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 the first of Bowen’s indices is the complement of a Lafay’s inter-industry trade index and, consequently we can consider it as an indicator of intra-industry trade. 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 Bela 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.

* This article is the result of theoretical and methodological reflexions for my thesis which has been supervised by Professor Avelino de Jesus. I have to thank also Professor Anabela Santos and Dr Paula Santos for their useful comments and patient revision of the English, and an anonymous referee for helpful comments on an earlier draft of this article. Obviously, any errors or omissions which may persist are my sole responsibility. We must point out that this is the original paper in format A4. So the number of pages and the page numbers do not correspond to those of the publication in the revue Estudos de Economia.

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The first index can be presented as follows:

\[
(1) \quad \text{RCA}_{ij} = \left[ \frac{X_{ij}}{\Sigma X_{ij}} \right] / \left[ \frac{\Sigma X_{ij}}{\Sigma \Sigma X_{ij}} \right]
\]

or

\[
(1') \quad \text{RCA}_{ij} = \left[ \frac{X_{ij}}{\Sigma X_{ij}} \right] / \left[ \frac{\Sigma X_{ij}}{\Sigma \Sigma X_{ij}} \right]
\]

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

\[
(2) \quad \text{RCA}_{ij} = \left( \frac{X_{ij}}{M_{ij}} \right) / \left( \frac{\Sigma X_{ij}}{\Sigma \Sigma M_{ij}} \right)
\]

Rearranging we obtain:

\[
(2') \quad \text{RCA}_{ij} = \left( \frac{X_{ij}}{\Sigma X_{ij}} \right) / \left( \frac{M_{ij}}{\Sigma M_{ij}} \right)
\]

where \( M_{ij} \) are the imports of product \( i \) in country \( j \) and \( \Sigma M_{ij} \) 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 autarcy 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 RCAs 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 partners).

II - The two Bowen’s indices

Bowen (1983) considers that comparative advantage 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.  

1 In the appendix we present the Vanek model using Leamer’s version. For a better understanding of the HOV theory, see Faustino (1989a)
According to Vanek’s identity, we have:

\[ T_{ik} \equiv Q_{ik} - C_{ik} \]

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:

\[ \frac{T_{ik}}{C_{ik}} \equiv \left( \frac{Q_{ik}}{C_{ik}} \right) - 1 \]

We can define,

\[ f_{ik} = \frac{T_{ik}}{C_{ik}} \]

which is what Bowen calls \textit{the net trade intensity index}

and

\[ f^0_{ik} = \frac{Q_{ik}}{C_{ik}} \]

which is Bowen’s \textit{production intensity index}.

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

\[ f_{ik} = f^0_{ik} - 1 \]

The \( f^0_{ik} \) index takes only positive values and equals one when there is neither comparative advantage nor disadvantage. When \( f^0_{ik} > 1 \) country i has comparative advantage in producing the product k; if \( f^0_{ik} < 1 \) then, the \( i^{th} \) country has a comparative disadvantage in producing this product.

The \( f_{ik} \) index takes positive values when there is comparative advantage, and negative values when there is comparative disadvantage. When \( f_{ik} = 0 \), 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.²

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 model is underlying the construction of the indices, then the choice of apparent consumption ($C_{ik} = Q_{ik} - X_{ik} + M_{ik}$) 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 specialisation or intra-industry specialisation?

IV - Bowen´s index and Lafay´s index

² 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.

³ 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).
Lafay (1979) suggests the following index of specialisation:

\[ d = \frac{Q}{D} \]  

where \( d \) measures the degree of specialisation ("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:

\[ d = \frac{(D+X-M)}{D} \]

or,

\[ d = 1 + \frac{X}{D} - \frac{M}{D} \]

\[ = 1 + x - m \]

with \( x = \frac{X}{D} \) e \( m = \frac{M}{D} \)

According to Lafay (1979, p. 22), inter-industry specialisation is given by \( d \) and it is a function of \((x-m)\), but the intra-industry or intra-product specialisation 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:

\[ I = \frac{(X-M)}{D} \]

\[ = \frac{(X-M)}{(Q+M-X)} \]

\[ (11') = \frac{(Q)}{D} - 1 \]

Bowen’s index is the complement of the Lafay’s inter-industry specialisation index. So if we accept that Lafay´s index is a good inter-industry specialisation index and inter-industry trade and intra-industry trade are complementary phenomena, we can conclude that Bowen’s index is an intra-industry
specialisation index. Then $I^0$ is an inter-industry specialisation index (which is equal to Lafay’s index although it has a different theoretical basis) and $I_1$ an intra-industry specialisation index.

In this way Bowen’s production intensity index ($I^0$) 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 ($I_1$) to an inter-industry specialisation index like Balassa’s indices.

V- The intra-industry specialisation 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 specialisation. At a disaggregate level, i.e., at the product level, we can speak of intra-product specialisation. That sort of specialisation 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.

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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).
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.

In synthesis, intra-industry trade takes place usually between countries with similar relative factorendowments 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 \((I)\) 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 1984 b).

On the other hand the study of intra-industry trade has to be linked to the analysis of three related issues: (i) imperfect competition strutures; (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 advantages (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 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.
Apendix - The Heckscher-Olhin-Vanek model in Leamer’s version

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

Definitions:
- \( T_i \) - vector nx1 of net trade from country i;
- \( E_i \) - vector nx1 of factor endowments from country i;
- \( E_w = s_i E_i \) - vector nx1 of world factor endowments;
- \( A_i \) - matrix mnx of the technical 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;
- \( Q_i \) - vector nx1 of the commodities produced in country i;
- \( Q_w = \sum Q_i \) - vector nx1 of the commodities produced at the world level;
- \( C_i \) - vector nx1 of the consumed goods in country i;
- \( Y_i \) - product or national income from country i;
- \( Y_w = s_i Y_i \) - product or world income;
- \( B_i \) - net trade for country i;
- \( P \) - vector nx1 of the commodity prices;
- \( s_i \) - constant that gives us the relation between the national product and the world product.

Identities:

\[ A_i Q_i \equiv E_i \quad (1) \]

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

\[ T_i + Q_i \equiv C_i \quad (2) \]

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

Heckscher-Olhin-Vanek equation:

\[ AT_i = E_i - s_i E_w \quad (3) \]
where \( s_i = (Y_i - B_i) / Y_w \)

Equation (3) tells 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,

\[
C_i = s_i Q_w
\]

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,

\[
AT_i = A (Q_i - C_i), \text{ owing to the multiplication from (2) to } A,
\]

\[
= AQ_i - AC_i
\]

\[
= E_i A s_i Q_w, \text{ considering (1) and (4),}
\]

\[
= E_i s_i E_w, \text{ given that by aggregation } AQ_w = E_w.
\]

To obtain \( s_i \), we calculate the net exports value multiplying the T vector by the vector of commodities’ prices. Thus:

\[
B_i = P^T T_i
\]

\[
= P^T A^{-1} (E_i - s_i E_w)
\]

\[
= Y_i - s_i Y_w
\]

solving for \( s_i \),

\[
s_i = (Y_i - B_i) / Y_w \quad (5)
\]

or,

\[
s_i = Y_i / Y_w \quad (5')
\]

if trade is balanced (\( B_i = 0 \)).
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