part of the capital currently dedicated to the production of wine to the manufacture of cloth, "which she would thus obtain probably inferior in quality as well as in quantity" (vol. I, p. 134). His claim that Portugal would get less cloth that way can easily be explained by the fact that the cost of production of the Portuguese cloth is higher than that of the Portuguese wine.

Ricardo returned in the very next paragraph to the proposition that he wanted to prove with the four numbers. He stated:

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. I, pp. 135–136)

Ricardo made it clear here that due to persistent differences in the ordinary rates of profit between countries, the quantities of labor required for production did not determine the relative value of commodities produced in different countries. This goes a long way in explaining why he completely neglected the corollary that it might be beneficial for a country to import a commodity that could have been produced locally with less labor than in the exporting country. As far as I know, he never referred to this corollary again. This is because, contrary to the assertion of Jacob Viner (1937, p. 441), the comparison of quantities-of-labor requirements between countries does not allow for making an inference about whether the cost of production of a commodity is higher in one country or the other. As Ricardo unambiguously indicated in one of his *Notes on Malthus*, only the internal comparison of quantities-of-labor requirements was relevant for make-or-buy decisions: “It can be of no consequence to America, whether the commodities she obtains in return for her own, cost Europeans much, or little labour, all she is interested in, is that they shall cost her less labour by purchasing than by manufacturing them herself” (vol. II, p. 383).

Since the production of 100 Englishmen is exchanged for that of eighty Portuguese, Ricardo must have assumed that profits in England were lower than in Portugal. He explicitly stated that profits might be lower in England than in Holland, Spain, or Russia (vol. I, p. 134). Unfortunately, he left Portugal out of this recount. Yet, there is enough evidence for concluding that profits were higher there, too. Ricardo indicated this clearly enough when claiming that under such circumstances, it would undoubtedly be advantageous to the capitalists of England to shift the production of cloth to Portugal (vol. I, p. 136). Besides this, one can also deduce it from his explicit indication that profits in Russia might be higher than in England (vol. I, p. 134), so that the produce of the labor of 100 Englishmen may be given for the produce of the labor of sixty Russians.

If capital would move as easily between countries as within the same country, the English capitalists would shift the cloth production to Portugal to earn more profit, and the difference in the rates of profit between the two countries would gradually disappear. In that case, Ricardo explained, the relative value of cloth and wine 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)

However, Ricardo thought that capital would not move freely towards countries with a higher rate of profit, as he explained in the very next paragraph:

Experience, however, shews, that the fancied or real insecurity of capital, when not under the immediate control of its owner, together with the natural disinclination which every man has to quit the country of his birth and connexions, and intrust himself with all



his habits fixed, to a strange government and new laws, check the emigration of capital. These feelings, which I should be sorry to see weakened, induce most men of property to be satisfied with a low rate of profits in their own country, rather than seek a more advantageous employment for their wealth in foreign nations. (vol. I, pp. 136–137)

To sum up in a single paragraph the detailed exegesis of the relevant passages in the *Principles*, Ricardo observed persistent differences in the ordinary rate of profits between countries. He explained this divergence by the fact that capital is less mobile across national borders than within the same country, which prevented the usual tendency for these different profit rates to converge. Consequentially, the relative value of commodities produced in two or more countries is not determined by the quantity of labor devoted to them. Thus, the sole purpose of the famous four numbers was to illustrate this momentary exemption of a key proposition related to his theory of value. For this exception to disappear, capital would have to become as mobile internationally as internally, so that the different national profit rates may tend to equalize.

Had economists always interpreted the numerical example in the *Principles* as outlined above, we would hardly find any reference to it in current economics textbooks. Indeed, the current popularity of Ricardo's numerical example is wholly detached from its original purpose. Nowadays, the four numbers are deemed "magical" because they allegedly showed that it might be beneficial for a country to import a commodity that could have been produced locally with a lower cost of production. I already debunked this myth in a previous paper (Morales Meoqui 2021), alongside the erroneous belief that Ricardo had proposed a different and alternative rule for specialization to Smith's. In the subsequent sections, I will refute other popular myths and false narratives about the numerical example.

### III. DEBUNKING THE MYTH ABOUT THE INDETERMINATE TERMS OF TRADE

Ricardo did not specify the quantities of bottles of Portuguese wine and rolls of English cloth exchanged in his famous numerical example. However, this omission was not because determining the terms of trade of international exchanges was a problem for him, as has been often claimed.<sup>5</sup> The specific amounts of cloth and wine traded were simply irrelevant to the proposition he wanted to prove with the four numbers.

The origin of the myth about the indeterminate terms of trade goes back, of course, to John Stuart Mill's 1844 essay "Of the Laws of Interchange Between Nations; and the Distribution of the Gains of Commerce Among Countries of the Commercial World" (in Mill 1844). From Ricardo's indication that the quantities of labor embodied in the cloth and wine did not determine how much wine should be given for the cloth, J. S. Mill inferred that the alleged principle that value is proportional to the cost of production was inapplicable to international exchanges (Mill 1844, p. 8). To fill this supposed gap in Ricardo's theory, he went on to formulate the theory of reciprocal demand in the essay. Four years later, he reproduced it with some extensions and omissions in chapter XVIII

<sup>5</sup> See, for example, John Chipman (1965, p. 488), Dennis R. Appleyard and Alfred J. Field (2014, p. 31), Akiro Takamasu (2017, p. 154), and Yoshinori Shiozawa (2017, p. 206).

of his monograph *Principles of Political Economy with some of their Applications to Social Philosophy* ([1848] 1965).

As already indicated in a previous paper (Morales Meoqui 2021, p. 445), the reason for Mill's erroneous claims lies in the fact that his notion of the cost of production did not include ordinary profits (Mill [1848] 1965, p. 471). For Mill, thus, the cost of production was synonymous with the cost price of a commodity. Consequently, he considered that the value or natural price of a commodity was *proportional* to the cost of production (Mill 1844, p. 8). For Ricardo, however, the cost of production always included ordinary profits. It was just another name for the natural price.

Mill was unaware of this conceptual difference between his and Ricardo's notion of the cost of production and, as a result, could not see its theoretical and practical consequences, either.<sup>6</sup> Two bundles of commodities with the same cost price but different profit rates do not have the same natural price. Therefore, Mill mistakenly inferred from the divergence of profit rates between countries that the cost of production could not be the ultimate regulator of the relative value of any two commodities in international exchanges. This led him to the false presumption that Ricardo had left the terms of trade for international exchanges indeterminate.

Unaware of J. S. Mill's missteps, scholars wondered how the higher quantity of labor contained in the English cloth could be converted into a lower selling price. Heinz Kurz (2015, 2017), for example, imagined the exploitation of arbitrage opportunities with non-convertible currencies. However, this complicated solution proposal does not correspond with what is written in the *Principles*, as Gilbert Faccarello (2015a, p. 760) acknowledged.

The most popular conjecture about how to get to the lower selling price for the English cloth in the Portuguese market invokes the international distribution of gold and silver, also known as the *price-specie-flow mechanism*.<sup>7</sup> The popularity of this conjecture somewhat puzzles me. It overlooks the simple but indisputable fact that, per definition, there is no international movement of precious metals in barter. How then could the price-specie-flow mechanism be relevant for interpreting the four numbers about the bartering of English cloth and Portuguese wine?

Scholars may claim that they were simply following Ricardo's reasoning in the *Principles*. After all, he also invoked the price-specie-flow mechanism there. Indeed, but they overlook that Ricardo used this mechanism to illustrate another proposition, namely that the precious metals gold and silver are distributed by the competition of commerce "in such proportions amongst the different countries of the world, as to accommodate themselves to the natural traffic which would take place if no such metals existed, and the trade between countries were purely a trade of barter" (vol. I, p. 137). To illustrate this proposition, Ricardo imagined a case where English winemakers discover a process that reduces the cost of production of wine, so it becomes in their interest to produce the wine locally instead of importing it from Portugal. The money price of wine in England would fall "while the cloth continued at its former price, and in Portugal no alteration would take place in the price of either commodity" (vol. I, p. 137). As Ricardo further

<sup>6</sup> J. S. Mill ([1848] 1965, p. 472) erroneously claimed: "Adam Smith and Ricardo have called that value of a thing which is proportional to its cost of production, its Natural Value (or its Natural Price)."

<sup>7</sup> See, for example, Matfás Vernengo (2000, p. 178), Reinhard Schumacher (2013, pp. 85–86), Kurz (2015, pp. 845–847; 2017, pp. 14–17), and Terry Peach (2017, pp. 17–18).

explained, the exportation of English cloth would go on for a while because its price would continue to be higher in Portugal than in England, but money instead of wine would be imported from Portugal. Only after some time, the continued accumulation of money in England and its diminution in Portugal should so operate on the relative value of cloth in the two countries that it would cease to be profitable to export the English cloth.

Moreover, Ricardo recognized a few pages later that such a great effect on the value of money would hardly occur under real-world conditions:

To simplify the question, I have been supposing the trade between two countries to be confined to two commodities—to wine and cloth; but it is well known that many and various articles enter into the list of exports and imports. By the abstraction of money from one country, and the accumulation of it in another, all commodities are affected in price, and consequently encouragement is given to the exportation of many more commodities besides money, which will therefore prevent so great an effect from taking place on the value of money in the two countries as might otherwise be expected. (vol. I, p. 141)

Therefore, Ricardo's reference to the price-specie-flow mechanism in the *Principles* offers no indication that it might be relevant to the proper interpretation of the famous four numbers. This conclusion is further strengthened if we consider his belief, expressed in one of his *Notes on Malthus*, that a high or low value of money would not affect foreign trade. He stated there:

It is undoubtedly true that if a country is to pay a certain money price for foreign necessaries and conveniences, it is for its interest to sell the commodity which it exports at a high, rather than at a low price; it is desirable that for a given quantity of its own commodity, it should obtain a large rather than a small quantity of foreign commodities in return, but in what way a nation can so regulate its affairs as to accomplish this by any means which it is in its power to adopt, I am totally at a loss to conceive. All trade is in fact a trade of barter, and if money can by any laws be so distributed or accumulated as to raise the price of exportable commodities, it will also raise the price of imported commodities; so that whether money be of a high or of a low value, it will not affect foreign trade; for a given quantity of a home commodity in either case will be bartered for a given quantity of a foreign commodity. (vol. II, pp. 146–147)

The interpretation of Ricardo's four numbers presented in the previous section explains why the English cloth had to have a lower natural price than the Portuguese cloth without resorting to the price-specie-flow mechanism. Consequently, it makes past speculations about how to get to the cheaper price of the English cloth based on this mechanism superfluous.

#### IV. ON THE GAINS-FROM-TRADE NARRATIVE

In addition to creating confusion about the determination of the terms of trade, J. S. Mill also played a central role in popularizing the myth that the purpose of Ricardo's numerical example was to illustrate the gains from trade. The origin of this false narrative

goes back to his influential essay “Of the Laws of Interchange ...” (1844), too. He claimed there that Ricardo was the first who substituted in the chapter “On Foreign Trade” “for the former vague and unscientific, if not positively false, conceptions with regard to the advantage of trade, a philosophical exposition which explains, with strict precision, the nature of that advantage, and affords an accurate measure of its amount” (Mill 1844, p. 1). This claim was factually incorrect, as Mill recognized in a footnote to the 1862 edition of his *Principles* (Mill [1848] 1965, p. 589). He conceded there that Robert Torrens already made an accurate statement of the gains from trade in *The Economists Refuted* (1808; in Torrens 2000).<sup>8</sup> However, as Ruffin (2005, p. 713) already pointed out, Torrens’s statement is not fundamentally different from this one written by Smith in the *Wealth of Nations*:

We must not, however, upon this account, imagine that the gain of the town is the loss of the country. The gains of both are mutual and reciprocal, and the division of labour is in this, as in all other cases, advantageous to all the different persons employed in the various occupations into which it is subdivided. The inhabitants of the country purchase of the town a greater quantity of manufactured goods, with the produce of a much smaller quantity of their own labour, than they must have employed had they attempted to prepare them themselves. (*WN*, III.i.1:376)

Continuing his remarkable series of missteps, J. S. Mill further claimed that Ricardo “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 in one country and in the other” (Mill 1844, pp. 5–6). He magnanimously conceded that this was not an error but a mere oversight of Ricardo. This error or oversight, of course, is not to be found in Ricardo’s *Principles* but in the first two editions of James Mill’s *Elements* ([1821] 1826).

More than eighty years later, Sraffa (1930, p. 541) rectified this mistaken attribution by pointing out that in Ricardo’s numerical example, England gains the labor of twenty Englishmen and Portugal gains the labor of ten Portuguese. In retrospect, however, this partial correction of the erroneous statements by J. S. Mill was only modestly helpful in improving the understanding of Ricardo’s numerical example. In a certain way, it made things even worse, as it reinforced the mistaken impression that the four numbers in the *Principles* were about the proper measurement of the gains from trade. I once believed this, too, at least partially (Morales Meoqui 2011, p. 757; 2017, p. 38). Although I noticed that Sraffa’s calculation of the gains from trade cannot be found in the *Principles*, it did not seem important to me at the time. After all, it was a simple subtraction that anybody could do independently, so I thought that maybe Ricardo had left his readers with a little homework assignment.

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<sup>8</sup> Torrens stated the following there: “If I wish to know the extent of the advantage which arises to England, from her giving France a hundred pounds’ worth of broad cloth, in exchange for a hundred pounds’ worth of lace, I take the quantity of lace which England has acquired by this transaction, and compare it with the quantity which she might, at the same expense of labour and capital, have acquired by manufacturing it at home. The lace that remains, beyond what the labour and capital employed on the cloth might have fabricated at home, is the amount of the advantage which England derives from the exchange” (Torrens 2000, vol. VI, p. 53).

However, it has now become clear to me why Ricardo refrained from making such a calculation of the gains from trade: that was not the purpose of his numerical example. As previously stated, he believed that the respective costs of production of two bundles of commodities made in the same country have to be approximately proportional to the quantities of labor embodied in them. So when he compared the quantities of labor required to produce the bundles of cloth and wine traded in England, he was in fact comparing the cost of production of the cloth necessary to purchase the Portuguese wine with the cost of production of making the wine locally. Therefore, the internal comparison of labor quantities should be seen as a correct application of the classical rule for specialization. This rule stipulates that one should not attempt to make a commodity that costs less to buy, and that it is generally beneficial to import commodities whenever they are bought more cheaply than what their internal production would cost.

Ricardo certainly believed that importing cheaper English cloth into Portugal and inexpensive Portuguese wine into England was beneficial for both trading partners. As shown in the previous section, he also thought that this exchange would cease when it was no longer advantageous to either side. These were not novel or controversial propositions that he had to prove with a numerical example. Hence, it no longer makes sense to believe that his famous four numbers were about illustrating the gains from trade.

## V. DEBUNKING THE PRODUCTIVITY NARRATIVE

For reasons that should be explored on another occasion, J. S. Mill's original contraposition of absolute and comparative advantage in the cost of production morphed into what I like to refer to here as the *productivity narrative*. According to this narrative, Ricardo meant to prove with the four numbers that international trade is based on relative rather than absolute advantages in productivity.<sup>9</sup>

The productivity narrative has been very popular with advocates of free trade. They use this interpretation of Ricardo's numerical example to refute two common objections to free trade. On the one hand, some protectionists claim that developing countries cannot benefit from free trade because they cannot compete with wealthier nations. On the other hand, protectionists in rich countries fear that producers in poorer countries would undercut many local producers if all trade barriers were removed. In contrast to these contradicting objections to free trade, Ricardo is said to have proven with the four numbers that all countries, rich and poor alike, could participate in and benefit from international trade.

There is no doubt that Ricardo indeed believed that a free trade policy would be beneficial for any country, regardless of its level of wealth and development of the productive forces of labor. What I am disputing here is the common belief that he formulated the famous numerical example to prove that international trade is based on relative productivity advantages, as the supporters of this narrative claim. Such a reading

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<sup>9</sup> See, for example, Arnaud Costinot and Dave Donaldson (2012); Rolf Weder (2017); Douglas A. Irwin (2017); James Gerber (2018); Paul Krugman, Maurice Obstfeld, and Marc Melitz (2018); Eduardo Crespo, Ariel Dvoskin, and Guido Ianni (2021); and Ricardo Hausmann, Daniel P. Stock, and Muhammed Yildirim (2021).

of the four numbers does not match up with the relevant passages in the *Principles* and neither is it compatible with Ricardo's theory of value.

To start with the most obvious mismatch, according to the productivity narrative, you need to know all four numbers to determine where the cloth and the wine should be made. Ricardo, however, proclaimed England's interest in exporting cloth and importing wine before even mentioning Portugal's numbers (vol. I, p. 135).

Then there is the problem with Portugal's alleged productivity advantage over England in the production of cloth and wine. This recurrent claim by supporters of the productivity narrative<sup>10</sup> defies traditional economic history. Ricardo was living in England at the time of the Industrial Revolution. Hence, some economists and historians wondered why he chose Portugal as the supposedly more productive country. They proposed various explanations for this inverted economic geography. For example, John E. King (2013, p. 88) suggested that Ricardo "was simply rather careless in his choice of examples." What King viewed as mere carelessness, Matthew Watson (2017, p. 259) interpreted as a perfidious ploy by Ricardo to conceal Portugal's deeply unequal trading relationship with England. Samuelson (1969, p. 5), on the other hand, mentioned *noblesse oblige*, although he did not really believe in it. He thought Ricardo wanted to prove to his readers that a foreign country could not undersell England in everything, even if the former were more productive in producing every commodity. According to Andrea Maneschi (2004, p. 440), Ricardo possibly wished to make the rhetorical point that, even if England were inefficient in producing both commodities, she could end up garnering 20/30 or two-thirds of the worldwide gains from trade. I once made a similar conjecture (Morales Meoqui 2011, p. 757), which indicates that my interpretation of the four numbers had not yet completely freed itself from magical thinking at that time.

Given the low plausibility of all these explanations, the question arises as to whether the claim of Portugal's alleged productivity advantage over England could be another misinterpretation of the four numbers. I certainly think so now. This claim is grounded, of course, in Ricardo's indication that the making of the cloth and wine traded required less quantity of labor in Portugal than in England. However, this does not necessarily imply that the former was more productive than the latter. Such an interpretation overlooks the fact that the quantities of labor indicated refer not only to the labor of the workers directly employed in the factories and vineyards but also to the labor bestowed on the various raw materials, tools, machinery, and buildings used in the production process, as Ricardo explained in section III of chapter I of the *Principles* titled "On Value" (vol. I, pp. 22–30). Hence the ubiquitous assertion that he considered labor as the only factor of production in the numerical example is simply absurd. Once this is acknowledged, it can no longer be inferred with certainty from the lesser quantity of labor embodied in the Portuguese cloth and wine that Portugal must have had a productivity advantage over England in making these commodities. The opposite inference is not only perfectly possible but even more plausible from a theoretical and historical perspective. It is safe to assume that cloth production in England had a higher level of mechanization than in Portugal at the beginning of the nineteenth century. The use of better tools and machinery would partially substitute the labor of English workers

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<sup>10</sup> See, for example, Takashi Negishi (2014, p. 23), Andrea Maneschi (2015), Anwar Shaikh (2016, p. 505), Thomas Gerber and Rolf Weder (2017, p. 49), Jonathan Eaton (2017, p. 23), and Daniel M. Bernhofen and John C. Brown (2018, p. 232).

in the cloth factory. If fewer workers were directly deployed in cloth production in England than in Portugal, the former would have higher labor productivity than the latter, regardless of the higher amount of labor embodied in the English cloth.

Thomas Gerber and Rolf Weder (2017, p. 48) used the myth of Portugal's higher productivity in conjunction with the presumption of a higher wage rate there to explain why the Portuguese cloth was dearer than the English cloth. However, this explanation attempt is incompatible with the economic history and Ricardo's analysis in the *Principles*. As already explained in the previous section, the logic of the numerical example rests on the assumption that profits were higher in Portugal than in England. Likewise, according to Ricardo, "the cost of production, in money, means the value of labour, as well as profits" (vol. II, p. 34; vol. VIII, p. 279).<sup>11</sup> Consequently, given two lots of commodities with the same cost of production but different profit rates, the lot containing more profit must also have a lower value of labor. According to Ricardo's theory of the inverse relationship between profits and wages (vol. I, pp. 110–127), both cannot be higher in Portugal than in England at the same time. Therefore, the wages of the Portuguese workers must have been lower than that of the English workers. This also corresponds with the historical reality at the beginning of the nineteenth century.

Proponents of the productivity narrative like to refer to the well-known footnote on page 136 of the *Principles* as supposed textual evidence that they are true to Ricardo's original intent. It states as follows:

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. I, p. 136n)

It is noteworthy that the clearest indication for the veracity of the productivity narrative is said to be found in a marginal place. Why would Ricardo have wanted to reveal the central purpose of the four numbers in a footnote instead of the main text? Likewise, each of the two sentences in the footnote refers to a specific passage in the *Wealth of Nations*. The second sentence refers to Smith's example of the shoemaker and the tailor (*WN*, IV.ii.11:456–457). In a previous paper (Morales Meoqui 2017, p. 44), I already indicated that it is not possible to say whether it is in the interest of the superior man to employ himself exclusively in making shoes without knowing the exchange ratio between hats and shoes. I further claimed there that the first sentence of the footnote was most probably referring to another passage in the *Wealth of Nations* (*WN* I.i.4:16). Smith explained there why a rich country's productivity advantage in agriculture does not always lead to a cheaper price of the produce. Thus, England might import some amount

<sup>11</sup> Ricardo's definition of the cost of production—value of labor plus profits—is not equivalent to wage costs plus general profits (Tabuchi 2018, pp. 87, 89, 90), as the latter seems to leave out the raw materials, intermediate goods, tools, and machinery used in the production process.

of corn from France and Poland despite having better-cultivated lands than these two countries.

More than anything else, the footnote seems to indicate that Ricardo agreed with Smith's explanation for why producers located in wealthier countries might not be able to bring some commodities cheaper to market than their less productive competitors from poorer countries. He did not need to prove this proposition again in the *Principles*. Therefore, the footnote should be seen as a further argument against the productivity narrative.

But even if we ignore for a moment the mentioned issues with the footnote and accept the myth of Portugal's productivity advantage over England, the proponents of the productivity narrative would run into the next unsolvable problem. As I already proved in a previous paper (Morales Meoqui 2017, pp. 41–43), the rule for specialization suggested by the productivity narrative—"each country exports the good in which it has the smallest absolute disadvantage or the largest absolute advantage" (Ruffin 2005, pp. 717–718)—might recommend an exchange, which would contradict the classical rule for specialization used by Ricardo. This means that the two rules cannot be considered logically equivalent to determine the beneficial nature of an exchange between two countries.

For all the reasons mentioned above, I consider that the productivity narrative is unfaithful to the original purpose of the four numbers in the *Principles*. In reality, this false narrative was a poorly disguised effort to reinterpret J. S. Mill's mistaken contraposition of absolute and comparative advantage in the cost of production as a comparison of relative productivity advantages between countries. The reframing was greatly facilitated by the fact that "comparative advantage" is a very flexible term. Its meaning can be altered at will simply by changing the specification of the advantage. Trade theorists have made extensive use of this malleability as several theories of comparative advantage can be found in the literature today. Regardless of their specificities, however, the various theories of comparative advantage have at least one thing in common: they were all built on myths and false narratives derived from J. S. Mill's misinterpretation of Ricardo's numerical example.<sup>12</sup>

## VI. CONCLUSIONS

For many decades, Ricardo has been showered with praise—and sometimes criticism—for allegedly revealing the law of comparative advantage in his famous numerical example about the exchange of English cloth and Portuguese wine. Unfortunately, scholars praised or criticized him for the wrong reasons. Contrary to what is written in countless economics textbooks and journal articles, Ricardo did not reveal a new law, principle, or rule for international specialization but merely applied an equivalent expression of the classical rule for specialization there. Likewise, it is also not true that he left the terms of trade indeterminate in the numerical example. Neither were his four

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<sup>12</sup> See Taichi Tabuchi (2017) for a critical account on how the comparative advantage theory developed from James and John Stuart Mill to the neoclassical theory of international trade by the way of Viner's real cost approach, Haberler's opportunity cost approach, and Ohlin's factor endowment approach.



numbers meant to clarify the nature and proper measure of the gains from trade. In addition, Ricardo did not depict Portugal as the more productive country, and neither was his numerical example meant to prove that a less productive economy could participate in international trade but could not undersell a wealthier country in the production of every commodity. The previous sections have shown the fallacious nature of these narratives currently associated with his numerical example.

A closer reading of the primary source reveals that Ricardo intended to illustrate with the four numbers only that the relative value of two commodities produced in different countries is not determined by the respective quantities of labor expended in their production. Thus, they were meant to prove a conditional exception to Ricardo's general proposition that the exchange value—i.e., the natural price or cost of production—is approximately proportional to the quantities of labor expended. As he explained at length in the surrounding paragraphs, this exception arises from the fact that countries may have different ordinary rates of profit. This difference will persist until capital becomes as mobile internationally as it is within a country.

The continued misinterpretation of his numerical example since the first half of the nineteenth century is a consequence of the poor understanding of Ricardo's theory of value by renowned scholars from all major schools of economic thought. For the same reason, successive generations of economists failed to detect the full extent of J. S. Mill's misinterpretation of the purpose, content, and implications of the numerical example.

Likewise, the enduring enchantment of many economists with Ricardo's four numbers is the manifestation of a profoundly human trait: that of admiring things and assigning them magical properties when we cannot find an adequate explanation for them. When they are properly understood, there is nothing counterintuitive about the four numbers, much less magical.

At the very least, the thorough demystification of Ricardo's four numbers debunks the Whig interpretation of the law of comparative advantage. The intellectual history of this law can no longer be presented as one of continuity and steady progress from its original formulation in the *Principles* to the contemporary neoclassical models of international trade, as is customary with Ruffin (2002, 2005, 2017), Maneschi (2004, 2008, 2015, 2017), Daniel Bernhofen and John Brown (2018), and most economics textbooks. In truth, the only thing that has progressed steadily since 1817 is the level of confusion about the four numbers. Furthermore, this demystification will have far-reaching implications for international trade theory since J. S. Mill's misinterpretation of Ricardo was the starting point for all future developments in this field.

Moreover, the demystification of Ricardo's four numbers underscores the urgent need to read the classics. The common practice of recycling old myths from the secondary literature must stop if we want to cut off the steady stream of misguided praise and straw man arguments about Ricardo's economic theories in textbooks and research papers. Instead, we should all go back to his writings and read them more carefully. They contain no magic numbers but are otherwise full of valuable insights for our time.

## COMPETING INTERESTS

The author declares no competing interests exist.

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