VERTICAL SPECIALIZATION AND INTRA-INDUSTRY TRADE: THE CASE OF CROATIA

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UDK 339.56 (497.5)
Originial scientific paper
Izvorni znanstveni rad

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ABSTRACT

This paper examines the structure of intra-industry trade specialization in Croatia and its implication on comparative advantages. Product groups in which intra-industry trade specialization is dominant are determined by applying the GL index. The RCA and RUV indicator are calculated for each product group and are used as variables in k-means cluster analysis. The empirical results indicate that three different clusters of product groups exist in Croatia relative to values of analyzed variables. Vertical specialization is divided into high quality exports and low quality exports. The homogeneous product groups with the highest comparative advantages and highest quality exports are identified for Croatia, and so are those with the lowest comparative advantages and the lowest quality exports. The implications of the research results are discussed.

Keywords: *intra-industry trade, vertical specialization, horizontal specialization, comparative advantages, Croatia*

1. INTRODUCTION

Today almost one fourth of world trade has an intra-industry nature, i.e. the simultaneous exports and imports of similar goods within the same industry (Reganati and Pittiglio 2005). Total intra-industry trade (TIIT) has been disentangled into its two components of horizontal intra-industry trade (HIIT) and vertical intra-industry trade (VIIT). The first component represents trade among commodities that are similar in terms of quality, while the second one is referred to commodities of different quality.

In the literature intra-industry trade has been explained through different approaches. The first approach considers goods that are horizontally differentiated and are produced with increasing returns to scale. In monopolistically competitive markets, Krugman (1979), Lancaster (1980) and Helpman (1981) found that when the two partner countries have identical factor endowments, the volume of international trade (which is entirely intra-industry) is determined by differences in their relative country size. In particular, the volume of trade is greater, the greater the similarity in size among countries. Adding factor endowment differences in a two -sector model, where one sector produces a homogeneous good and the other a differentiated product, Helpman and Krugman (1985) found that the volume of international trade will be determined by both differences in relative country size and differences in factor endowments between the

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Članak primljen u uredništvo: 7.12.2006.

trading countries. In particular, this kind of model predicts that IIT will decline as countries' factor endowments diverge. An alternative approach considers models with vertically differentiated products. Falvey (1981) and Falvey and Kierzkowski (1987) suggest that since higher-value added products require higher capital-intensity in production, in an open economy the capital-rich country will export high-quality products whereas the labor-rich country will export low-quality products. These models predict that the share of intra-industry trade in bilateral trade should be greater, the greater the difference in relative factor endowments between the two countries.

The role and significance of intra-industry trade in the process of globalization and integration of transition economies on international markets is becoming more important than previously. Research in the field of international trade shows that intra-industry is the fastest growing segment in the international trade of transition economies (Aturupane, Djankov and Hoekman 1997; Kaminski 2001). The key question is what happens with the comparative advantages and utility in international trade. Namely, we can ask, does an increase in the integration with international markets and growth in intra-industry trade specialization correspond to the changes in comparative advantages towards higher value added products?

The purpose of this paper is to analyze the structure of intra-industry trade and vertical specialization in Croatia. The key question is which component of intra-industry trade is dominant, horizontal or vertical specialization. If it is vertical, what follows then is its specific structure. The paper attempts to find which component is dominant, low quality exports or high quality exports. Also, in each component of intra-industry trade, comparative advantages are analyzed. By applying k-means cluster analyses homogeneous product groups are generated based on the values of the RUV and RCA indicators.

The basic hypothesis of this paper is that in Croatian intra-industry trade low quality exports are dominant.

The paper is divided into four parts: introduction, methodology, empirical results and conclusion.

2. METHODOLOGY

The data are at the 3-digit level according to the SITC (Standard International Trade Classification) and include 80 product groups. The analysis is conducted using the data for 2004. The data are taken from the Croatian Bureau of Statistics.

The empirical analysis of the trade pattern in Croatia was calculated using the following indicators:

- "Grubel-Lloyd Index", GL index;
- "Relative Unit Value" (RUV indicator);
- "Revealed Comparative Advantages" (RCA indicator).

The GL index shows the level of intra-industry trade specialization. The methodologies and calculations of the GL index were developed and applied by Grubel and Lloyd (1975).[1]. For individual product groups the GL index is calculated using the formula:

[1] See more details about the use of index of intra-industry trade specialization in transition economies in Kaminski and Ng (2001).

$$GLi = \frac{\sum_{i=1}^{n}(X_i + M_i) - \sum_{i=1}^{n}|X_i - M_i|}{\sum_{i=1}^{n}(X_i + M_i)} * 100$$

GL_i is the value of the Grubel-Lloyd index for product group i. X is defined as the value of exports, and M is the value of imports. The coefficient can vary from 0 to 1. The closer it is to 1, the higher the degree of specialization in intra-industry trade. A lower value of the coefficient shows that the country has a higher level of specialization in inter-industry trade.

For each individual product group in the analysis, the GL index is higher than 0.50.

The RUV indicator was originally developed by Abd-el-Rahman (1991). Later, numerous derivations originated from this indicator (Greenawy, Hine and Milner 1994, 1995). The RUV indicator is useful for the purpose of analyses of horizontal and vertical intra-industry trade. The indicator is based on the unit value of exports and imports. The unit value of exports is calculated as the value of exports divided by the quantity and the unit value of imports as the value of imports divided by the import quantity:

$$1 - \alpha \leq \frac{UVX_i}{UVM_i} \leq 1 + \alpha$$

UVX_i refers to the unit value of exports of product groups i, and UVM_i refers to the unit value of imports. Parameter α is a dispersion factor. The value of the parameter can be arbitrarily fixed. In most studies the parameter is assumed to be equal to 0.15 (Algieri 2004; Reganati and Pittiglio 2005). If the exports and imports unit values differ by less than 15%, then intra-industry trade is horizontal, and if the difference is higher, intra-industry trade is vertical. If the RUV is within the interval (0.85; 1.15) intra-industry trade is horizontal; conversely if it is outside of this interval it is vertical. If the RUV is greater than 1.15, the country is "exporting quality" while if it is smaller than 0.85 the country is "importing quality". Vertical intra-industry trade is assumed to have two components, high quality (HQVIIT) and low quality (LQVIIT). A high share of LQVIIT means that a country is specializing in relatively low-priced export goods in the vertically differentiated sectors. A high share of HQVIIT implies that VIIT takes the form of high-valued exports. Therefore if the relative unit value of a good is below the limit of 0.85, it is considered to be a low quality export. Conversely, if the RUV indicator is over the limit 1.15, it is considered a high quality export. To summarize, the intra-industry trade (IIT) contains the following components:

$$IIT = HIIT + LQVIIT + HQVIIT$$

The methodology for calculating the RCA indicator was originally developed by Bela Balassa (1965). Later, numerous derivations originated from this indicator. The RCA indicator is useful for the purpose of comparing comparative advantages for individual product groups[2]. The RCA indicator is calculated by the formula:

[2] See more details about the use of RCA indicator in Balassa (1965), Lafay (1992), and for transition economies Kaminski and Ng (2001), Yilmaz (2003).

$$RCA = \ln\left[\frac{X_i}{M_i}\right] \times \left(\frac{\sum_{i=1}^{n} X_i}{\sum_{i=1}^{n} M_i}\right) \times 100$$

X is defined as the value of exports, while *M* is the value of imports. Index *i* is the product group classified according to SITC. A positive value indicates that the country has comparative advantages in the corresponding product group. Conversely, a negative sign for the RCA indicator implies that there are no comparative advantages.[3] An alternative for RCA indicators is Lafay's RCA index. Compared to Balassa's RCA indicator, Lafay's index takes in regard the flows of trade inside each sector of the economy, GDP as well as exports and imports for each group of products.[4]
Besides Balassa's RCA indicator and Lafay's index, the export structure can be analyzed by using the CEP (Comparative Export Performance) indicator.[5]

By applying k-means cluster analysis, the RCA indicator, the GL index and the RUV indicator are analyzed. In general, k-means clustering procedure can be understood as ANOVA in reverse. Analyzed objects (products at the three-digit level of SITC) are moved in and out of clusters until the most significant ANOVA results are achieved. As an indicator of how well the respective variable discriminates between clusters, the magnitude of the F values is used.

In k-means cluster analysis statistically generated cluster centers are computed by procedures in which objects are primarily organized according to the distance between themselves. After that, k number of cluster centers is chosen in order to classify all objects in k number of clusters (k is a predetermined number of clusters). Objects are assigned to particular clusters according to their distance from particular cluster centers. The procedure is repeated until cluster centers are found that allow classification of all objects in k number of clusters with the most significant ANOVA results.

In k-means cluster analysis distances between objects and between objects and cluster centers are measured by unscaled squared Euclidean distances. For example, the distance D(i,k) of an object i from cluster center k for M analyzed variables X_j is calculated as follows:

$$D(i,k) = \sqrt{\frac{1}{M}\sum_{j=1}^{M}\left(X_{ij} - \overline{X}_j^{(k)}\right)^2}$$

where $\overline{X}_j^{(k)}$ is the mean value of variable j for cluster k.

Values X_j are not rescaled in any way, therefore distances between objects and between objects and cluster centers are expressed in measurement units of analyzed variables.

[3] In analyzing the trade structure in transition countries using RCA indicators, see for example in Djankov and Hoekman (1997), Kaminski and Ng (2001), Yilmaz (2003).
[4] See more details about the use of Lafay's index in Lafay (1992).
[5] See more details about the use of CEP indicator in Donges (1982).

3. EMPIRICAL RESULTS

By applying the GL index, product groups in which intra-industry trade specialization is dominant are determined. From a total number of 246 product groups at the three-digit level according to the Standard international trade classification (SITC), 80 have intra-industry specialization. These product groups represent 76.5% of the value of total Croatian exports and 37.0% of the value of total imports.

K-means cluster analysis was used to identify the existence of different clusters of product groups in Croatia relative to the ratio between unit value of exports and unit value of imports, as well as the comparative advantages. As variables in k-means cluster analysis, the values for the RCA indicator and the RUV indicator are used. Product groups at the three-digit level according to the SITC which have intra–industry specialization represent objects of clustering.

The results of the k-means cluster analysis indicate that in Croatia three different clusters of product groups exist relative to the values of the analyzed variables. The best generated solution is with these three clusters. Generated clusters represent product groups that are maximally homogeneous within each cluster, and maximally heterogeneous between clusters. Table 1 shows mean values for the RCA indicator and the RUV indicator for generated clusters.

Table 1.

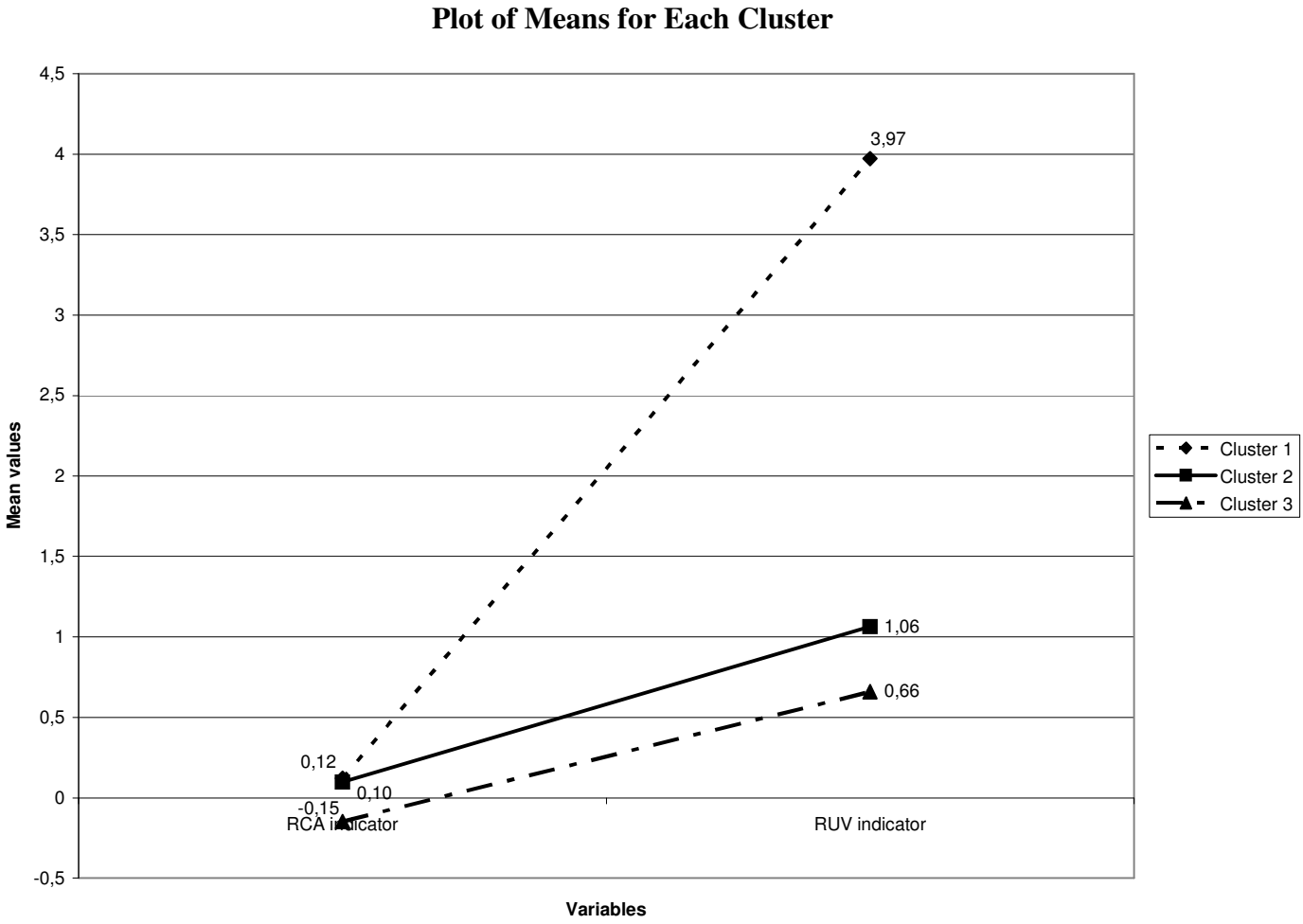
Means for Each Cluster

Variables	Cluster Number 1	Cluster Number 2	Cluster Number 3
RCA indicator	0.119768	0.096639	-0.146675
RUV indicator	3.971212	1.063598	0.658484

Source: Calculated by the authors

Also, the mean values for the RCA indicator and the RUV indicator for generated clusters are showed on Graph 1.

Graph 1.



Source: Calculated by the authors

ANOVA procedures found there were significant differences among three generated clusters of product groups of the analyzed variables (Table 2). These results indicate that product groups are maximally homogeneous within each cluster and maximally heterogeneous between clusters.

Table 2.

Analysis of Variance

Variable	Between SS	df	Within SS	df	F	p-value
RCA indicator	1.14814	2	5.87589	77	7.5228	0.0010
RUV indicator	71.62041	2	14.01539	77	196.7398	0.0000

Source: Calculated by the authors

The following table shows Euclidean distances and squared Euclidean distances between generated clusters. Note that clusters 2 and 3 are relatively close together (Euclidean distance = 0.43) with respect to the distance of cluster 3 from clusters 1 and 2.

Table 3.

Euclidean distances between clusters (squared distances above diagonal)

Cluster Number	No. 1	No. 2	No. 3
No. 1	0.0000	2.8986	5.5226
No. 2	1.7025	0.0000	0.4392
No. 3	2.3500	0.6627	0.0000

Source: Calculated by the authors

Compared to other clusters, Cluster 1 is the smallest, with respect to the number of product groups, and contains 7 products. These product groups contribute to 8.9% of the value of total exports and 2.4% of the value of total imports. Cluster 1 has comparative advantages and vertical intra-industry specialization. Also, high quality exports are predominant in this homogenous product group. With respect to products in Cluster 1 we can conclude that Croatia has high quality exports in tobacco products, medicinal and pharmaceutical products, some textile products (men's and boy's outerwear, textile fabrics not knitted or crocheted) and fish products.

Cluster 2 contains 22 product groups that contribute to 41.0% of the value of total exports and 14.3% of the value of total imports. This homogeneous product group has comparative advantages. Although the RCA indicator is positive, the value is lower than that of Cluster 1. Horizontal intra-industry specialization is dominant for Cluster 2. Concerning the product groups, the main characteristic for Cluster 2 is the shipbuilding industry, which is not typical for the trade patterns of other transition economies, and has the highest share in Croatian exports of goods, 13.5%. Typical products in Croatian trade patterns that have horizontal specialization are the shipbuilding industry, footwear, furniture and parts thereof, and some textile products (women's, girls, infant's outerwear, not knitted or crocheted, outwear knitted or crocheted, not elastic nor rubberized).

Compared to other clusters, Cluster 3 is the biggest, with respect to the number of product groups: containing 51 products. These product groups contribute to 27.5% of the value of total exports and 19.3% of the value of total imports. Cluster 3 has no comparative advantages. For this homogeneous product group vertical specialization is dominant. Low quality exports are also predominant. Cluster 3 contains the vast majority of food products (edible products and preparations, cereal, flour or starch preparations of fruits or vegetables). The loss of comparative advantages for the Croatian food industry in the last few years is the consequence of a higher level of liberalization in domestic markets and significant growth in the quantity of imports of food products, and at the same time stagnating exports. Typical low quality export product groups are the great majority of food products, wood products, beverages, and petroleum products.

The empirical results show that product groups in Cluster 1 have high quality exports and the highest comparative advantages, compared to Cluster 2 and Cluster 3.

Unfortunately, this homogeneous product group has the lowest share in total trade. Conversely, the biggest cluster has low quality exports and there are no comparative advantages. These results confirm the basic hypotheses that low quality exports are dominant in the Croatian intra-industry trade structure. Cluster 2 represents horizontal specialization, i.e. trade among products that are similar in terms of quality.

4. CONCLUSION

Product groups in which intra-industry trade specialization is dominant are determined. The k-means cluster analysis indicates that in Croatia three different clusters of product groups exist relative to values of analyzed variables. The cluster of product groups, in which Croatia shows the highest comparative advantages and high quality exports, has the lowest share in trade patterns compared to other clusters. Croatia has high quality exports in trade with tobacco products, pharmaceutical and medicinal products, some textile products and fish products. The shipbuilding industry, that has the greatest share in Croatian exports, has horizontal specialization. The most important low quality export products are the great majority of food products, wood products, beverages, and petroleum products. In Croatian intra-industry trade vertical specialization is dominant, as well as low quality exports.

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VERTIKALNA SPECIJALIZACIJA I UNUTAR-INDUSTRIJSKA TRGOVINA: SLUČAJ HRVATSKE

SAŽETAK

U radu se analizira struktura intra-industrijske razmjene u Hrvatskoj i implikacije na komparativne prednosti. Primjenom GL indeksa određene su grupe proizvoda u kojima prevladava intra-industrijska specijalizacija. Kao varijable u k-means klaster analizi korišteni su RCA i RUV pokazatelji. Obzirom na vrijednosti analiziranih varijabli empirijski rezultati ukazuju na postojanje tri klastera proizvodnih grupa. Vertikalna specijalizacija je podijeljena na izvoz visoke dodane vrijednosti i niske dodane vrijednosti. Za Hrvatsku je identificirana homogena grupa proizvoda s najvišom razinom komparativnih prednosti te visokom dodanom vrijednošću izvoza kao i grupa s najnižom razinom komparativnih prednosti te niskom dodanom vrijednošću izvoza. Na kraju rada se razmatraju implikacije rezultata istraživanja.

***Ključne riječi**: intra-industrijska razmjena, vertikalna specijalizacija, horizontalna specijalizacija, komparativne prednosti, Hrvatska*