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OVERALL REVEALED COMPARATIVE ADVANTAGES

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Abstract

This paper offers a new approach to the measurement of revealed comparative advantages, respectively, the specialization of exports, in addition to the classical approaches of Bella Balassa and Thomas Vollrath. The proposed approach aims to summarize the divergent expression of comparative advantages by commodity groups and countries and to arrive at the general pattern of export specialization. The conclusion is drawn that the contemporary international trade is characterized by asymmetric specialization of exports. This is reflected in the specialization of a large group of countries in the export of lower-processed products and vice versa, a small group of countries specialized in the export of highly-processed products.

Keywords: Revealed Comparative Advantages, Specialization, International Trade

1. Introduction

Comparative advantages are a key concept in explanation of specialization in the exports of goods. On this basis, a number of research approaches have been developed, starting with B. Balassa, T. Vollrath and going to A. Hoen and J. Oosterhaven. The emphasis of these approaches is placed on the study of the comparative advantages of a country with regard to a given commodity (or commodity group) against another country (or group of countries). Given that comparative advantages are manifested diversely (both as variations and as fluctuations), the question arises of what the general trend is, what the natural occurrence that is common for all goods and countries in today's international trade is?

Various aspects of relative advantages are the subject of a series of studies (Arvis, 2013; Bowen, 1986; Huang *et al.* 2013; Lederman *et al.* 2007; Proudman and Redding, 1998; Siggel, 2006). However, no approaches have been developed and tested for the general study of specialization covering all goods and countries in today's international trade. No studies have been conducted on the result that this divergent manifestation of comparative advantages in goods and countries bears on the global economy. The growing role of foreign trade in the development of the globalizing world economy and the emerging additional "effects" create a need for the creation of new approaches and further specialization research. The aim of this paper is the development and testing of an approach for the study of overall revealed comparative advantages.

A number of approaches have been developed to research comparative advantages. The foundations were laid by Balassa who suggested a specific index known as the Balassa index (Balassa, 1965; 1989). He applied the category "revealed comparative advantages"[1], assuming that the realized commercial streams are an approximation of the relative prices. The

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[1] RCA

index is interpreted also as a measurement of the specialization of the exports of a given country in relation to a given commodity. The original expression of the index is as follows:

$$RCA_1 = \left(X_{ij} / X_{it} \right) / \left(X_{nj} / X_{nt} \right)$$

(1)

where RCA_1 is Balassa's revealed comparative advantages index; X stands for export; i – country; j – commodity or industry; t – commodity group (group of industries); n – group of countries.

The popularity and wide use of Balassa's index stem from its simplicity and clear economic interpretation. At the same time it is believed that the index has weaknesses. Balassa's RCA index is useful for assessing whether a country has comparative advantages in the export of a product in relation to a particular group of countries. In many respects, however, its use is limited and problematic (Ballance *et al.* 1986; Benedictis and Tamberi, 2001; Hinloopen and Marrewijk, 2001).

The next most commonly used approach for the study of revealed comparative advantages is that of Vollrath (1991). He puts forward three alternative concepts for measuring revealed comparative advantages by country. These are the "relative export advantages", the logarithm of "relative export advantages" and "revealed competitiveness".

The index of relative trade advantage (RTA) is the difference between the "relative export advantage" (RXA) and its twin "relative import advantage" (RMA). The index of relative trade advantages is established as follows:

$$RTA = RXA - RMA$$

(2)

where RTA is the relative trade advantages index; $RXA = RCA_1 = \left(X_{ij} / X_{it} \right) / \left(X_{nj} / X_{nt} \right)$; $RMA = \left(M_{ij} / M_{it} \right) / \left(M_{nj} / M_{nt} \right)$; M – import;

The second approach for measuring the revealed comparative advantages adopted by T. Vollrath's uses an algorithm of relative export advantages:

$$RCA_2 = \ln RXA = \ln RCA_1$$

(3)

T. Vollrath's third approach for measuring the revealed comparative advantages is the manifested competitiveness which is established in the following manner:

$$RC = \ln RXA - \ln RMA$$

(4)

where RC is the revealed competitiveness index;

Keld Laursen (1998) suggests another index, which is believed to possess symmetrical qualities:

$$SRCA_j^i = \left(RCA_j^i - 1 \right) / \left(RCA_j^i + 1 \right)$$

(5)

where $RCA_j^i = RCA_1$; $SRCA_j^i$ – symmetrical index of revealed comparative advantages.

Proudman and Redding (1998) suggest that Balassa's classical RCA index is weighted with the country's average index. The formula is, as follows:

$$WRCA_j^i = RCA_j^i / \left[\left(1 / N \right) \sum_{j=1}^{N} RCA_j^i \right]$$

(6)

where WRCA$_j^i$ is the weighted revealed comparative advantages index; N is the number of goods;

Hoen and Oosterhaven (2006) believe that the disadvantages of Balassa's classical index are caused by its multiplication form. They suggest an additive form of the index, which is expressed in the following way:

$$ARCA_j^i = \left(X_j^i / X^i \right) - \left(X_j / X \right) \tag{7}$$

where ARCA$_j^i$ is the additive index of the revealed comparative advantages ;

Other authors suggest a more general solution in the study of comparative advantages (Yu *et al.* 2009). They have developed a "normalized index of comparative advantages" starting from the point of neutral comparative advantages, the classical Balassa's index, the symmetrical SRCA index and the additive ARCA index:

$$NRCA_j^i = X_j^i / X - X_j X^i / XX \tag{8}$$

where NRCA$_j^i$ is the normalized index of revealed comparative advantages;

Apart from the above-mentioned indexes a number of derivative indexes have also been developed for the revealed comparative advantages, e.g. the Grubel-Lloyd index[2], the Michaely index[3], the Aquino index[4] and many others. This group of indexes is not a subject of discussion in this paper.

2. Overall Revealed Comparative Advantages

The most commonly used approach, that of Bella Balassa and the indices based thereon have specific characteristics. First, the indicators refer to the comparative advantages of a single commodity, commodity group or industry. Secondly, Balassa's approach provides analytical capabilities for characterizing the exports of a country, the degree of technological processing of the exported goods, etc. in relation to a group of countries. A characteristic of the traditional approaches to study the RCA is that they use a specific market as a scale. All the features of advantage / disadvantage are rescaled in relation to the specific (in space, time, etc.) market. As a result, individual studies have become incomparable. In addition to this peculiarity Balassa's indices and their derivatives artificially overestimate the comparative advantages of small economies, respectively the specialization of small economies (Lederman *et al.* 2007; Yu *et al.* 2009). This is due to the artificial favoring of small economies through rescaling the exports of a product (commodity group) in relation to the exports of the small country.

The listed features of Balassa's approach limit the opportunities to study the processes of specialization generally for the world economy. This requires the creation of a generalized approach through which countries can be differentiated according to the typical specialization of exports. Numerous bilateral studies suggest a trend that a great number of countries lose their comparative advantages in the export of highly-processed products. The generalized approach could provide an answer to the question of whether these single findings (one country versus another country or a group of countries) are an expression of a manifest pattern of export specialization in today's international trade or not.

To solve the problem we propose to use the well-reasoned and researched mathematical concept of "Euclidean space" (Hazewinkel, 2002). If we assume that the share of exported goods of a country are a multidimensional Euclidean space (feature space), the separate countries as points (objects) of it, then the "distance" from each country to another country can be regarded as a measure of overall revealed comparative advantage for all goods or Euclidean space of exports specialization:

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[2] Grubel-Lloyd index
[3] Michaely index
[4] The Aquino index

$$s_{il} = \sqrt{\sum_{j=1}^{p} \left[\left(X_{ij} / X \right) - \left(X_{lj} / X \right) \right]^2} \qquad (9)$$

where s_{il} is the Euclidean space of export specialization between country *i* and country *l*; i,l=1,…,n; n – number of countries; X – export; j – commodity groups; j=1,...,p; p – number of commodity groups; p-measuring space;

Values close to 0 are interpreted as close, neutrally revealed comparative advantages overall for all goods between two countries. Larger values are interpreted as revealed comparative advantages generally for all goods between two countries. The measure does not provide an answer to the question of which of the two compared countries has a revealed comparative advantage overall for all goods.

Current conditions of international trade suggest a multidirectional process of acquisition and loss of comparative advantages, both by commodities and by countries. A revealed comparative advantage over a country is no guarantee of a revealed comparative advantage over another country for the same commodity. Therefore, the specialization of a country can be characterized both by the revealed comparative advantages over one or more countries, and by revealed disadvantages to other countries. A complex multidimensional property like the specialization of exports cannot be expressed by a scalar value only. Therefore, we suggest that the exports specialization of a country be characterized by a vector of Euclidean spaces per specialization of exports to all countries. Thus the comparative advantages in the export of a country over any other country will be revealed. The vector of exports specialization, which we call a vector of overall revealed comparative advantages, is expressed as follows:

$$V_i = ORCA_i = \left(s_{i1}, s_{i2}, \ldots, s_{ii-1}, 0, s_{ii+1}, \ldots, s_{in} \right) = \left\| s_{il} \right\|_{l=1}^{n} \qquad (10)$$

where V_i, $ORCA_i$ is the vector of overall revealed comparative advantages of country *i*; s_{il} - Euclidean space of export specialization between country *i* and country *l*;

Vector analysis of overall revealed comparative advantages gives an idea of the revealed regularities in the acquisition of comparative advantages and comparative loss of a country with respect to another. The vector, however, does not allow to summarize the overall pattern in the manifestation of comparative advantages for all countries. For this purpose we propose to apply statistical groups as an approach to generalization of specialization in exports. In this case, however, the one-dimensional grouping approach used by a number of authors cannot be applied (Hinloopen and Marrewijk, 2001; Yu *et al.* 2009; Zhelev, 2009). The problem stems from the fact that in traditional approaches revealed comparative advantages are represented by scalars, while the pooled comparative advantages are presented by vectors. Therefore, to summarize the revealed comparative advantages it is necessary to use appropriate multivariate methods.

The cluster analysis is a well-known and well-developed multidimensional method of classifying units into groups on the basis of a number of features (Everitt *et al.* 2011; Milligan and Cooper, 1987). If we assume that all vectors of overall revealed comparative advantages are a dissimilarity matrix[5], then the grouping of countries by generalized export specialization can be done through the hierarchical cluster analysis. Thus the countries playing on the international export market would be divided into relatively homogeneous groups by export specialization. This grouping in turn would provide grounds to draw conclusions concerning the revealed comparative advantages under the contemporary conditions of international trade.

## 3. Asymmetric Specialization of Export

For the approbation of the proposed approach for the study of overall revealed comparative advantages we have used the exports of member states of the World Trade Organization in

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[5] Dissimilarity matrix

2011. To present exports we have applied the groups of the commodity classification used by the World Trade Organization. The latter divides commodities into primary, processed and other goods, and represents a compilation of the sections, divisions and groups of the Standard International Trade Classification (SITC).

As a source of statistical information we use the *WTO statistics database* (WSDB)[6]. The statistical data on exports has been extracted by the "general trade" system, no re-exports, FOB, USD, current prices, country of consumption as a criterion for the determination of the country of export. Stata 10.0[7] and specially developed applied software have been used to evaluate the vectors of overall revealed comparative advantages. The hierarchical cluster analysis has been used to group the countries into relatively homogeneous clusters by export specialization. The *Calinski-Harabasz pseudo-F index* (Milligan and Cooper, 1987) have been applied as a criterion for the determination of the number of groups[8]. The "intergroup linkage" criterion[9], ensuring disjoint relatively homogeneous groups (Gower, 1967) has been used for the group formation. The grouping of countries by overall revealed comparative advantages is shown through dendrograms on Figure 1.
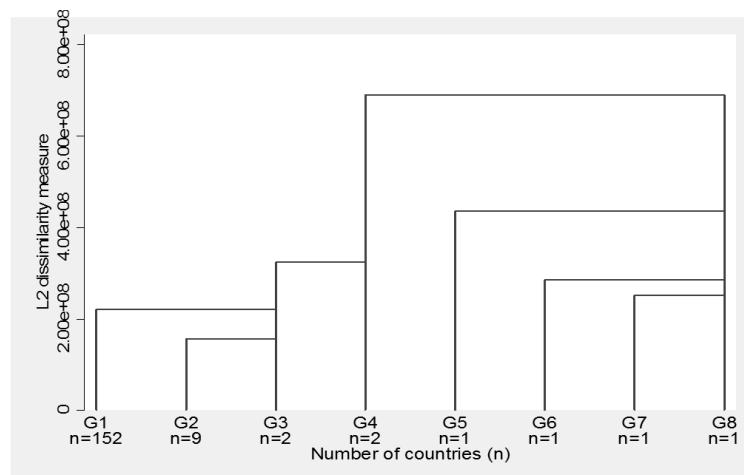
Figure 1. Dendogram of overall revealed comparative advantages for 2011

The analysis of the dendrogram (Figure 1) has shown that a very large group of countries (90% of the countries) are in the same cluster (G1) and are at relatively small Euclidean spaces. At the same time a small group of countries (10%) are distributed in the other clusters (G2-G8). This group of countries is at a greater Euclidean space from the first group. Within the second group the distances between the countries and clusters are much greater than between the first group of countries. These results allow us to conclude that there is considerable unevenness in the overall specialization of countries.

A logical question arises, as to the similarities between countries in the large group (G1) having similar overall revealed advantages and how they differ from the countries in the other groups. In this regard and in order to detect the commodity groups that share a similarity or that manifest the biggest differences, we suggest to transpose the matrix from "countries-variables" data to "variables-countries" data. This suggestion corresponds to the idea of Yu *et al.* (2009) that the standard study of revealed comparative advantages by countries should be supplemented by a "cross" study of revealed comparative advantages by commodity groups. It is conventionally assumed that countries are features, while commodity groups are objects. The matrix of overall revealed comparative advantages is re-evaluated. Based on this and on the
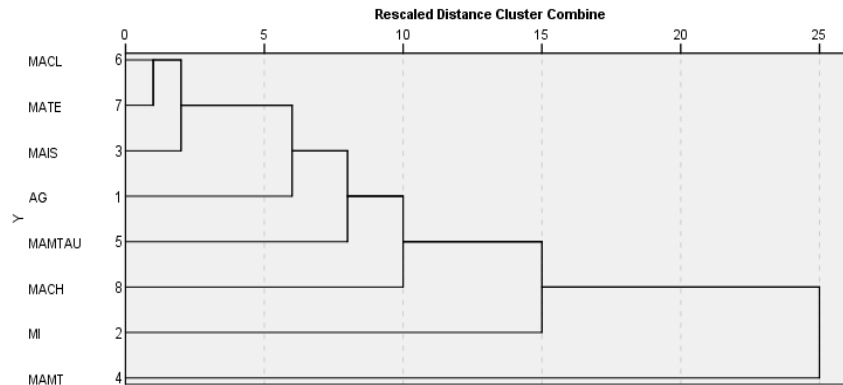
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[6] http://stat.wto.org/Home/WSDBHome.aspx
[7] www.stata.com
[8] Stopping rules
[9] Average linkage between groups

hierarchical cluster analysis the classification by commodity groups is carried out. The results are presented in Figure 2.

Figure 2. Dendogram by overall revealed comparative advantages by commodity groups
Notes: AG – agricultural products; MI – fuels and extractable products; MAIS – iron and steel; MAMT – machines and transportation vehicles; MAMTAU – car products; MACL – clothes; MATE – textiles; MACH – chemicals

The smallest Euclidian distances are established in the commodity groups "clothing", "textiles" and "iron and steel" ($\bar{s}_{il} = 0.232$). At the same time it has been established that the largest Euclidian distances ($\bar{s}_{il} = 0.907$) arise in relation to exports of processed products from the "machinery and transport vehicles" group. Given that the establishment of the revealed comparative advantages is based on the same matrix of "countries - variables ", several conclusions can be drawn. First, since small Euclidean spaces are typical for a large group of countries (G1), it follows that their specialization in exports is in low-processed products such as "textiles" and "clothing". Secondly, since large Euclidean spaces are typical for a small group of countries (G2-G8), it follows that their specialization in exports is in highly-processed products such as "machinery and transport vehicles". This state of overall revealed comparative advantages, respectively overall specialization of countries we define as "asymmetric specialization of exports".

4. Conclusion

The proposed approach to study the overall revealed comparative advantages has the potential to synthesize the disparate changes of specialization by country and commodity groups. On the basis of the Euclidean space and the vector of overall revealed comparative advantages it becomes possible to generalize the diverse manifestation of comparative advantages by goods. The division of objects into relatively homogeneous groups of exports specialization through the hierarchical cluster analysis creates the necessary conditions for assessing trends in revealed comparative advantages in goods and countries simultaneously.

The hypothesis put forward by a number of economists is proved through the above-discussed approach of overall revealed comparative advantages. As a result of the divergent manifestation of comparative advantages a sustainable feature of international trade is formed which we call asymmetric specialization of exports. It is expressed in the fact that most countries export mainly low-processed products such as raw materials, textiles, clothing. And at the same time a small part of countries export mainly highly-processed products such as vehicles. This feature of international trade is sustainable and has not changed significantly in recent decades.

Given the relationship of comparative advantages and divergence, it is necessary to focus our attention on the specialization of exports, especially in less developed countries.

Efforts are needed to achieve a more equal distribution of the benefits of contemporary liberal international trade, including through the management of exports specialization.

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