Economic performance of european agriculture companies using factor analysis

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Jana Hornungová
Ph.D. in Business Economics
Institution: Brno University of Technology
Faculty of Business and Management, Department of Economics
E-mail: **Jana.Hornungova@vut.cz**

Abstract

Agricultural production is one of the traditional sectors of the national economy. Business in this area is also very specific as it is highly dependent on weather and climate compared to other sectors. Increasingly, the sector has to be more and more environmentally sustainable, which is often a difficult task given its cost-effectiveness. In the article is analyzed economic performance, through financial data from 2 873 agriculture subjects in four parts of Europe. The main aim is to find crucial factors in the field of economic performance. Factor analysis was used for this finding. The new created variable is Factor of profitability, which includes variables ROE and ROCE. Then Pearson's chi-square test was used to find possible dependencies between observed factor and the European region of the company. At the end of the paper, the corresponding map was constructed for a graphical representation of the newly calculated factor and the European region. Best results of profitability factor were achieved by Western and Northern countries and Southern countries are the worst performers in terms of profitability.

Keywords: Economic performance. Agriculture. European Union. Factor analysis. Correspondence map.

1. Introduction

Agriculture is considered a strategic sector, as they fulfil a range of social, economic and environmental functions. Not only does it contribute national income, it also supplies society with food and raw materials for industry and fulfils essential environmental functions. In addition, globalisation and the associated liberalisation of economic relations are reinforcing the importance of this sector (Nowak and Rózanska-Boczula, 2022).

Performance measurement can be characterized as the process of creating indicators to assess progress towards predetermined goals and comparing actual performance against these indicators. In general, any performance needs to be monitored and evaluated in some way in order to it makes sense to address it in the business. Rating performance should be continuously updated not only based on the needs of the company, but above all, that the results of the performance evaluation are to respond to changes affecting the corporate

environment (Huyetta and Viguerie, 2005). As stated by Marinič (2008) and also Parmenter (2010), once the right Key Performance Indicators (KPIs) are defined that reflect the company's objectives (those that can be measured), these performance indicators can be used as a tool to measure performance. It only depends on the perspective of the actors outside and inside the enterprise approach performance and to what purpose they pursue performance. The most common and most used method is the financial and economic evaluation performance of a company using fundamental or technical analysis, which evaluates a company from an economic point of view based on a detailed study and analysis of financial statements. The financial indicators are very easy to visualize. Therefore, they are often considered to be the most commonly used indicators. However, there is a risk that if management focuses only on financial indicators, it can easily forget about some important objectives and success factors. If the entire performance measurement system is unilaterally focused (i.e. concentration on a few financial indicators), they are then other important factors that can be expressed in monetary units are ignored cannot be (Fisher, 1992; Chow and Van der Stede, 2006; Uyar, 2010).

The paper aims to find crucial factors in the field of economic performance in European Union agriculture companies, because these field plays a significant role in the economics of every country.

2. Literature Review

Performance evaluation methods have changed significantly. Increasingly, companies are realising that economic sustainability alone is not a sufficient condition for the overall sustainability of their organization (Bos-Brouwers, 2010; Gladwin et al., 1995). Performance indicators are of a different nature and should reflect the extent to which available resources are used to achieve the desired results (Bumbescu, 2020).

With regard to agriculture, economic performance is very often associated with environmental performance and environmental management. This area includes various initiatives to reduce or minimise the adverse environmental impacts of the organisation's activities. These efforts aim to improve environmental performance, reduce costs, improve corporate image, reduce the risk of non-compliance and improve marketing benefits. However, many organizations still view environmental initiatives as trade-offs between environmental and economic performance. The financial performance of firms is affected by environmental performance in a variety of ways. When waste, both hazardous and non-hazardous, is minimized as part of environmental management, it results in better utilization

of natural resources, improved efficiency and higher productivity and reduces operating costs. Again, when the environmental performance of the firm improves, it ushers in tremendous marketing advantage, and this leads to improved revenue, increased market share, and new market opportunities. Organizations that minimize the negative environmental impacts of their products and processes, recycle post-consumer waste and establish environmental management systems, are poised to expand their markets or displace competitors that fail to promote strong environmental performance (Klassen and Mclaughlin, 1996).

There is much debate about environmental management in relation to the economic performance of a company. Some argue that greening may not directly lead to improved economic performance, while others argue that, for example, greening of the input phase should lead to a reduction of pollution directly at the source and therefore to minimisation of other costs, hence also on financial performance. A number of indicators are used to establish the link between these two performances, including: new market opportunities, product price increase, profit margin, sales and market share (Bos-Brouwers, 2010). Bumbescu (2020) on this topic further states that there are many conceptual approaches and factors influencing performance, but due to the specificity of the agricultural sector, performance is influenced by: the farm size, the degree of technology, the natural conditions, the soil quality, education, age, together with other factors specific to other branches of the national economy (legislative, economic, social, political factors).

The efficient use of inputs in relation to economic resources is of considerable importance from the point of view of state management. It is possible to reduce production costs and at the same time increase the productivity and income of producers by determining the optimal combinations of the factors of production used (Celik, 2021).

Hornungová and Milichovský (2018) summarized in terms of previous research, that several studies have focused on farm performance across Europe through profitability, economic efficiency and technical efficiency (Latruffe et al., 2012; Bojnec and Latruffe, 2013; Svatoš et al., 2014). Thomassen et al. (2009) use gross value added productivity indicators to measure the economic performance of dairy farms. Similarly, Van Passel et al. (2007) use partial labour productivity, capital productivity and land productivity indicators to measure economic performance (Giannakis and Bruggeman, 2015).

3. Material and Methods

The methodology used in this paper was chosen to answer the main research question in relation to the main objective, which is to find crucial factors in the field of economic

performance in European Union agriculture companies. The analysis content economic data gathered from Orbis Europe database, containing information on more than 110 million companies. Data were processed by the statistical program IBM SPSS Statistics, specifically through factor analysis. The selection of agricultural companies was made according to these criteria:

- Geographical location (European Union 27);
- Classification of economic activities according to NACE classification – code 01 (Crop and animal production, hunting and related service activities);
- The corporate size – large and very large companies.

The resulting sample of the number of enterprises surveyed was 2 873, by European region were the numbers: Western (747), Northern (214), Southern (1415) and Eastern (497). All cases and data were involved to same year 2020. The financial and accounting variables chosen were:

- X_1 – Operating revenue (Turnover) [th EUR];
- X_2 – P/L before tax [th EUR];
- X_3 – Cash flow [th EUR];
- X_4 – ROE using P/L before tax [%];
- X_5 – ROCE using P/L before tax [%].

The method used in the paper is factor analysis. The aim of the factor analysis is selection of significant indicators and performance factors for selected area from the input database. Factor analysis is a method by which we try to replace the relation between numerous interconnected small number of variables not directly observable characteristics factors. This is also attributed to its primary function – data reduction, i.e. variable reduction.

To implementation of factor analysis, it is necessary to have *n* observations each *k* variables X_1, X_2, X_3 ... X_k. If among these variables exists linear dependence, their correlation coefficients large in absolute terms. When meeting provided further factor analysis for the dependence of the variables is common variables – factors, the partial correlation coefficients of the variables X_1, X_2, X_3 ... X_k are very small.

Mathematically, it is possible to describe the process of factor analysis as an expression

examined standardized variables X_i using a linear combination a smaller number of hypothetical factors F_j using the following relationship:

$$Xi = ai1\ F1 + ai2\ F2 + ai3\ F3 + + aim\ Fm + ei,$$

for i = 1, 2, 3, ...k, where:

k – number of variables,

m – number of factors; valid: m < n,

ei – specific component variables Xi.

Two methods are generally used to determine whether the use of factor analysis is appropriate:

- Kaiser-Meyer-Olkin rate (the KMO) – indicates the proportion of variation among variables that may be the cause the importance of individual factors. If the KMO value close to 1 (interval values 0-1) data can be used to create factors, while values below 0.5 are unacceptable.
- Bartlett's sphericity test – scans the entries in the correlation matrix (variables) that are not correlated and are therefore also suitable for creating the structure factor.

After the performed factor analysis is appropriate to confirm this analysis use indicator Cronbach's alpha, which is also known as the coefficient of reliability or consistency coefficient. It takes values from 0 to 1, the extreme value of 0 means that individual indicators are not correlated. On the other hand, the value of 1 indicates correlated variables. The closer the value is to 1, the higher is recognized degree of consensus. Cronbach's alpha is thus analogous to a correlation coefficient (Tarnanidis et al., 2015; Hornungová, 2014; Hammer et al., 2011; Škaloudová, 2010; Hrach and Mihola, 2006).

For Cronbach's alpha coefficient applies a formula:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} S_i^2}{S_x^2}\right)$$

4. Results and Discussion

Variables X_1-X_5, which were defined in the previous chapter, were subjected to descriptive statistics. The latter is used to summarize and describe the variable or variables for that data sample. The results can be seen in Table 1.

Table 1: Descriptive statistics of used variables

Variable	Mean	Min.	Min. (Country)	Max.	Max. (Country)	Std. deviation
Operating revenue	41 613.08	-167.00	PT	2 358 325.00	NL	144 391.70
P/L before tax	1 695.08	-51 248.00	RO	297 040.00	CY	10 015.68
Cash flow	2 812.12	-34 500,00	CY	332 100.00	FR	11 966.91
ROE	7.58	-680.99	IT	579.54	IT	43.32

ROCE	8.53	-593.05	SI	853.03	IT	39.34

According to the research results, operating revenue was between -167.00 and 2 358 325.00 th EUR, the average value was 41 613,08 th EUR. For the other variables the average values were: P/L before tax (1 695.08 th EUR), Cash flow (2 812.12 th EUR), ROE (7.58 %) and ROCE (8.53 %).

Before using factor analysis, Kaiser-Meyer-Olkin (KMO) method and Bartlett´s test of sphericity has been used firstly. The resulting KMO value is 0.606 and these result shows that the use of factor analysis could be applied to the data because the result is between 0 and 1, and in this case the value is closer to 1, which means that the variable is perfectly correlated with itself (close to 1). Also, the result of Bartlett's test leads to the rejection of the null hypothesis (the observed significance level is equal to 0.000). Bartlett's test verifies that it is not a so-called (unit identity) correlation matrix.

The result of factor analysis is rotated component matrix that is used to interpret the factors. As we can see in the following Table 2, two factors result, but only one of them (Index 2) is acceptable – based on Cronbach´s alpha.

Table 2: The component matrix of indicators

	Index 1	Index 2
Operating revenue	**0.846**	-0.067
P/L before tax	**0.895**	0.204
Cash flow	**0.959**	0.048
ROE	0.028	**0.888**
ROCE	0.074	**0.890**
Cronbach´s alpha	0.244	0.617

The number of factors should be as few as possible and the dependencies found should be explained as simply as possible. If we identify and name the factors, then we can work with them further-e.g. create aggregate indices from the item scores based on the individual factors. These groups are normally indicating names that capture the essence of what that factor expresses; in this case we can use a factor of profitability. This group of variables is the basis for further processing in terms of performance identification factor.

The last step of factor analysis is the construction of a new variable. Based on the research conducted, it was found that of the five indicators used to assess economic

performance, it is possible to construct a new variable from only two items based the calculation of the factor score. On the basis of the individual factor scores was compiled new variable, which make it possible to calculate this factor for individual agriculture companies. The new variable is referred to as the factor score or index factor. The new created variable is:

$$Factor\ of\ profitability = ROE \times 0.501 + ROCE \times 0.499$$

These financial performance indicators should help companies demonstrate progress towards their sustainability goals. The basic statistics of the newly calculated factor (index) are presented in Table 3.

Table 3: Descriptive statistics of observed factor

Variable	Mean	Min.	Min. (Country)	Max.	Max. (Country)	Variance	Median
Factor of profitability	7.9673	-356.65	IT	425.66	IT	1 053.619	4.8314

In the next step, the possible dependence between the defined factor and the European region was calculated using the Pearson chi-square test. Due to the large number of firms, the factor results were scaled into three groups using the median and mean for further testing. The value of Pearson chi-square test was 35.589 and Asymp.Sig (0.000). Keeping the % confidence of the test, the value is for the association between the defined factor and European region is set at 0.05, representing a 5% confidence level. So this leads to the conclusion that the alternative hypothesis is valid – there is a relationship between the factor and European region. there is a relationship between the factor and European region.

Correspondence analysis is used to graphically represent most important relationships between variables, specifically to cluster categories of nominal variables. This technique retains the categorical nature of the variables, given that the analysis is done at the level of the response categories themselves, not at the level of the variables. It plots relative frequencies in the form of distances between row and column profiles and distances to the average row and column profile in low-dimensional space (Sourial et al., 2010; Nagpaul 1999).

The map is presented in Figure 1. Dimension 1 is represented by the horizontal axis and dimension 2 by the vertical axis. The degree of "clustering" or proximity of points on the map with respect to their angle from the origin and points in the same quadrant can be used to interpret relationships between row and column variables (Higgs, 1991).

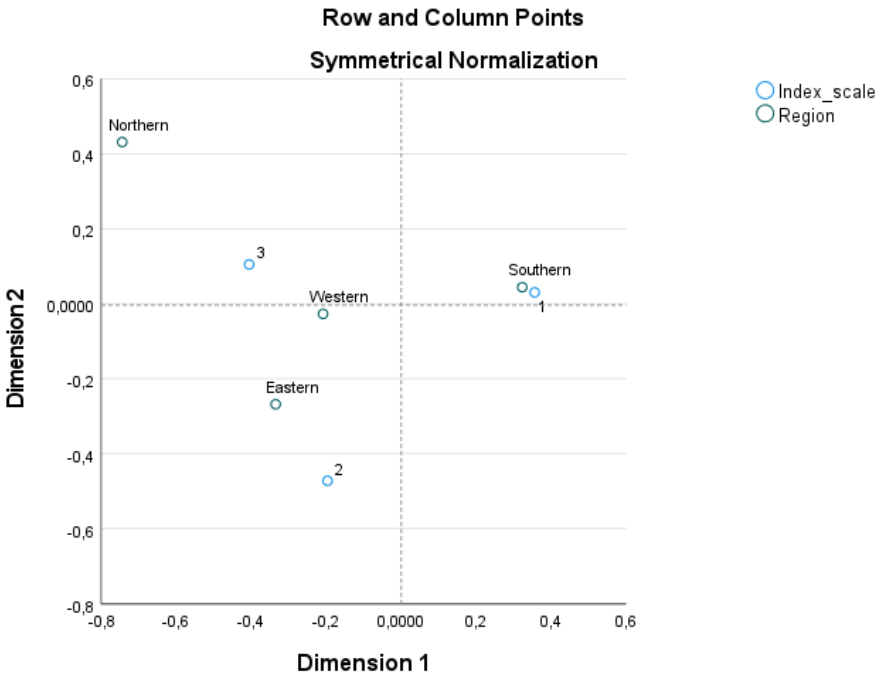

Figure 1: Correspondence map of Index scale and European region

The chart shows that countries in the Southern region achieved a profitability index below the median value (i.e. 4.8314%), the middle value (i.e. between 4.8314% and 7.9673%) was achieved by Eastern countries and the best results (i.e. profitability factor value > 7.9673%) were achieved by Western and Northern countries.

5. Conclusion

This research focuses on the identification of economic performance factors within the agricultural sector in EU Member States. The paper analyzed economic (financial) indicators from 2 873 companies. The main statistical method for empirical research was used factor analysis – that is usually used for the reduction of surveyed indicators. Two indexes were found, but only one was acceptable based on Cronbach´s alpha. The new created variable is Factor of profitability, which includes variables ROE and ROCE. Then dependence between the defined factor and the European region was calculated using the Pearson chi-square test. Identified factor is connected within the region – significance value is in 5 % of limit error. And then, by means of a correspondence map, it is possible to see the distribution of European regions in relation to the calculated profitability factor. Best results of profitability factor were achieved by Western and Northern countries and Southern countries are the worst performers in terms of profitability. The results of this research highlight the main indicators

that significantly affect the economic performance of EU agricultural enterprises expressed by ROCE and ROE. The paper makes an important influence to sound decision making aimed at the economic performance of the agricultural sector. This methodology can be used in any field of performance and can be applied to any area.

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