AN ANALYSIS OF THE AGRICULTURAL SECTOR OF THE ECONOMIC COOPERATION ORGANZATION REGION AND ITS CONTRIBUTION TO FOOD TRADE

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Abstract: *This paper intends to present the Economic Cooperation Organization (ECO) as an example of regional integration, and focuses on the agricultural production of the member states, revealing their contribution to the export and import of food. The methodology used for attaining these objectives consists of a multiple linear regression study and a multicriteria ranking achieved by applying two procedures specific to regional rankings. The multiple regression showed a direct link between the export of food and cropland and an inverse link between the export of food and agricultural land. The second method – the multicriteria ranking helped to make comparisons between the analysed countries of ECO.*

Key words: *Economic Cooperation Organization, regional integration, agricultural trade*

1. Introduction

This paper analyses the Economic Cooperation Organization established in 1964 as an example of regional integration, and focuses on the agricultural production of the member states, revealing their contribution to increasing the food export potential. For attaining these objectives, two methods were used, namely a multiple linear regression study and a multicriteria ranking achieved by applying two procedures specific to regional rankings.

We have selected the agricultural sector because it remained a major contributor to the national economies of the ECO member states (Mirzael and Heidelbach, 2006).

The multiple regression model showed a direct relationship between export of food and cropland and an inverse relationship between export of food and agricultural land, but also between export of food and rural population. The second method – the

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multicriteria ranking – helped to make some comparison between the analysed countries of ECO.

The paper is organized as follows: the next section contains a brief history of the foundation and evolution of the Economic Cooperation Organization. Then, the part of methodology consists of data, the multiple linear regression model and the multicriteria ranking method. The last section of the paper is represented by the concluding remarks.

2. Brief history of ECO foundation and evolution

The ECO Region shelters more than 460 million inhabitants and expands over 8 million square kilometers of land, connecting the north to south, south and east to the west, Asia to Europe and Eurasia to the Arab World. Composed of some Caucasus, South, West and Central Asian countries, ECO is one of the oldest intergovernmental organizations (https://eco.int/history/).

The origins of ECO and its evolution are very well described by Pomfret (1997). ECO was established in 1964 by Iran, Pakistan and Turkey and was initially called the Regional Cooperation for Development (RCD), aiming to promote economic, technical, and cultural cooperation among the respective member states.

In 1985, RCD was renamed Economic Cooperation Organization (ECO), expanding its scope and trying to enhance the regional cooperation.

After the end of the Cold War, in 1992, ECOA received other seven new members: Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. In this way, the total membership amounted to 10, the countries being united by common economic, historical, and cultural ties.

The organization's objectives, stipulated in its Charter, the Treaty of Izmir, include the promotion of conditions for sustained economic growth in the region (Turner, 2010).

The main objectives of ECO consist of promotion of regional trade, transportation, energy and economic integration. ECO supported ECOTA (ECO Trade Agreement) and cross-border connectivity between the member countries by railway and road networks.

ECO has contributed, over the years, to the development of projects focusing on sustainability, energy security, and intra-regional trade.

It has also tried to solve the challenges confronted by the region, fighting to reduce poverty and to build infrastructure.

3. Methodology

Two methods were used, namely: a multiple linear regression study (Duguleană, 2011), continued with a multicriteria ranking achieved by applying two procedures specific for regional rankings.

The following indicators were calculated for the Multiple Linear Regression model: F, p-value, Adj R^2, R^2, t-value, Ica and β (Duguleană, 2012).

Following the first analysis of the regression table, from all the indicators included in the model, namely:
Y: Export of food (billion US $)
X1: Imports of food (million US $)
X2: Agricultural Land (square kilometres)
X3: Agricultural Land Use
X4: Rural population (million persons)
X5: Cropland and
X6: Land area equipped for irrigation,
it resulted that three indicators were not statistically significant and, therefore, they were eliminated from the analysis. Thus, a new multiple regression model resulted, which includes only three explanatory variables, this time all being statistically significant. The resulting multiple regression model is composed of:
Y: Export of food (billion US $)
X2: Agricultural Land (square kilometres)
X4: Rural population (million persons)
X5: Cropland.

For the multicriteria ranking, two methods were used, namely: *the method of relative distances* and *the method of ranks* (Lilea, Bugudui & Deatcu, 2013). This multicriteria ranking is completed with the comparison of the results recorded with both methods. For this and to continue the study in the same direction, the same indicators (that were included in the linear multiple regression model, which is globally significant from a statistical point of view) remain in the analysis. Thus, the following indicators are analysed: Export of food (billion US$), Agricultural Land (square kilometers), Cropland and Rural population (million persons).
The method of relative distances involves the steps:
- Calculation of the relative distance from the maximum performance for each indicator;
- Depending on the maximum values recorded, the relative distance is calculated;
- The partial ranks (r_{ij}) are calculated according to the formula:

$$r_{ij} = \frac{x_{ij}}{x_i^{max}}$$

(1)

- The average rank is calculated for each administrative-territorial unit, using the geometric mean of the relative distances;
- The unit with the highest geometric mean is chosen and the relative distance to it is calculated for all other administrative-territorial units, finally obtaining a clearer ranking by assigning the final ranks.

The application of *the ranking method* involves: the selection of socio-economic indicators, including in the analysis the variables of the multiple regression model realized in the previous step; calculation of partial ranks for each territorial unit; calculation of the score for each territorial unit; establishing the final hierarchy of territorial units.

3.1. Data

The data included in the regression model, but also used for the multi-criteria ranking of administrative-territorial units, were taken from ECO Statistical Report 2021, which allowed an easy access to regional statistical data. This information supports ECO's regional initiatives.

3.2. The Multiple Linear Regression model

The variables included in the Multiple Linear Regression model are:
- Y: Export of food (billion US$);
- X1: Imports of food (million US$);
- X2: Agricultural Land (square kilometres);
- X3: Agricultural Land Use;
- X4: Rural population (million persons);
- X5: Cropland;
- X6: Land area equipped for irrigation.

The multiple regression model is:

$$y_t = a_0 + a_1 x_{1t} + a_2 x_{2t} + a_3 x_{3t} + a_4 x_{4t} + a_5 x_{5t} + a_6 x_{6t} + \varepsilon_t \qquad (2)$$

The results for the multiple regression model show that the model is suitable, because $F_{(6,3)} = 54.232$, $p<0.05$, Adj $R^2 = 0.973$ and $R^2 = 0.991$. The regression with the six explanatory variables is globally significant ($F^* = 54.232 >$ F theoretic = 8.94). However, when analysing the coefficients table, the following aspects are observed: p-value for estimators a_0 (p = 0.348), a_1 (p = 0.053) and a_3 (p =0.174) has a value > 0.05, and the confidence interval for the three estimators changes its sign. For this reason, they are removed from the model, one by one. After removing them from the model X3 and then X1, the coefficients table is again analysed and it is observed that for X6 p-values = 0.134 > 0.05, and ICa_6 = [-1.182; 0.212]. As a result, it has been decided to remove also X6 from the model.

Therefore, the final model analysed for the multiple regression is:

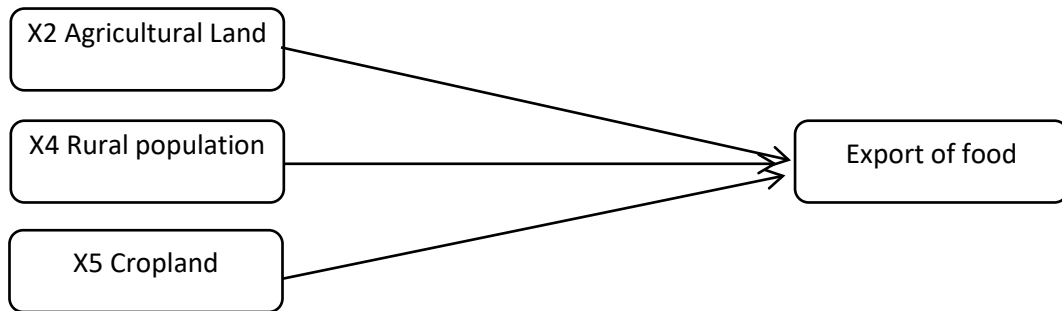$$y_t = a_0 + a_2 x_{2t} + a_4 x_{4t} + a_5 x_5 + \varepsilon_t$$

Fig.1. *The Multiple Linear Regression model*
Source: conceived by the authors

Hypothesis 1: There is a significant impact of Agricultural Land on the export of food.
Hypothesis 2: There is a significant impact of Rural population on the export of food.
Hypothesis 3: Cropland would positively influence the export of food.

The identified model is:

$$\widehat{y_t} = 1094.897 - 0.01103x_2 - 0.00016\,x_4 + 0.8953x_5 \tag{3}$$

The results for the new multiple regression model obtained from the elimination of the three variables show that the model is suitable and globally significant ($F^* = 26.55$ >F theoretic = 4.757). In addition to the global significance test, the individual significance tests of the coefficients are also analysed, from which it results that each explanatory variable in the model contributes to the explanation of the variance of the variable Y (since the values $\left|t^*_{\widehat{a_1}}\right|$ =6.89, $\left|t^*_{\widehat{a_2}}\right|$ =6.42, $\left|t^*_{\widehat{a_3}}\right|$ =8.77 > t theoretic = 2.44). This model is also suitable because Adj R^2=0.895 si R^2=0.930. Multiple R with a value of 0.964 shows a very strong intensity of the simultaneous link between the variables Y, X2, X4, X5. The linear model explains 93% of the variance of Y depending on the three remaining variables in the model: X2, X4, X5. Analysing the confidence intervals for the three estimators of the coefficients of the explanatory variables, it is concluded that there is a direct link between Y and X5, and an inverse link between Y and X2, but also between Y and X4. It is also important that the sign for the confidence intervals does not change, the p-values < 0.05 for the three variables remaining in the model.

Summary of the findings   Table 1

Hypothesis	Regression Weight	Beta Coefficient	R^2	F	t-value	p-value	Hypotheses supported
H1	X2→ Y	-1.338	0.93	26.55	-6.89	0.00**	YES
H2	X4→ Y	-1.24	0.93	26.55	-6.42	0.01*	YES
H3	X5→ Y	2.16	0.93	26.55	8.77	0.00**	YES

Note: *: $p<0.05$,   **: $p≤0.001$, X2: Agricultural Land (square kilometr 1s), X4: Rural population (million persons), X5: Cropland, Y: Export of food (billion US$)

Source: realized by the authors, using the results obtained from SPSS.

In conclusion, the multiple regression model developed by the authors is a significant global one, with a very strong intensity of the variables. The results show that there is a direct link between Export of food and Cropland, and an inverse link between Export of food and Agricultural Land, but also between Export of food and Rural population.

3.3. The multicriteria ranking

The analysis is continued with the application of the method of relative distances for the multicriteria ranking of the administrative-territorial units.

Table 2

The multicriteria ranking of ECO states by applying the method of relative distances and the method of ranks

Country	Method of relative distances			Ranking method					
	Geometric mean	Relative distance	Final rank	Partial rank 1	Partial rank 2	Partial rank 3	Partial rank 4	SCORE	Final rank
Afghanistan	0,117	0,261	**6**	7	3	5	2	17	**5**
Azerbaijan	0,037	0,082	**4**	6	9	7	8	30	**7**
Iran	0,261	0,583	**7**	2	2	4	3	11	**2**
Kazakhstan	0,295	0,658	**8**	4	1	2	6	13	**4**
Kyrgyzstan	0,029	0,065	**3**	8	8	9	9	34	**8**
Pakistan	0,448	1,000	**10**	3	5	1	1	10	**1**
Tajikistan	0,021	0,046	**2**	9	10	10	7	36	**10**
Turkey	0,375	0,837	**9**	1	4	3	4	12	**3**
Turkmenistan	0,018	0,040	**1**	10	6	8	10	34	**9**
Uzbekistan	0,102	0,227	**5**	5	7	6	5	23	**6**

Following the ranking after the application of the ranking method, it is observed that Turkmenistan is in the first place, followed by Tajikistan and Kyrgyzstan. On the last places are Kazakhstan, Turkey and Pakistan. This ranking will be compared with that

achieved with the application of the ranking method. Then, following the application of the ranking method, it is observed that Pakistan ranks first, followed by Iran, Turkey and Kazakhstan. With this method, Turkmenistan and Tajikistan are on the last places.

Making a comparison between the ranks resulted from the application of the two methods, changes are observed in the recorded results, both for the top of the ranking (where Turkmenistan is in the first place with the method of relative distances and in the 9th place with the method of ranks, and Pakistan is in the top of the ranking with the method of ranks and in the last place with the method of relative distances, but also for the countries occupying the last positions. The middle of the ranking is approximately the same for both methods used, where Uzbekistan and Afghanistan occupy the 5th and 6th place with both methods.

4. Concluding remarks

The Economic Cooperation Organization is an attempt of regional integration uniting countries that share cultural, historical, and economic ties.

This paper tried to analyse the agricultural sector and food trade of the countries belonging to this organization by using a regression model and a ranking method. The model proved to be suitable and globally significant with a very strong intensity of the variables. It showed a positive relationship between export of food and cropland and a negative relationship between export of food and agricultural land, but also between export of food and rural population. These results could help the decision-making factors to adopt suitable trade policies for the analysed countries.

The multicriteria ranking of ECO states, accomplished both by the method of relative distances and the ranking method, allowed to make some comparisons between the member states.

Potential future research can include in the regression model the food prices, the technology used in the agricultural sector and even the political turmoil and insecurity concerns in this region, which could affect the agricultural production and food export.

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