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THE RICARDIAN THEORY OF INTERNATIONAL TRADE: A CRITICISM

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SUMÁRIO

1. INTRODUCTION

For almost two centuries, the theory of international trade has been entirely dominated by the principle of comparative advantage. Originally formulated by Ricardo (or Torrens) based on the labor theory of value,[1] this principle was incorporated into the supply-and-demand approach, through the Heckscher-Ohlin model.[2] Even the neo-Ricardian (or Sraffian) school, which criticized the Heckscher-Ohlin model on the grounds that it is inconsistent when produced capital goods are introduced among a country's inputs,[3] has also preserved the principle of comparative advantage,[4] which has thus found only a few critics so far, like Shaikh (1979a and 1979b), who nevertheless has not presented a fully formalized alternative model.

However, as will be shown later, neither Ricardo's principle of comparative costs nor its neo-Ricardian version seem to be compatible with the concept of long-run equilibrium prices (Ricardo's "natural prices") when money is a commodity like gold. The reason is that neither labor is traded against labor nor commodities are traded against commodities. Commodities are traded against money so that comparing relative prices in different countries do not make sense. What matters are prices in terms of gold, that is, absolute prices. Even in an economy where fiat money takes the place of commodity money, although the exchange rate can indeed make room for a commodity that was previously excluded from the international market, there is little room for the principle of comparative advantage.

The objective of this article is to address the question of international trade under the light of the theory of long run equilibrium prices. Particular attention is given to the principle of comparative advantage and the relationship between free trade and efficiency. To avoid a long discussion over issues that are not the main concern of this article, the financial aspects of international trade will be ignored.

This article is composed by ten sections and one appendix. Section 2 presents a simple model of long-run equilibrium prices for the gold standard, that is, an economy with commodity-money (gold). Section 3 discusses the dual of the price system, which is the system of sectorally balanced growth. Sections 4 to 6 present the argument in favor of the principle comparative advantage and discuss the relationship between free trade, profitability, balance of trade and economic growth. The criticism on the principle of comparative advantages is presented in section 7. Section 8 discusses the relationship between trade and the exchange rate. A numerical example is shown in section 9 and the conclusions are listed in section 10. The Appendix discusses Morishima's contention that the labor theory of value has no relation to determining the comparative advantage between two countries.

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[1] Chipman (1966, p. 482) argues that "it would be fair to say that both Torrens and Ricardo contributed in essential ways to the development of the law of comparative advantage; and that credit for the principal discovery should go to Torres".

[2] See Samuelson, 1948 and 1949; Lerner, 1952; Jones, 1956; Johnson, 1957; Bhagwati and Srinivasan, 1984.

[3] See Metcalfe and Steedman, 1972 and 1973; Evans, 1989a.

[4] The Sraffian authors recognize the possibility of losses from free trade arriving from the non-optimality of the choice of specialization or from a temporary fall in employment in an economy that adopts the free trade regime. However, when the economy grows at its maximum rate, the long-run effects of international trade are positive, leading to an outward shift in the wage-profit and the consumption-growth frontiers. See Mainwaring, 1973; Parrinello, 1973; Metcalfe and Steedman, 1974, Steedman, 1979; Evans, 1989; and Pasinetti, 1993.

2. A SIMPLE MODEL OF LONG-RUN EQUILIBRIUM PRICES FOR THE GOLD STANDARD

The first precise definition of long-run equilibrium prices can be found in Chapter 7 of Book I of The *Wealth of Nations*, where Smith distinguishes "natural" prices from market prices. While the formers are defined as prices that allow labor, capital, and land to be remunerated according to their ordinary or average rates (Smith, 1976 p. 62), the latter are conceived as actual prices that depend on the balance between the quantity supplied and the level of "effectual demand," (the quantity that would be demanded if long-run equilibrium prices prevailed in the market). Market prices may either be above, or below, or exactly the same as the natural prices (Smith, 1976 p. 63).

Smith is also clear regarding natural prices as the prices that encapsulate the persistent forces in the economic system, in opposition to market prices, which depend on temporary and accidental factors. The central position of the natural prices is assured by the presence of economic forces that are unleashed as soon as actual prices diverge from natural prices. These forces comprise the adjustment mechanism, which works as follows. If the quantity of a commodity brought to the market exceeds the effectual demand, some component parts of its price must be paid below their natural rate, which makes some factors of production to withdraw from this employment. The consequence is that the quantity brought to market decreases until it is just sufficient to supply the effectual demand. Then, the market price as well as the remuneration of the different factors of production rise up to their equilibrium levels. The opposite takes place when the quantity brought to market falls short of the level of effectual demand (Smith, 1976, p. 65).

Smith concludes by considering natural prices as *centers of gravity* of market prices: "The natural price, therefore, is, as it were, the central price, to which the prices of all commodities are continually gravitating. Different accidents may sometimes keep them suspended a good deal above it, and sometimes force them down even somewhat below it. But whatever may be the obstacles which hinder them from settling in this center of repose and continuance, they are constantly tending towards it" (Smith, 1976, p. 65).

Ricardo does not add anything new to Smith's analysis, since he recognizes that "in the 7th chapter of the Wealth of Nations, all that concerns this question [- the difference between market prices and natural prices and the gravitation of the formers around the latter -] is most ably treated" (Ricardo, 1951, p. 101). Nevertheless, Ricardo shifts the emphasis toward the fact that it is the tendency to an uniform rate of profits across sectors that brings about the process of gravitation of market prices around natural prices. He concludes, thus, that "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" (Ricardo, 1951, p. 91).[5]

[5] The same conception is held by Marx, who points out that "it is competition of capitals in different spheres, which first brings out the price of production equalizing the rates of profit in the different spheres" (Marx, 1894, p. 180).

A modern expression of the Smithian-Ricardian concept of "natural" prices may be obtained by using matrix algebra. To avoid unnecessary difficulties not related to the question under exam, it is assumed a simple economy subject to constant returns to scale, without joint production and fixed capital. The turnover time of circulating capital is supposed to be unitary.[6]

If this economy produces n commodities, the system of long-run equilibrium prices can be expressed as:[7]

$$\mathbf{p} = \mathbf{p}\,\mathbf{A} + w\,\mathbf{a_0} + r\,(\mathbf{p}\,\mathbf{A} + w\,\mathbf{a_0}) = (1 + r)\,(\mathbf{p}\,\mathbf{A} + w\,\mathbf{a_0}) \tag{2.1}$$

where **p** is the row vector of long-run equilibrium prices; **A** the n by n matrix of technical coefficients; $\mathbf{a_0}$ the row vector of labor coefficients; w the wage rate and r the rate of profits, which means that **pA** represent raw material unitary costs, $w\mathbf{a_0}$ stands for labor unitary costs and $r(\mathbf{pA} + w\mathbf{a_0})$ are profits per unit of product since $(\mathbf{pA} + w\mathbf{a_0})$ represents the amount of (circulating) capital per unity of output.

Considering (2.1) as a system of **relative** prices, it can be seen that it has n independent equations and n+1 unknowns such that it has one degree of freedom. But Ricardo sustains that the twin concepts of competition and normal prices also hold in the labor market so that the price of labor power considered as an ordinary commodity should be equal to its costs of production. This idea can be formally expressed through the wage equation:

$$w = \mathbf{p}\,\mathbf{d} \tag{2.2}$$

where **d** is the column vector representing the (given) wage basket, which is the real wage determined by the "subsistence" requirements of the labor force.

Substituting (2.2) into (2.1) gives a system of homogeneous equations, which solution requires:

$$\det\left[\lambda\mathbf{I} - (\mathbf{A} + \mathbf{d}\mathbf{a_0})\right] = 0 \tag{2.3}$$

where

$$\lambda = 1/(1+r) \tag{2.4}$$

Note that since the technical properties of the economic system must be such as to permit the production of at least some product in addition to those needed for the replacement of the means of production used up in the production process and to those necessary to satisfy workers' needs, the spectral radius of the matrix $(\mathbf{A} + \mathbf{d}\mathbf{a_0})$, λ_{max}, should be less than unity. Now, if in addition $(\mathbf{A} + \mathbf{d}\mathbf{a_0})$ is assumed to be

[6] The system presented below is the same as Morishima's (1990, pp. 126-146).

[7] Land is excluded because Ricardo considers ground rent always as differential rent so that it does not enter price determination (the "natural price" of agricultural products are determined in the land of higher costs).

irreducible, it follows from the Perron-Frobenius theorem that its eigenvector **p** associated with its maximum eigenvalue, λ_{max}, and defined in the identity

$$\mathbf{p}\,[\lambda_{max}\mathbf{I} - (\mathbf{A} + \mathbf{da_0})] = 0 \qquad (2.5)$$

is positive (see Graham, 1987, pp. 112-68; Pasinetti, 1977, pp. 267-76). Note that this eigenvector is unique with the only qualification that its length is undefined: any other vector of the form k**p** where k is a constant different from zero is also a solution of the above characteristic equation. In other words, once the technology and the real wage are known, the classical system of long-run prices yields a solution that exists and is unique but for a proportional factor.

Once the existence and uniqueness of equilibrium have been established, it is possible to show the inverse relationship between the profit rate and the real wage. First, assume that the composition of the real wage is fixed but its level is variable:

$$\mathbf{d} = \omega\,\mathbf{d} \qquad (2.6)$$

where $0 \leq \omega \leq \omega_{max}$. The maximum real wage ($\omega_{max}\mathbf{d}$) corresponds to that situation where the economic system does not produce any "surplus", such that all the product is required to replace the means of production used up in the production process and to satisfy workers' needs. Then the following condition holds:

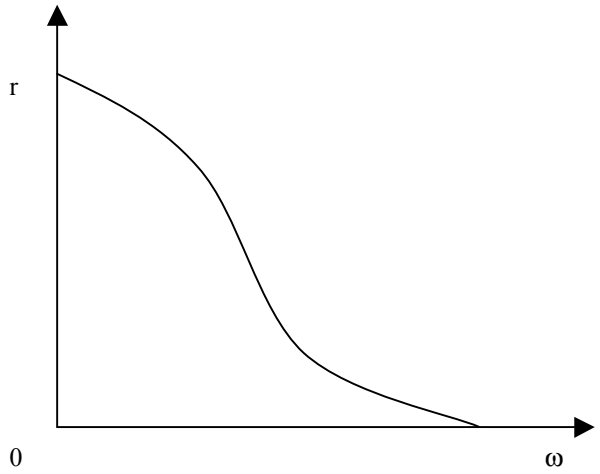
$$\det\,[\mathbf{I} - (\mathbf{A} + \omega_{max}\mathbf{da_0})] = 0$$

which means that

$$\lambda_{max} = 1$$

Assuming then a given technology (which corresponds to a matrix of technical coefficients **A** and a vector of labor coefficients $\mathbf{a_0}$), the elements of the matrix ($\mathbf{A} + \omega\mathbf{da_0}$) will be a crescent function of the real wage level ω. But because the Perron-Frobenius Theorem states that the spectral radius λ_{max} of a non-negative matrix is a crescent function of its elements, it follows from (2.4) that the profit rate is an inverse function of the elements of the real wage (see Figure 1).

Figure 1: Wage-Profit Curve



Having examined the determination of the profit rate and the equilibrium prices based on a given technological set, (**A**, $\mathbf{a_0}$), and the real wage, $\omega\mathbf{d}$, the only question that remains regarding the existence of equilibrium is then the choice of technology, which means the choice of the elements of matrix **A** and vector $\mathbf{a_0}$.

Okishio's Theorem (Okishio, 1961; Roemer, 1988, pp. 97-98) may be used to address this question. Assuming a given real wage $\omega\mathbf{d}$, competition forces the entrepreneurs of each sector to use the available technology associated with the lowest cost of production. Okishio's Theorem ensures that the resulting technological set, (**A**, $\mathbf{a_0}$), will be associated with the highest profit rate r so that the solution of the problem of technique's choice is equivalent to the choice of the particular technological set associated with the lowest λ_{max}.

As seen, the Smithian-Ricardian theory of value and distribution developed above is sufficient to determine all relative prices and the shares of the different "factors of production" in the product. However, the system is open since the price level remains undetermined. To close it both Smith (1976, pp. 25-26) and Ricardo (1811, p. 74) ascribe to a specific commodity the role of money.[8] As Hawtrey (1950, p. 17) asserts, "according to the classical theory of money (...), money is a selected commodity" (see also Vickers, 1975, p. 483). A unity of this commodity - say, a gold coin - is, then, the standard of value of the price system:[9]

[8] Marx also works with commodity-money. See Marx, 1867, vol. I, p. 74.

[9] Note that prices in terms of gold coins may diverge from prices in terms of bullion in the long run due to two causes (Smith, 1996, p. 52). First, the price of bullion differs from the price of production of gold coins by the costs of coinage, if no additional state seignorage is charged. Second, the wear and tear of coins due to the circulation process may cause their real weight to be different from their "nominal" weight. To avoid additional and unnecessary difficulties, it is supposed in this study that the cost of coinage is covered by the state and that the coins remain in full weight by an efficient management, which means that there is no divergence between prices in terms of coins and prices in terms of gold in the long run.

$$p_o = 1 \tag{2.7}$$

Equation (2.7) closes the Smithian-Ricardian price system allowing the determination of price level. Therefore, equations (2.1), (2.2), and (2.7) constitute the Smithian-Ricardian price model, which determines the distributive variables w and r and absolute prices $\mathbf{p} = \mathbf{p}/p_o$. It shows that price level depends in the long run upon the purchasing power of the commodity-money, i.e., on its price of production vis-a-vis the price of production of the other commodities.

3. A SIMPLE MODEL FOR BALANCED GROWTH (DUALITY)

Although the model outlined in section 2 allows to exam the impacts of international trade upon economic efficiency measured by the rate of profits, it does not have the elements to study the relationship between international trade and economic growth.

To address this question, it is necessary to consider the balance between supply and demand for all commodities. Assuming that there is no technical progress, that consumers' preferences are constant over time,[10] that workers do not save and that, as in Quesnay's *Tableau Economique* or in Marx's schemes of reproduction, production in one period is consumed in the next one, the balance between supply and demand in all sector may be described as

$$\mathbf{x}_t = \mathbf{A}\,\mathbf{x}_{t+1} + \omega\,\mathbf{d}\,\mathbf{a}_0\,\mathbf{x}_{t+1} + \mathbf{c}_{t+1} \tag{3.1}$$

where $\mathbf{x}_t$ represents the vector of quantities supplied in period t; $\mathbf{A}\,\mathbf{x}_t$ is vector of demand for inputs; $\omega\mathbf{d}\mathbf{a}_0\mathbf{x}_{t+1}$ stands the vector of demand for wage goods; and $\mathbf{c}_{t+1}$ is the vector of capitalistic demand for consumption goods.

Assuming that growth is sectorally balanced (i.e., that all sectors grow at the same rhythm)[11], it follows that:

$$\mathbf{x}_{t+1} = (1 + g)\,\mathbf{x}_t \tag{3.2}$$

which implies that equation (3.1) becomes:

$$\mathbf{x}_t = (1 + g)\,[\mathbf{A} + \omega\mathbf{d}\mathbf{a}_0]\,\mathbf{x}_t + \mathbf{c}_{t+1} \tag{3.3}$$

Now, if it is assumed that capitalists invest all profits or that capitalist consumption is included in the wage bundle, then $\mathbf{c}_{t+1} = 0$, which means that the condition for reproduction becomes:

[10] Pasinetti (1977, p. 191) classifies a model that considers such hypothesis as "quasi-dynamic".

[11] Pasinetti (1977, p. 190-1) considers this simplified type of dynamics as "proportional dynamics."

$$[\mathbf{I} - (1 + g)(\mathbf{A} + \omega \mathbf{d a_0})]\, \mathbf{x}_t = 0 \tag{3.4}$$

which solution requires

$$\det [\lambda \mathbf{I} - (\mathbf{A} + \omega \mathbf{d a_0})] = 0 \tag{3.5}$$

where

$$\lambda = 1/(1 + g) \tag{3.6}$$

Comparing the relations above with (2.4) and (3.6) gives:

$$g = r \tag{3.7}$$

which means that, under the assumption that all profits are invested, the sectorally balanced growth rate is equal to the profit rate.

4. COMPARATIVE ADVANTAGE AND PROFITABILITY

The principle of comparative advantage, as put forward by Ricardo, states that if a country, no matter how backward it is in technological terms, concentrates its production in the relatively cheaper commodities and imports the others, then it would end up better off comparing to the pre-trade situation, in the sense that through international trade a given set of inputs would result into more outputs than before trade. Thus, absolute costs do not matter; all that is important is relative costs.

To exam this proposition, consider a country (Portugal) and the rest of the world economy, whose technological sets are given by ($\mathbf{a}_{0P}$, $\mathbf{A}_P$) and ($\mathbf{a}_{0R}$, $\mathbf{A}_R$) respectively. Their wage baskets are respectively $\mathbf{d_P}$ and $\mathbf{d_R}$. According to the theory outlined in section 2, if it is assumed that gold is the standard of value, these elements are sufficient to determine the autharchic rate of profit and the price vector for both Portugal ($r_\mathbf{P}$ and $\mathbf{p_P}$) and the rest of the world ($r_\mathbf{R}$ and $\mathbf{p}_R$).

The assumption that the Portuguese economy is less developed than the rest of the world's economy may be expressed through the concept of rate of economic surplus, ε, which is defined as the proportion between outputs and inputs, which include workers' consumption:

$$\mathbf{X_t} = (1 + \varepsilon)(\mathbf{A} + \mathbf{d}\, \mathbf{a_0})\, \mathbf{x_t} \tag{4.1}$$

Because the surplus rate is given by

$$\varepsilon = 1/\lambda_{max} - 1 \qquad (4.2)$$

the hypothesis that Portugal is less developed that the rest of the world may be expressed as

$$\lambda_{max}\ \{\mathbf{A}_P + \mathbf{d}_P\, \mathbf{a_0}_P\} > \lambda_{max}\ \{\mathbf{A}_R + \mathbf{d}_R\, \mathbf{a_0}_R\}.$$

where $\lambda_{max}\{\mathbf{A}_P+\mathbf{d}_P\mathbf{a_0}_P\}$ is the spectral radius of matrix $(\mathbf{A}_P + \mathbf{d}_P\ \mathbf{a_0}_P)$ and $\lambda_{max}\{\mathbf{A}_R+\mathbf{d}_R\mathbf{a_0}_R\}$ is the spectral radius of $(\mathbf{A}_R + \mathbf{d}_R\ \mathbf{a_0}_R)$.

Comparing (2.4) and (4.2) and considering that $\lambda = \lambda_{max}$, it is clear that the surplus rate is equal to the profit rate:

$$\varepsilon = r \qquad (4.3)$$

which means that the supposition that Portugal is less developed than the rest of the world is equivalent to the hypothesis that the rest of the world's economy has a higher profit rate than the Portuguese economy $(r_{\mathbf{R}} > r_{\mathbf{P}})$.

If this is the case, it would not be not difficult to prove that at least one price in the rest of the world is lower than in Portugal.[12] This implies that, if it prevails a free trade regime and if transportation costs are null, Portuguese merchants will import those commodities that are cheaper in the rest of the world while merchants from the rest of the world will purchase those commodities that are cheaperly produced in Portugal. Imports will then take the place of domestic production for those commodities that are cheaperly produced in the rest of the world so that the corresponding columns in the Portuguese matrix $\mathbf{A}_P$ will become null and so the corresponding entries in the Portuguese domestic price vector $\mathbf{p}_P$. After-trade price equation will then assume the form

$$\mathbf{p}_P = (1 + r_{TP})\ (\mathbf{p}_P\, \mathbf{A}_{DP} + \mathbf{p}_R\, \mathbf{A}_{IP} + w_P\, \mathbf{a_0}_{DP}) \qquad (4.4)$$

where $r_{\mathbf{TP}}$ represents after-trade Portuguese rate of profit, $\mathbf{A}_{DP}$ is the Portuguese after-trade matrix of technical coefficients of domestically produced goods; $\mathbf{A}_{IP}$ is the Portuguese matrix of technical coefficients of imported goods; w_P is the Portuguese wage rate; and $\mathbf{a_0}_{DP}$ stands for the Portuguese row vector of labor coefficients.

But since the wage basket may include imported goods as well, the wage equation becomes

$$w_P = \mathbf{p}_P\, \mathbf{d}_{DP} + \mathbf{p}_R\, \mathbf{d}_{IP} \qquad (4.5)$$

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[12] Assume that $\mathbf{p}_R \geq \mathbf{p}_P$. Multiplying both sides by $(\mathbf{A}_R + \mathbf{d}_R\ \mathbf{a_0}_R) = \mathbf{M}_R$ yields $\mathbf{p_R}\ \mathbf{M}_R \geq \mathbf{p}_P\ \mathbf{M}_R$, or $\mathbf{p}_R\ \mathbf{M}_{R.j}/\ p_{Rj} \geq \mathbf{p}_P\ \mathbf{M}_{R.j}/\ p_{Rj}$. Because $\mathbf{p}_R\ \mathbf{M}_{R.j}/\ p_{Rj} = \lambda_R$, it follows that $\lambda_R \geq \mathbf{p}_P\ \mathbf{M}_{R.j}/\ p_{Rj}$. But since $\mathbf{p}_P \neq \mathbf{p}_R$ it follows that $\min_j\ (\mathbf{p}_P\ \mathbf{M}_{R.j}/\ p_{Rj}) < \lambda_R < \min_j\ (\mathbf{p}_P\ \mathbf{M}_{R.j}/\ p_{Rj})$, which is a contradiction.

where $\mathbf{d}_{DP}$ and $\mathbf{d}_{IP}$ stand for the column vectors of Portuguese domestic and imported wage goods respectively.

Substituting (4.5) into (4.4) yields

$$\mathbf{p}_P = (1 + r_{TP}) [\mathbf{p}_P \mathbf{A}_{DP} + \mathbf{p}_R \mathbf{A}_{IP} + (\mathbf{p}_P \mathbf{d}_{DP} + \mathbf{p}_R \mathbf{d}_{IP}) \mathbf{a}_{0DP}] \quad (4.6)$$

Now, assuming that matrix $[\mathbf{I} - (1 + r_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]$ is non-singular, it follows that:

$$\mathbf{p}_P = (1 + r_{TP}) \mathbf{p}_R (\mathbf{A}_{IP} + \mathbf{d}_{IP} \mathbf{a}_{0DP})[\mathbf{I} - (1 + r_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]^{-1} \quad (4.7)$$

The necessary and sufficient condition to have a non-singular matrix $[\mathbf{I} - (1 + r_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]$ and a non-negative $[\mathbf{I} - (1 + r_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]^{-1}$, which is required to obtain a non-negative price vector $\mathbf{p}_P$, is given by

$$r_{TP} > r_{P} \quad (4.8)$$

To see why, rewrite equation (4.7) as

$$\mathbf{p}_P = \mathbf{p}_R (\mathbf{A}_{IP} + \mathbf{d}_{IP} \mathbf{a}_{0DP})[\lambda\mathbf{I} - (\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]^{-1}$$

where $\lambda = 1/(1 + r_{TP})$. Since $\mathbf{p}_P$ and $(\mathbf{A}_{IP} + \mathbf{d}_{IP} \mathbf{a}_{0DP})$ are non-negative, it follows that matrix $[\lambda\mathbf{I} - (\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]^{-1}$ must exist and be non-negative to ensure the non-negativeness of $\mathbf{p}$. But this double condition can be satisfied only if $\lambda > \lambda_{max}\{\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP}\}$. In this case, $[\lambda\mathbf{I} - (\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})]$ becomes a Maiakovsky matrix, which is non-singular and non-negative by definition (Graham, 1987, pp. 169-70). Now, since λ is a monotonically increasing function of the elements of its corresponding matrix and the difference between $(\mathbf{A}_P + \mathbf{d}_P \mathbf{a}_{0P})$ and $(\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP})$ is that the former includes some columns that are null in the latter, it follows that $\lambda_{max}\{\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP}\} \leq \lambda_{max}\{\mathbf{A}_P + \mathbf{d}_P \mathbf{a}_{0P}\}$. Condition (4.8) follows then from the fact that, according to (2.4), $r_{TP} = 1/\lambda_{max}(\mathbf{A}_{DP} + \mathbf{d}_{DP} \mathbf{a}_{0DP}) - 1$ and $r_P = 1/\lambda_{max}(\mathbf{A}_P + \mathbf{d}_P \mathbf{a}_{0P}) - 1$.

Condition (4.8) is striking, because it shows that specialization results in a higher rate of profits, confirming the comparative advantage principle. [13]

[13] In this sense, production specialization induced by free trade can be viewed as a particular case of choice of technique: according to the profit maximising criterion (Mainwaring, 1973).

5. COMPARATIVE ADVANTAGE, BALANCE OF TRADE, AND GROWTH

To consider the relation between economic specialization, balance of trade and economic growth, assume that the Portuguese economy is growing at its maximum rate. Under a free trade regime, its imports, $\mathbf{x}_{IP}$, are given by:

$$\mathbf{x}_{IP} = (1 + g_{TP}) [\mathbf{A}_{IP} + \mathbf{d}_{IP}\, \mathbf{a}_{\mathbf{0}DP}]\, \mathbf{x}_{DP} \tag{5.1}$$

while its production, $\mathbf{x}_{\mathbf{DP}}$, by:

$$\mathbf{x}_{DP} = (1 + g_{TP}) [\mathbf{A}_{DP} + \mathbf{d}_{DP}\, \mathbf{a}_{\mathbf{0}DP}]\, \mathbf{x}_{DP} + \mathbf{x}_{EP} \tag{5.2}$$

where $g_{\mathbf{PT}}$ stands for Portugal's growth rate under a free trade regime and $\mathbf{x}_{\mathbf{EP}}$ for Portugal's exports.

Since equilibrium in trade balance requires

$$\mathbf{p}_P\, \mathbf{x}_{EP} = \mathbf{p}_R\, \mathbf{x}_{IP} \tag{5.3}$$

it is not difficult to see that

$$\mathbf{p}_P [\mathbf{I} - (1 + g_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP}\, \mathbf{a}_{\mathbf{0}DP})]\, \mathbf{x}_{DP} = (1 + g_{TP})\, \mathbf{p}_R\, (\mathbf{A}_{IP} + \mathbf{d}_{IP}\, \mathbf{a}_{\mathbf{0}DP})\, \mathbf{x}_{DP}$$

which can also be obtained from (4.6) under the condition that

$$g_{\mathbf{T}P} = r_{\mathbf{T}P} > r_P = g_P \tag{5.4}$$

which means that (i) under free trade the maximum growth rate is also equal to the profit rate; (ii) free trade increases economy's efficiency since both profitability and the maximum rate of growth are augmented by trade liberalization.

6. COMPARATIVE ADVANTAGES AND PROFIT RATE EQUALIZATION

An important hypothesis implicit in the reasoning developed in sections 4 and 5 is that Portugal is a small economy in the sense that its external market is unlimited irrespective of its after trade productive specialization. This assumption, however, should be abandoned in so far as a full model for the world economy is available.

To extend the model developed in the previous sections to the world economy the first step is to consider that Portugal's imports represent the rest of the world's export's and Portugal's exports are the rest of the world's imports:

$$\mathbf{p}_P \, \mathbf{x}_{EP} = \mathbf{p}_R \, \mathbf{x}_{IR} \tag{6.1}$$

and

$$\mathbf{p}_R \, \mathbf{x}_{ER} = \mathbf{p}_P \, \mathbf{x}_{IP} \tag{6.2}$$

which means that

$$\mathbf{p}_P \, [\mathbf{I} - (1 + g_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP} \, \mathbf{a}_{\mathbf{0}DP})] \, \mathbf{x}_{DP} = (1 + g_{TR}) \, \mathbf{p}_R \, (\mathbf{A}_{IR} + \mathbf{d}_{IR} \, \mathbf{a}_{\mathbf{0}DR}) \, \mathbf{x}_{DR}$$

Using (5.1), (5.2) and (5.3), it is easy to see that

$$r_{P\mathbf{T}} = g_{PT} = g_{RT} = r_{RT} \tag{6.3}$$

which means that free trade tends to equalize profits rates in the different countries in the long run.[14]

In fact, this should not be surprising since it is a consequence of the fact that growth is dependent on exports/imports, that are themselves mutually dependent. Besides, there is no need to assume capital mobility among countries to have a world-wide homogeneous profit rate since capital supply is internally regulated and it depends on the speed of growth.

7. COMPARATIVE OR ABSOLUTE ADVANTAGES?

If it is assumed that, in a world of free trade, the cost of production of each commodity is not the same in two countries, an homogeneous profit rate implies that each commodity will be produced in only one country. As a consequence, the world price system can be modeled as if it were a single economy:

$$\mathbf{p}_M = (1 + r_M) \, \mathbf{p}_M \, (\mathbf{A}_M + \mathbf{d}_M \, \mathbf{a}_{\mathbf{0}M}) \tag{7.1}$$

where $\mathbf{A}_M$ is the matrix of technical coefficients of the world economy. Notice that, although a country of this integrated economy can have more than one industry, each vector $\mathbf{A}_{M\cdot\mathbf{j}}$ represents an industry localized in only one country. Matrix $\mathbf{d}_M\mathbf{a}_{\mathbf{0}M}$ is also a composit one in the sense that it shows the product of the labor coefficient of an industry that is localized in determined country by the j-th element of the labor basket of the same country.

[14] This is the classical counterpart of the so-called factor price equalization theorem, derived from the Heckscher-Ohlin model (Samuelson, 1948 and 1949)

In this economy, the profit rate is given by

$$r_M = 1/\lambda_{max}\{\mathbf{A}_M + \mathbf{d}_M\,\mathbf{a_0}_M\} - 1 \qquad (7.2)$$

and, accepting the Ricardian notion of commodity-money, the price level is still determined by (2.7).[15]

At this stage of analysis, it seems clear that the Ricardian theory of comparative advantage involucrates a contradiction: assuming that the world economy can be divided in two different parts – Portugal's economy and the rest of the world economy – it is not difficult to see that, although trade liberation increases Portugal's profit rate, it may cause the rest of the world's profit rate to fall.

The question is that, unless the Portuguese economy has absolute advantages in some sectors, its merge with the rest of the world's economy causes a loss of efficiency and produces a lower rate of profit for the rest of the world's economy. To prove this proposition it is sufficient to assume that Portugal has no absolute advantage in any sector and nevertheless participates in the world economy. In this case, the spectral radius of matrix $[\mathbf{A}_R+\mathbf{d}_R\mathbf{a_0}_R]$ will be lower than the spectral radius of matrix $[\mathbf{A}_M+\mathbf{d}_M\mathbf{a_0}_M]$. As a result, both the world's after-trade surplus rate and profit rate would be lower than the rest of the world's autarchic surplus rate and profit rate:

$$\varepsilon_{\mathbf{R}} = r_{\mathbf{R}} > \varepsilon_{\mathbf{M}} = r_{\mathbf{M}} \qquad (7.3)$$

Another way to look at the same question is through Okishio's Theorem, which ensures that a given technology α will be used only if, at the prevailing prices, the costs of production resulting from the use of this technology is lower or equal than the costs of production associated with the prevailing technology. In other words, if Portugal uses a given technique to produce commodity j, it will continue producing it after adopting free trade if and only if

$$\mathbf{p}_M\,(\mathbf{A}_{P\bullet j}^{\alpha} + \mathbf{d}_P\,\mathbf{a_0}_{Pj}^{\alpha}) \leq \mathbf{p}_M\,(\mathbf{A}_{R\bullet j} + \mathbf{d}_R\,\mathbf{a_0}_{Rj}) \qquad (7.4)$$

Conversely, assuming a world economy composed by Portugal and the rest of the world and supposing that Portugal has no absolute advantage in producing any commodity, the rest of the world's entrepreneur would use their technology to expel Portuguese producers from the world market.

In sum, in an economy where gold is the standard of value, there can not be any principle of comparative advantages: absolute advantages in the world economy and a country that does not produce any commodity at costs equal or lower than the other countries is simply excluded from the world economic system.

[15] By assumption, money (gold) is produced in only one country.

8. COMPARATIVE ADVANTAGES AND THE EXCHANGE RATE

Although the above reasoning is valid for an economy with commodity-money, it does not seem to be extendable to an economy with fiat money because in this economy the law of one price does not hold and international prices are related to domestic prices through the exchange rate (e) such that price system of country P becomes:

$$\mathbf{p}_P = (1 + r_{TP}) [\mathbf{p}_P \mathbf{A}_{DP} + e\, \mathbf{p}_R \mathbf{A}_{IP} + (\mathbf{p}_P \mathbf{d}_{DP} \mathbf{a}_{0DP} + e\, \mathbf{p}_R \mathbf{d}_{IP} \mathbf{a}_{0DP})] \quad (8.1)$$

The introduction of the exchange rate makes room for a weak version of the comparative advantage theory. Because a country like Portugal will continue using an available technique α to produce commodity j after adopting free trade if and only if

$$\mathbf{p}_P(\mathbf{A}_{DP\bullet j}^{\alpha} + \mathbf{d}_{DP}\mathbf{a}_{0Pj}^{\alpha}) + e\mathbf{p}_R(\mathbf{A}_{IP\bullet j}^{\alpha} + \mathbf{d}_{IP}\mathbf{a}_{0Pj}^{\alpha}) \leq e\mathbf{p}_R(\mathbf{A}_{DR\bullet j} + \mathbf{d}_{DR}\mathbf{a}_{0Rj}) + \mathbf{p}_P(\mathbf{A}_{IR\bullet j} + \mathbf{d}_{IR}\mathbf{a}_{0Rj})$$

it follows that it can make this technique competitive in the international market determining the exchange rate greater than the quotient between the difference between the domestic component of the cost of production in country P and the imported component of cost of production in the rest of the world and the difference between the domestic component of the cost of production in the rest of the world and the imported component of cost of production in country P:

$$e \geq \frac{\mathbf{p}_P(\mathbf{A}_{DP\bullet j}^{\alpha} + \mathbf{d}_{DP}\mathbf{a}_{0Pj}^{\alpha}) - \mathbf{p}_P(\mathbf{A}_{IR\bullet j} + \mathbf{d}_{IR}\mathbf{a}_{0Rj})}{\mathbf{p}_R(\mathbf{A}_{IP\bullet j}^{\alpha} + \mathbf{d}_{IP}\mathbf{a}_{0Pj}^{\alpha}) - (\mathbf{A}_{DR\bullet j} + \mathbf{d}_{DR}\mathbf{a}_{0Rj})} \quad (8.2)$$

The cost of such a policy for country P, however, can be high in terms of inflation, because, as identity (8.3) shows, in an economy with fiat money the exchange rate works as the anchor for the price level[16]

$$\mathbf{p}_P = (1 + r_{TP})\, e\, \mathbf{p}_R (\mathbf{A}_{IP} + \mathbf{d}_{IP}\, \mathbf{a}_{0DP})[\mathbf{I} - (1 + r_{TP})(\mathbf{A}_{DP} + \mathbf{d}_{DP}\, \mathbf{a}_{0DP})]^{-1} \quad (8.3)$$

For the world economy the cost of using the exchange rate as a competitive variable is also high in terms of loss of efficiency. Indeed, introducing the exchange rate in the world's price system gives

$$\mathbf{p}_M <\mathbf{e}> = (1 + r_M)\, \mathbf{p}_M <\mathbf{e}> (\mathbf{A}_M + \mathbf{d}_M\, \mathbf{a}_{0M})$$

[16] The role of the exchange rate as an anchor for the price level (in opposition of the interest rate and monetary control) has been demonstrated by the effect of exchange rate appreciation on the domestic price level, and by the many stabilization experiences of currencies subject to high inflation/ hyperinflation in this century. See, for instance, Zini, 1993.

where <**e**> stands for the diagonal matrix of exchange rates. Because it is non-singular, the international price system may be expressed as:

$$\mathbf{p}_M = (1 + r_M)\, \mathbf{p}_M <\mathbf{e}> (\mathbf{A}_M + \mathbf{d}_M\, \mathbf{a}_{0M}) <\mathbf{e}>^{-1} \qquad (8.4)$$

which means that the international profit rate is still determined by identity (7.2) since

$$\lambda_{max}\{<\mathbf{e}> (\mathbf{A}_M+\mathbf{d}_M\mathbf{a}_{0M}) <\mathbf{e}>^{-1}\} = \lambda_{max}\{<\mathbf{e}>\}\ \lambda_{max}\{\mathbf{A}_M+\mathbf{d}_M\mathbf{a}_{0M}\}(1/\lambda_{max}\{<\mathbf{e}>\})$$
$$= \lambda_{max}\{\mathbf{A}_M+\mathbf{d}_M\mathbf{a}_{0M}\}$$

But since matrix $(\mathbf{A}_M+\mathbf{d}_M\mathbf{a}_{0M})$ includes some Portuguese industries that have higher costs than the rest of the world corresponding sectors, it can be concluded that the world economy that comes about from Portugal's use of the exchange rate to make room for these industries is less efficient then the system that would result from Portugal exclusion from the world economy.

9. A NUMERICAL EXAMPLE

To have a clearer understanding of the issues involved in this discussion, suppose two economies characterized in the following way:

Portugal

$$\mathbf{A}_P = \begin{bmatrix} 0.3 & 0{,}8 \\ 0.3 & 0{,}2 \end{bmatrix} \quad \mathbf{a}_{0P} = \begin{bmatrix} 0.2 & 0.1 \end{bmatrix}$$

$$\mathbf{D}_P = \begin{bmatrix} 0.4 \\ 0.4 \end{bmatrix}$$

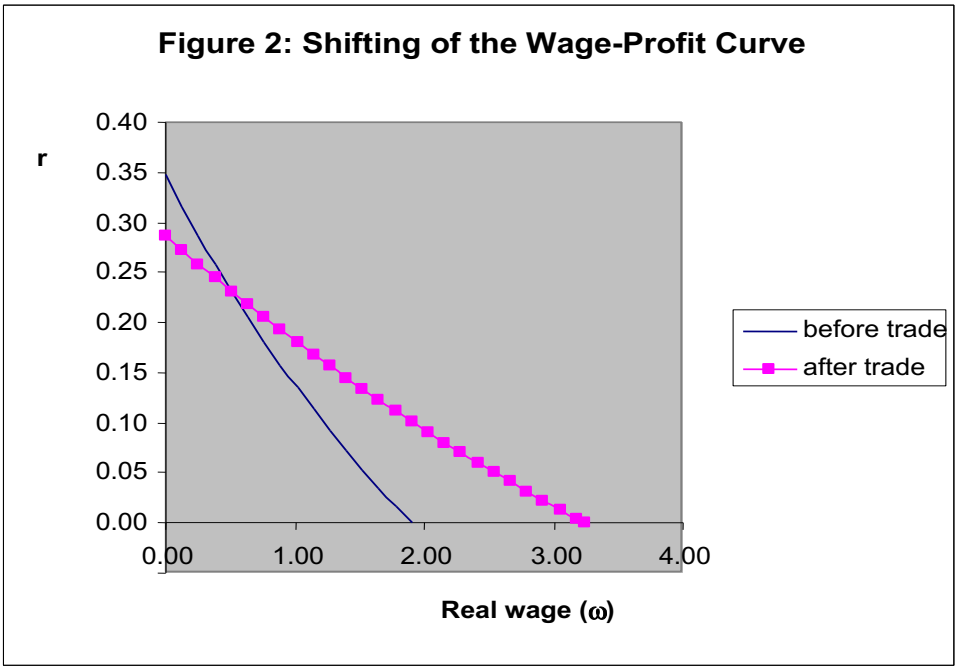
Rest of the world:

$$\mathbf{A}_R = \begin{bmatrix} 0.4 & 0.5 \\ 0.1 & 0.3 \end{bmatrix} \quad \mathbf{a}_{0R} = \begin{bmatrix} 0.2 & 0.1 \end{bmatrix}$$

$$\mathbf{d}_R = \begin{bmatrix} 0.4 \\ 0.4 \end{bmatrix}$$

Using (2.1) it can be seen that Portugal's before trade profit rate, r_P, is 13.73%, while the rest of the world's before trade profit rate, r_R, is 37.07% and that, if commodity 2 is taken as the *numeraire* of the price system ($p_{P2}=p_{R2}=\$\ 1$), then the price of commodity 1 is \$ 0.76107 in Portugal and \$ 0.72135 in the rest of the world. The nominal wage is \$ 0.70443 in Portugal and \$ 0.68854 in the rest of the world.

If the principle of comparative advantage worked, the adoption of free trade would force Portugal to specialize in the production of commodity 2 and import commodity 1 from the rest of the world. Assuming that Portugal is a "small economy" in the sense that the price of commodity 1 would not change if Portugal joined the international economy, the cost of production of commodity 2 would fall to \$ 0.86896, which is lower than its before trade cost of production (\$ 0.87930). The profit rate would increase to 15,09%, while the cost of the wage basket would fall from \$ 0.70443 to \$ 0.69926. In other world, the profit-rate curve would shift such that at the current real wage there would be an increase in Portugal's profit rate (Figure 2).



However, the principle of comparative advantage assumes that the rest of the world would specialize in the production of commodity 1. As a result, the world's economic system would be characterized by the following matrixes:

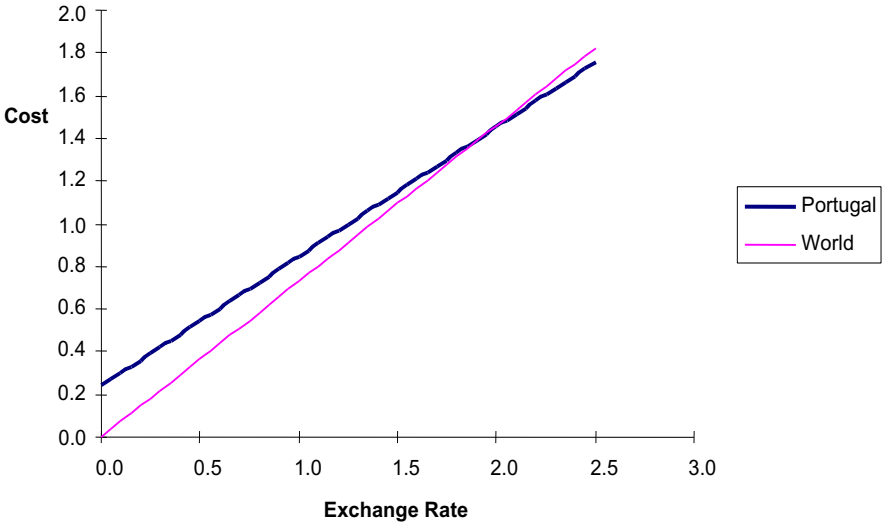
$$\mathbf{A}_M = \begin{bmatrix} 0.4 & 0.8 \\ 0.1 & 0.2 \end{bmatrix} \quad \mathbf{a}_{0M} = \begin{bmatrix} 0.2 & 0.1 \end{bmatrix}$$

$$\mathbf{d}_M = \begin{bmatrix} 0.4 \\ 0.4 \end{bmatrix}$$

Considering that in this economic system the profit rate (30.39%) would be lower than the rest of the world's before trade profit rate and that the cost of production of commodity 2 ($ 0.76694) would be higher, it is clear that the rest of the world would lose trading with Portugal. For the rest of the world it would be more profitable to produce commodity 2 instead of buying it from Portugal. As a consequence, Portugal would be excluded from the international economy.

But in a world where the exchange can be determined by the government, Portugal may change it in order to make its production of any commodity competitive in the international market. Figure 3 shows the relationship between Portugal's exchange rate and the cost of production of commodity 2 by both Portugal and the rest of economy. If Portugal's exchange rate were greater than $ 1.8527, its cost of production in international currency would be lower than in the rest of the world. Assuming that the prevailing exchange rate is $ 1.0000 and that the Portuguese economy produces 1,682,363 units of commodity 1 and 1,000,000 units of commodity 2,[17] an exchange rate of $ 1.8527 would make the price level increase 346.7% since the domestic price of commodity 1 would be $ 1.1649 and the price of commodity 2 would be $ 5.9454. Therefore, the world economy's profit rate would be lower than the rest of the world before trade profit rate, which shows that as a result of Portugal's entry into the international economy there would be a loss of efficiency of the world economic system.

Figure 3: Exchange Rate and the Cost of Production of Commodity 2



[17] These numbers obey the proportions given by (3.4), which are compatible with the maximum rate of economic growth.

10. CONCLUSIONS

From the above it can be concluded that the Ricardian theory of comparative advantage rests on sandy grounds and a country that has no absolute advantage in the production of some commodities is excluded from the international market unless it uses the exchange rate as a competitive instrument. However, the world economic system composed by countries that use this kind of barrier is less efficient than an economic system where the countries without absolute advantages are excluded.

APPENDIX: LABOR VALUE AND INTERNATIONAL COMPETITIVENESS

In his *Ricardos's Economics* (p. 131-133), Morishima asserts that when prices are not proportional to their labor values, the labor theory of value has nothing to do with determining the comparative advantage between two countries. This is true in so far as it refers to the fact that what matters in international trade are equilibrium prices and not labor values. However, labor values are intimately related the degree of competitiveness of a country.

Indeed, it is easy to verify that the surplus rate (ε), which measures a country's degree of competitiveness is equal to the rate of surplus value, σ, defined as the ratio between surplus labor ($\mathbf{a_0 x} - \mathbf{a_0 A x}$) and the labor that is expended in the production of means of production ($\mathbf{a_0 A x}$) if the Sraffian standard commodity is used as the factor to weigh labor quantities:

$$\sigma = (\mathbf{a_0\, x} - \mathbf{a_0\, A\, x}) / \mathbf{a_0\, A\, x} = \mathbf{a_0\, x} / \mathbf{a_0\, A\, x} - \mathbf{a_0\, A\, x} / \mathbf{a_0\, A\, x} = \mathbf{a_0\, x} / \mathbf{a_0\, A\, x} - 1 =$$

$$= 1 / (\lambda(\mathbf{A})\, \mathbf{a_0\, x} / \mathbf{a_0\, x}) - 1 = 1 / (\lambda(\mathbf{A}) / \mathbf{a_0\, x}) - 1 = \varepsilon$$

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