

# ON THE CONTROVERSY BETWEEN BALLANCE-FORSTNER-MURRAY AND BOWEN ABOUT MEASURING COMPARATIVE ADVANTAGE (\*)

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## Introduction

In order to understand how the BFM-Bowen controversy evolved we shall start with a brief presentation of Balassa's indices as well as of some of the comments that they are originated. The rest paper is organized as follows. In the second section we present the two Bowen's indices: the *net trade intensity index* and the *production intensity index*. In the third section we present the BFM critics and the Bowen's reply. In the fourth section we show that first of Bowen's indices is the complement of a Lafay's inter-industry specialization index and, consequently, we can consider it as an indicator of intra-industry specialization. In the fifth section we undertake a small survey of the intra-industry analysis and we show the failure of HOV theory to explain the intra-industry trade. We finish this paper with some concluding remarks.

## I — Balassa's indices

The revealed comparative advantage indices (RCA) of Balassa are well known (cf., Balassa, 1965, 1967, 1977). The difference between the two indices lies in the fact that one of them includes only exports whereas the other includes both exports and imports.

The first index can be presented as follows:

$$(1) \quad RCA_{ij} = \left[ \frac{X_{ij}}{\sum_{j=1}^n X_{ij}} \right] \left[ \frac{\sum_{i=1}^n X_{ij}}{\sum_{i=1}^n \sum_{j=1}^n X_{ij}} \right]$$

or

$$(1') \quad RCA_{ij} = \left[ \frac{X_{ij}}{\sum_{i=1}^n X_{ij}} \right] \left[ \frac{\sum_{j=1}^n X_{ij}}{\sum_{i=1}^n \sum_{j=1}^n X_{ij}} \right]$$

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Index (1) shows the ratio between exports of product  $i$  in country  $j$  ( $X_{ij}$ ) and the world exports of this product ( $\sum_j X_{ij}$ ) as a proportion of the share of country  $j$  in world total exports.  $\sum_j X_{ij}$  are the exports of all products of country  $j$  and  $\sum \sum X_{ij}$  are world exports.

If we calculate this index for all products we obtain a ranking which gives us the pattern of a country's comparative advantage.

Balassa prefers this index because it does not reflect the impact of protection through tariffs on imports upon comparative advantages. However when we compare  $RCA$  between countries this problem may not exist if they impose the same tariffs on the same products.

*The second index suggested by Balassa can be presented as follows:*

$$(2) \quad RCA_{ij} = (X_{ij}/M_{ij}) / \left( \frac{\sum_{i=1}^n X_{ij}}{\sum_{i=1}^n M_{ij}} \right)$$

Rearranging we obtain:

$$2' \quad RCA_{ij} = \left( \frac{X_{ij}}{\sum_{i=1}^n X_{ij}} \right) / \left( \frac{M_{ij}}{\sum_{i=1}^n M_{ij}} \right)$$

where  $M_{ij}$  are the imports of product  $i$  in country  $j$  and  $\sum M_{ij}$  are the world imports of this product.

The formulation (2) represents the rate of coverage imports by exports of the product  $i$  divided by the rate of coverage imports by exports of all products traded in country  $j$ . Thus, if (2) is higher than one, then product  $i$  has a positive effect upon  $j$ 's trade balance.

On the other hand according to (2') country  $j$  will have comparative advantage in producing commodity  $i$  if the share of this product on exports (the numerator) is higher than its share on imports (the denominator).

When we apply logarithms to both indices (1) and (2) and we have  $\ln RCA > 0$  then there are comparative advantages; by contrast, when  $\ln RCA < 0$  there are comparative disadvantages. However, the index (2) has a limitation: it would be systematically negative (in log-terms) in economies which register a high total import/export ratio.

Balassa (1965, p. 105) justified his indices by stating that: «It is suggested here that 'revealed' comparative advantage can be indicated by the trade performance of countries in regard to manufacturing products, in the sense that the commodity pattern of trade reflects relative costs as well as differences in no-price factors.»

However Hillman (1980) argued that Balassa's  $RCA$  indices do not reveal comparative advantage in terms of the difference of relative autarky costs. He demonstrated that for the first of Balassa's indices the  $RCA$  values are independent of the question of knowing which of any two goods is cheaper.

Yeats (1985) pointed out the issue of compatibilization between the ranking of *RCA* indices for several products in the same country and the ranking of *RCA* indices of one product in several countries. For instance, a certain product can be ranked high in a comparison of *RCA*s for that product between several countries, whilst it can be ranked low when comparison concerns the *RCA* for different products in each country. So, according to Yeats, the analysis of *RCA* indices for products or sectors in a country often alters the ranking order of each product in the world ranking (or in the ranking involving that country's trade patterns).

## II — The two Bowen's indices

Bowen (1983) considers that comparative advantages is a net trade concept. So, in what concerns the indices (like the Balassa's indices) which deal with exports and imports separately the term «comparative advantage» is perhaps misapplied. On the other hand, for the first Balassa's index (where only exports are taken into account) we should speak in terms of «comparative export advantage». As a matter of fact, under the assumption that no country exports all its goods there is no theoretical basis to infer that an *RCA* index above (below) unity indicates comparative advantage (disadvantage) in producing any given product. Thus, Bowen suggested two new indices for revealing comparative advantage: the «net trade intensity index» and the «production intensity index». The theoretical basis of these two indices is the Heckscher-Ohlin-Vanek (HOV) model <sup>(1)</sup>.

According to Vanek's identity, we have:

$$(3) \quad T_{ik} \equiv Q_{ik} - C_{ik}$$

This means that the output from production is directed either to exports or to consumption.  $T_{ik}$ ,  $Q_{ik}$  and  $C_{ik}$  are respectively: net trade, production and consumption of commodity  $k$  in country  $i$ . To obtain his new indices Bowen divides expression (3) by  $C_{ik}$ , which gives:

$$(4) \quad T_{ik}/C_{ik} \equiv (Q_{ik}/C_{ik}) - 1$$

We can define:

$$(5) \quad I^T_{ik} = T_{ik}/C_{ik}$$

which is what Bowen calls *the net trade intensity index*, and

$$(6) \quad I^Q_{ik} = Q_{ik}/C_{ik}$$

which is Bowen's *production intensity index*.

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(1) In the appendix we present the Vanek model using the Leamer's version. For a better understanding of the HOV theory, see Faustino (1989a).

The relationship between the two indices can be found by combining (4), (5) and (6).

$$(7) \quad I_{ik}^T = I_{ik}^Q - 1$$

The  $I_{ik}^Q$  index takes only positive values and equals one when there is neither comparative advantage nor disadvantage. When  $I_{ik}^Q > 1$  country  $i$  has comparative advantage in producing the product  $k$ ; if  $I_{ik}^Q < 1$  then, the  $i$ th country has a comparative disadvantage in producing this product.

The  $I_{ik}^T$  index takes positive values when there is comparative advantage, and negative values when there is comparative disadvantage. When  $I_{ik}^T = 0$ , the situation is neutral: there is no comparative advantage nor disadvantage.

### III — Ballance-Forstner-Murray's comments and Bowen's answer

The first question faced by BFM (1985) is that «the validity of Bowen's measures is dependent on the applicability of the homothetic preference hypothesis». Thus, they tested the validity of Bowen's indices by testing the hypothesis of identical homothetic tastes.

As we can see in the appendix, this is one of the assumptions of Vanek's model which provides the basis of Bowen's indices. But the main issue is to know whether one should reject HOV's theory when that hypothesis is rejected in empirical tests. Bowen (1985) answers negatively and we agree with him. Although BFM pretend to criticize that assumption of the HOV model, that does not necessarily have to imply criticism of Bowen's indices.

The second question faced by BFM (1986) concerns which variable should be chosen to represent comparative advantage <sup>(2)</sup>.

To BFM Bowen's indices are based on the concept of «neutral world»: it is possible to conceive an hypothetical world with no comparative advantages — a world in which all the countries would have equal pre-trade relative prices — and actual trade would be compared with it.

According to BFM, «the usefulness of relating the ICA [a world of inferred comparative advantage] to a NCA [a world of neutral comparative advantage] world as a method to 'reveal' comparative advantage appears to be, at least, questionable» (p. 377).

According to Bowen, BFM's remarks do not reveal a clear distinction of: (i) the definition of comparative advantage and the variable which is chosen to represent it (which must be consistent with the definition); (ii) the construction of an index of comparative advantage that takes the scale effect into account (the scale variable must be chosen in concordance with the model upon which the index is based).

As the HOV model is a model of net exports, the variable chosen to represent comparative advantage is  $T_{ik} = (X-M)_{ik}$ . In the same way, if the HOV

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<sup>(2)</sup> The comparative advantage is one advantage in terms of autarkic relative prices, which are unobservable. This explains the need to find an observable variable to represent it.

model is underlying the construction of the indices, then the choice of apparent consumption ( $C_{ijk} = Q_{ijk} - X_{ijk} + M_{ijk}$ ) is theoretically consistent.

As we shall see, both BFM's remarks and Bowen's answers do not tackle the essential issue: the «specialisation» issue. Are they assuming inter-industry specialization or intra-industry specialization <sup>(3)</sup>?

#### IV — Bowen's index and Lafay's index

Lafay (1979) suggests the following index of specialization:

$$(8) \quad d = Q/D$$

where  $d$  measures the degree of specialization («engagement» in the French literature),  $Q$  is the production,  $D = Q + M - X$  is the apparent consumption,  $X$  are the exports and  $M$  the imports.

This index could be estimated for each product or group of products produced by any given country.

The Lafay's index is based upon the relationship between the national economy and the rest of the world. The index  $d$  give us the weight of the product or group of products in the domestic market. As we shall see at a desagregated level, the evolution of  $d$  is explained by the evolution of exports and imports, or better, by their weight in the domestic market.

We can present (8) as follows:

$$(9) \quad d = (D + X - M)/D$$

or:

$$(10) \quad d = 1 + (X/D) - (M/D) = 1 + x - m$$

with  $x = (X/D)$  and  $m = (M/D)$

According to Lafay (1979, p. 22), inter-industry specialization is given by  $d$  and it is a function of  $(x - m)$ , but the intra-industry or intra-product specialization is given in each country by the smallest of the  $x$  and  $m$  ratios.

As to Bowen's index, if we use the same notation as Lafay we have:

$$(11) \quad I^T = (X - M)/D = (X - M)/(Q + M - X)$$

$$(11') \quad = (Q/D) - 1$$

*Bowen's index is the complement of the Lafay's inter-industry specialization index.* So if we accept that Lafay's index is a good inter-industry specialization index and inter-industry trade and intra-industry trade are complementary

<sup>(3)</sup> Greenaway and Milner (1986) make a distinction between intra-industry trade and intra-industry specialization. As this distinction is not the aim of the paper we do not develop it here. About this subject you may see, for instance, Kol (1988).

phenomenon, we can conclude that Bowen's index is an intra-industry specialization index. Then  $I^Q$  is an inter-industry specialization index (which is equal to Lafay's index although it has a different theoretical basis) and  $I^T$  an intra-industry specialization index.

*In this way Bowen's production intensity index ( $I^Q$ ) is the same as Lafay's index and should be used as a revealed comparative advantage index based upon HOV's model. Then, we can oppose Bowen's RCA index ( $I^Q$ ) to Balassa's indices.*

## V — The intra-industry specialization and the theory of Heckscher-Ohlin-Vanek

After the creation of the European Economic Community (EEC) some economists realized that some countries produced, exported and imported similar products (see, for instance, Verdoorn 1960, Balassa 1965, 1966). That phenomenon was called intra-industry specialization (4). At a disaggregate level, i.e., at the product level, we can speak of intra-product specialization. That sort of specialization was considered to be a feature of developed countries with similar factor endowments, and a consequence of the reduction in tariffs.

In the same direction, Grubel's study (1967) confirmed empirically the increase in trade among the EEC countries from 1955 to 1963 as a result of the reduction in import tariffs. The increase in trade was translated mainly in the exchange of products belonging to the same industry.

Grubel and Lloyd (1975) concluded also, from a strong empirical evidence, that after the liberalization in the trade between the EEC countries, this trade was characterized by a strong intra-industry component: the intra-industry trade between EEC countries which represented 53 % in 1959 increased to 65 % in 1967, and the percentage of this trade in total EEC trade evolved from 44 % in 1959 to 53 % in 1967. However they concluded also that the intra-industry feature does not occur only in industrial countries, as the case of Australia showed.

To Krugman (1979, 1980, 1981), and Lancaster (1980, 1982) or Helpman (1981, 1984) the intra-industry trade can be the result of the firms' scale economies and of product differentiation. The main issue concerning scale economies at the firm level is that its persistence undermines the assumption of «price-taking» behavior and of full competition. The big firms have advantages over the small ones and one or several firms will end up dominating the trade of one particular product: competition is imperfect and the price is higher than the marginal cost.

So we have to take into account the three types of imperfect competition: monopoly, oligopoly and monopolistic competition. For instance, Krugman and Lancaster models are models of monopolistic competition, although the treatment given to the consumers preferences is different in the two models.

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(4) The pioneering work on this subject was due to Verdoorn (1960), Balassa (1965, 1966), Grubel and Lloyd (1975). For a survey about intra-industry trade analysis and particularly on intra-industry trade indices see Faustino (1989b, pp. 11-18).

In synthesis, intra-industry trade takes place usually between countries with similar relative factor endowments so the HOV's theory of factors proportions cannot explain it.

However, Finger (1975) and Neme (1982) among others take a different stand; they consider the intra-industry trade just a problem of statistical aggregation: the products belonging to the same industry are not homogeneous and can be produced with different factor proportions (5).

If we accept this point of view then Bowen's index ( $I^T$ ) would be simple a measure of inter-industry trade. So it could be only explained by HOV's theory. But, we do not think this is the right solution.

## Conclusion

Our own view can be summed up as follows: part of the trade — the inter-industry trade — is explained by differences in the technology (the Ricardo approach) and by differences in relative factor endowments (Heckscher-Ohlin model); other part — the intra-industry trade — is explained by economies of scale and product differentiation (imperfect competition models). Thus we need a formal trade model which brings together the several types of trade. However, research on such a model is still in the beginning (see, for instance Helpman 1984b).

On the other hand the study of intra-industry trade has to be linked to the analysis of three related issues: (i) imperfect competition structures; (ii) the role of Direct Foreign Investment and (iii) the strategy of multinational firms. Bowen's *net trade intensity index*, being a complement of the Lafay's inter-industry specialisation index may be considered as an indicator of intra-industry specialisation. Bowen's index reflects not only the cost advantages (the supply side) but also consumers preference (the demand side). Thus Bowen's index can't be used in the empirical models of static comparative advantage (only in terms of costs).

As the models based on Heckscher-Ohlin-Vanek theory do not consider the demand side we can not use Bowen's index in an econometric model to evaluate the validity of the factor proportions theory. BFM and Bowen do not take this into account.

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(5) The analysis of intra-industry trade is not the main aim of this paper, so this discussion will not be developed here. See for instance Rahman (1986) on the subject of hierarquization of comparative advantages.

APPENDIX

The Heckscher-Ohlin-Vanek model in Leamer's version

The assumptions used are the same of the Heckscher-Ohlin-Vanek model, plus the assumption of equalization of factor prices.

Definitions:

- $T_j$ — vector  $n \times 1$  of net trade from country  $i$ ;
- $E_j$ — vector  $n \times 1$  of factor endowments from country  $i$ ;
- $E_W = \sum E_j$ , vector  $m \times 1$  of world factor endowments;
- $A_j$ — matrix  $m \times n$  of the technic coefficients from country  $i$ , where  $a_{ij}$  is a quantity of factor  $i$  needed for unity of product  $j$ . The matrix  $A$  is equal, for hypothesis, for all countries;
- $Q_j$ — vector  $n \times 1$  of the commodities produced in country  $i$ ;
- $Q_W = \sum Q_j$ , vector  $n \times 1$  of the commodities produced at the world level;
- $C_j$ — vector  $n \times 1$  of the consumed goods in country  $i$ ;
- $Y_j$ — product or national income from country  $i$ ;
- $Y_W = \sum Y_j$ , product or world income;
- $B_j$ — net trade for country  $i$ ;
- $P$ — vector  $n \times 1$  of the commodity prices;
- $s_j$ — constant that give us the relation between the national product and the world product.

Identities:

$$A_i Q_j = E_j \quad (1)$$

or, the demand for factors is identical to the offer;

$$T_j = Q_j - C_j \quad (2)$$

or, the production has two destinations: exports and consumption.

Heckscher-Ohlin-Vanek equation:

$$AT_j = E_j - s_j E_W \quad (3)$$

where  $s_j = (Y_j - B_j) / Y_W$ .

Equation (3) tell us that the factor contents in net trade are equal to the excess offer of factors. If the demand for factors is smaller than the offer we have  $AT > 0$ ; in the opposite case we have  $AT < 0$ .

We derive (3) from (2) considering that:

$$C_j = s_j Q_W \quad (4)$$

that is, assuming *homothetic and identical preferences across countries*, each country's consumption of a commodity is proportional to world consumption (which equals world production). Thus:

$$\begin{aligned} AT_j &= A(Q_j - C_j), \text{ owing to the multiplication from (2) to } A, \\ &= A Q_j - A C_j \\ &= E_j A S_j Q_W, \text{ considering (1) and (4),} \\ &= E_j s_j E_W, \text{ given that by agregation } A Q_W = E_W. \end{aligned}$$

To obtain  $s_j$  we calculate the net exports value multiplying the  $T$  vector by the vector of commodities prices. Thus:

$$B_j = P'T_j = P'A^{-1} (E_j - s_j E_W) = Y_j - s_j Y_j$$

solving for  $s_j$ :

$$s_j = (Y_j - B_j) / Y_W \quad (5)$$

or:

$$s_j = Y_j / Y_W \quad (5')$$

if trade is balanced ( $B_j = 0$ ).



## BIBLIOGRAPHY

- BALASSA, Bela, (1965), «Trade Liberalisation and 'Revealed' Comparative Advantage», *Manchester School of Economics and Social Studies*, vol. 33, n.º 2, pp. 99-123.
- — (1986), «Tariff Reductions and Trade in Manufactures Among Industrial Countries», *American Economic Review*, vol. 56, n.º 3, pp. 466-473.
- — (1967), *Trade Liberalisation Among Industrial Countries*, New York, McGraw-Hill, p. 251.
- — (1977), «'Revealed' Comparative Advantage Revisited: An Analysis of Relative Export Shares of the Industrial Countries, 1953-1971», *Manchester School*, n.º 4, pp. 327-344.
- BALLANCE, Robert, FORSTNER, H., and MURRAY, T. (1985), «On Measuring Comparative Advantage: A Note on Bowen's Indices», *Weltwirtschaftliches Archiv*, vol. 121, 1985, pp. 346-350.
- — (1986), «More on Measuring Comparative Advantage: A Reply», *Weltwirtschaftliches Archiv*, vol. 122, pp. 375-378.
- BOWEN, Harry (1983), «On the Theoretical Interpretation of indices of Trade Intensity and Revealed Comparative Advantage», *Weltwirtschaftliches Archiv*, vol. 119, pp. 464-472.
- — (1985), «On Measuring Comparative Advantage: A Reply and Extension», *Weltwirtschaftliches Archiv*, vol. 121, pp. 351-354.
- — (1986), «On Measuring Comparative Advantage: Further Comments», *Weltwirtschaftliches Archiv*, vol. 122, pp. 379-381.
- FAUSTINO, Horácio (1989a), *A Generalização do Modelo e do Teorema de Heckscher-Ohlin*, CEDEP — Centro de Estudos de Economia Internacional, ISEG, documento de trabalho n.º 6, p. 24.
- — (1989b), *A Análise do Comércio Intra-setorial*, CEDEP — Centro de Estudos de Economia Internacional, ISEG, documento de trabalho n.º 5, p. 22.
- FINGER, J. (1975), «Trade Overlap and intra-industry trade», *Economic Enquiry*, December.
- GREENAWAY, D., and MILNER, C. (1986), *The Economics of Intra-Industry Trade*, Basil Blackwell, 1986, p. 207.
- GRUBEL, Herbert (1967), «Intra-Industry Specialisation and the Pattern of Trade», *Canadian Journal of Economics and Political Science*, vol. 33, n.º 3, pp. 374-388.
- GRUBEL, H., and LLOYD, P. (1975), *Intraindustry Trade. The Theory and Measuring of International Trade in Differentiation Products*, London, Mcmillan Press, p. 205.
- HELPMAN, Elhanan (1981), «International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlin-Heckscher-Ohlin Approach», *Journal of International Economics*, vol. 11, pp. 305-340.
- HELPMAN, E. (1984a), «Increasing Returns, Imperfect Markets, and Trade Theory» in R. Jones and P. Kenen (eds.), vol. 1, pp. 325-365.
- — (1984b), «A Simple Theory of International Trade with Multinational Corporations», *Journal of Political Economy*, vol. 92, n.º 3, pp. 451-471.
- HILLMAN, Arye (1980), «Observations on the Relation Between 'Revealed Comparative Advantage' and Comparative Advantage as Indicated by Pre-Trade Relative Prices», *Weltwirtschaftliches Archiv*, vol. 116, pp. 315-321.
- JONES, R., and KENEN, P. (eds.) (1984), *Handbook of International Economics*, North-Holland, Amsterdam, vol. 1, pp. xxi+623.
- KOL, Jacob (1988), *The Measurement of Intra-Industry Trade*, doctoral thesis, p. 261.
- LAFAY, Gérard (1979), «Dynamique de la Spécialisation Internationale», *Economica*, Paris, pp. 176.
- LANCASTER, Kelvin (1980), «Intra-Industry Trade under Perfect Monopolistic Competition», *Journal of International Economics*, vol. 10, pp. 151-175.
- — (1982), «Comment», in J. Bhagwati (ed.) *Import Competition and Response*, The University of Chicago Press, pp. 208-216.
- LASSUDRIE-DUCHÊNE, B., and MUCCHIELLE, J-L (1979), «Les Échanges Intra-Branche et la Hiérarchisation des Avantages Comparés dans le Commerce International», *Revue Économique*, vol. 30, n.º 3, pp. 442-485.
- LEAMER, Edward (1980), «The Leontief Paradox, Reconsidered», *Journal of Political Economy*, vol. 88, pp. 495-503.
- NEME, C. (1982), «Ambiguités de la Théorie de la Spécialisation Intra-Branche», in J. Reiffers (ed.), pp. 158-173.

- RAHMAN, Abd-El, K. (1986), «Réexamen de la définition et de la Mesure des Échanges Croisés de Produits Similaires entre les Nations», *Revue Économique*, vol. 37, n.º 1, pp. 89-115.
- RAHMAN, Abd-El (1986), «La 'Différence' e la 'Similitude' dans l'Analyse de la Composition du Commerce International», *Revue Économique*, vol. 37, n.º 2, pp. 307-340.
- REIFFERS, J. (ed.) (1982), *Économie et Finance Internationales*, Dunod, Paris, p. 449.
- VANEK, Jaroslav (1968), «The Factor Proportions Theory: The N-Factor Case», *Kyklos*, vol. 21 (4), pp.749-756.
- VERDOORN, P. (1960), «The Intra-Bloc Trade of Benelux», in E. Robinson (ed.) *Economic Consequences of the Size of Nations*, London, Mcmillan.
- YEATS, Alexander (1985), «On the Appropriate Interpretation of the Revealed Comparative Advantage Index: Implications of a Methodology Based on Industry Sector Analysis», *Weltwirtschaftliches Archiv*, vol. 121, pp. 61-73.