

Performance analysis of the Romanian food industry

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This research used a complex method to measure company performance instead of traditional financial ratios in order to gain a more comprehensive picture of firm efficiency. The study aims to investigate the efficiency of Romanian food industry companies. The performance analysis is based on the financial statements of Romanian food industry firms between 2018 and 2020. The companies included in the research database operate in different sub-sectors of the food industry. First, an empirical analysis was performed using Data Envelopment Analysis (DEA) to examine the efficiency of the firms considering all the companies and four sub-sectors. A multivariate and multifactorial analysis of variance (MANOVA) was performed to investigate the efficiency and profitability differences, using several factors affecting the efficiency scores and the selected profitability ratios. Based on the efficiency analysis results, it can be concluded that the Romanian food companies operated with an efficiency of over 50% in all three years. However, it can also be seen that, while the number of companies operating with an efficiency of at least 70% in the first two years exceeded 50%, in the third year, this proportion was only 25%. The decrease was most likely an effect of the Covid-19 epidemic. It can be stated that the efficiency of Romanian food companies is generally average, taking into account what was mentioned before. The analysis by sub-sector shows that only the average efficiency value of the largest sub-sector (680 firms - 46.41%; Manufacturing of bakery and farinaceous products) is below the average efficiency indicator of the whole company database. Except for two sub-sectors (Manufacturing and processing of milk and dairy products; Manufacturing of bakery and farinaceous products), the average efficiency coefficient of all sub-sectors is above 0.7, which can be considered good enough. Based on the analysis of variance results, it can be concluded that county and size-1 (Ranking by Total Revenue) factors have a statistically significant effect on all profitability indicators. However, the years have had no significant impact. The analysis of variance for the efficiency scores shows that all factors affect them significantly. In the last case, the most substantial effects come from two size measures (6.85 and 9.40%), year (9.03%), and county (4.35%) factors.

Keywords: financial performance, profitability ratios, multivariate analysis of variance, Data Envelopment Analysis, food industry.

JEL codes: G01, G30, G32, L25.

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Introduction

Today's unpredictable global economic developments have intensified competition among economic actors. The efficient operation of companies is a prerequisite for staying competitive, which requires continuous company performance monitoring. Moreover, managers' decision-making style may influence a company's success. Therefore, competitive firms can only base their decision-making on rational and relevant information. These days, the information provided by annual reports may not be sufficient for well-founded decisions. Performance analysis is also a useful tool for investors and shareholders to measure the value added to their investments. However, the annual financial reports can also provide an adequate basis for a deeper financial analysis of corporate performance.

In contrast to financial data from financial reports, like turnover, earnings after taxes and total assets, financial ratios permit a comparative analysis of companies with different activities or of different sizes. However, researchers faced several problems in their research, so the traditional methods based on financial ratios should be replaced or supplemented with other methods. One shortcoming of the conventional performance analysis based on financial ratios is that it does not accurately represent the financial performance of shareholders and managers (Fenyves et al. 2015). So a new, more adequate approach is needed to judge the financial performance better. DEA could be considered a more suitable method for measuring financial performance than the conventional financial ratios. The performance analysis based on frontier analysis provides benchmarks for managerial decision-making. The great advantage of this method is that it can use more input and output variables simultaneously, and efficiency is defined as the ratio of outputs to inputs (Fenyves et al. 2018).

The main aim of the research is to carry out a performance analysis of Romanian food industry companies. The food industry represents 18% of manufacturing in Romania, which is a significant share compared to other sectors. This suggests that the food industry is an essential contributor to economic growth, and its changes could affect the country's economy. This is the reason why we analysed this sector of the Romanian economy. For a comprehensive analysis of companies' financial performance, we used both profitability ratios and the DEA approach in our research. Fenyves et al. (2020) also used profitability ratios in a comparative analysis of the financial performance of Hungarian and Romanian retail food businesses.

Literature review

There are many articles on the application of the DEA method in almost every area of the economy and society, including the food industry.

Giokas et al. (2015) used the DEA method to examine the liquidity and sales efficiency of the Food and Beverage firms listed on the Athens Exchange from 2006 to 2012. They revealed that the liquidity efficiency of the firms is higher than their sales efficiency. Over 90% of the firms shifted the efficiency frontier, and 33.3% caught up and improved their productivity by reducing inefficiency. The empirical study reveals that the overall technical inefficiencies of the firms were primarily caused by pure technical inefficiencies rather than scale inefficiencies.

Lukac and Gardijan (2017) studied the competitiveness of over 200 large companies in the food industry from Central and Eastern European (CEE) countries, measuring their efficiency based on the DEA method. They used financial ratios as inputs and outputs. The results showed that some countries were more efficient than others. However, no efficiency patterns could be recognised in the food industry sub-sectors. The DEA method revealed sources of inefficiency on a national level.

Machmud et al. (2019) determined and analysed the efficiency level of the Indonesian food industry using the DEA method. The findings of the study showed that the use of production factors is not yet optimal in the Indonesian food industry, which was confirmed by DEA efficiency values of less than one. The main reason for the suboptimal result is the bad condition of materials and labour.

Guzman et al. (2021) analysed the Colombian dairy industry to identify efficient companies using the DEA method with the VRS (Variable Returns to Scale) model oriented to inputs and outputs. The input variables analysed were current assets, property, plant and equipment, non-current liabilities, and equity, while the output variables were revenue and profit. Findings revealed that seven DMUs were efficient in the input and output orientation. In addition, companies of different sizes and with or without quality certifications were efficient in the sample analysed.

Kedzo and Lukac (2021) analysed small food and beverage companies in the selected European Union countries and estimated their financial efficiency using raw financial variables. The relative efficiency was determined using the DEA method. The results show that the number of efficient small companies varied in the analysed period. Furthermore, the number of efficient companies was

variable within countries and in the food and beverage industry. Around 23% of food producers were relatively efficient, and the proportion of efficient beverage producers increased from 20% to 23%.

Náglová and Pechrová (2021) focused on evaluating the technical efficiency of food and beverage companies to find its determinants in the Czech Republic. They found out that foreign-owned companies had a stronger position, but their efficiency was comparable with Czech-owned companies. The results confirmed that the company's size influences technical efficiency. The highest efficiency was shown in the bakery and milk processing sectors, and the lowest efficiency was in the fruit and vegetable processing sector.

Research methodology

Research database

The analysis of food companies' performance is based on the financial statements of Romanian enterprises. The companies included in the study operate in different sub-sectors of the food industry. The enterprise data were collected from the official website of the EMIS database between 2018 to 2020. This study runs an empirical analysis of firms' performance using the enterprise data mentioned above. The distribution of the companies included in the investigation by sub-sector is shown in Table 1.

Table 1. Distribution of selected Romanian food companies by sub-sector

Sub-sectors	Number of companies
Production and processing of meat and meat products	252
Processing of fruits and vegetables	57
Manufacturing of vegetable and animal oils and fats	110
Manufacturing and processing of milk and dairy products	120
Flour and semolina production	5
Manufacturing of bakery and farinaceous products	680
Fish processing	15
Manufacturing of other food products	187
Feed production	39
Sector total	1,465

Source: Own editing

Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a widely used method for the relative analysis of corporate efficiency. DEA is a data-oriented approach to evaluating and improving performance. Nowadays, there is a growing interest in DEA methodologies and their applications. Formally, Data Envelopment Analysis (DEA) is a method directed to frontiers rather than central tendencies. In the case of DEA, one develops a linear surface on top of the observations. Because of this perspective, DEA can uncover relationships between the entities that remain hidden from other methods. For example, what does one mean by efficiency, or what does one mean when they say that one DMU (decision-making unit) is more efficient than another DMU? DEA accomplishes this straightforwardly and does not require expectations and conditions from various models (Cook–Zhu 2005).

The ‘DEA’ function of the ‘Benchmarking’ package of the R statistical system was used to calculate the efficiency coefficients. A presentation of the theoretical foundations of the DEA method and a detailed description of the ‘Benchmarking’ package can be found in the book by Bogetoft and Otto (2011).

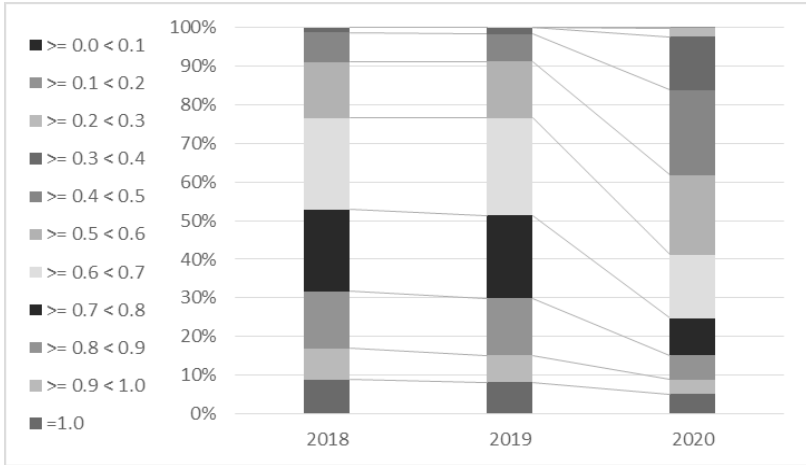
Results and discussion

Efficiency of the Romanian food industry

First, in line with the main aim of the research, we determined annual efficiency scores there were determined efficiency scores of Romanian food companies annually. The Data Envelopment Analysis was applied to calculate the efficiency coefficients. This method determines which investigated enterprises have optimal output if we define the input as reused resources (inputs). So it becomes clear to us what proportion of selected inputs is used to maximise outputs. This means that we are looking for the input-output combination in which the ratio is the smallest. Enterprises with this characteristic assign an efficiency value of 1, and the other enterprises will have values between 0 and 1.

First, an analysis was performed for the whole investigated database. The enterprises were grouped on a decile scale based on efficiency coefficients and all the efficient companies were put in a separate group. The 11 groups created were plotted on a yearly bar chart (Figure 1). The results show whole efficiencies (with value 1) for around 8-9% of investigated food enterprises in the first two years. In 2020, the number of whole efficient companies reduced, and only 5% of the analysed companies reached this value. However, it can also be seen that

the share of least efficient enterprises is the lowest in this group. Over 90% of the enterprises investigated achieved at least a 50% efficiency in the first two years, and this rate was around 60% in 2020.



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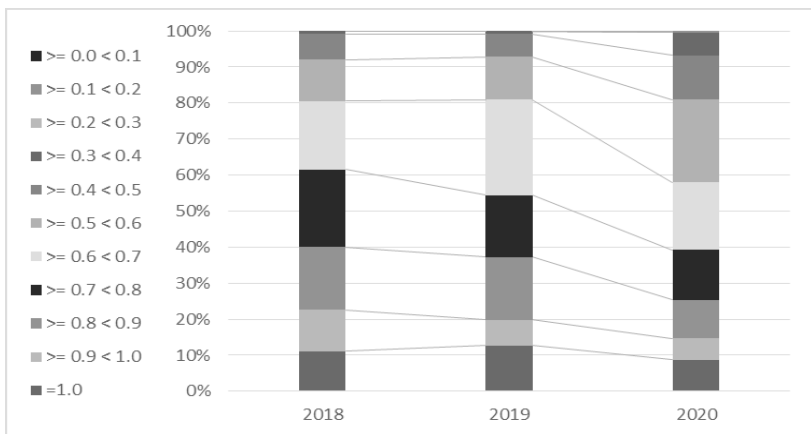
Figure 1. Performance analysis results for the food industry using DEA

In 2018, 60% of the examined enterprises had an efficiency coefficient between 0.6 and 0.9, which increased to 61% in 2019. This rate dropped, and only 32% of food companies were included in this efficiency range in 2020. These tendencies are most likely due to the negative effects of the coronavirus epidemic that affected most sectors of the world economy. This performance decline was also reflected in the average performance of food companies, which was above 70% in the first two years, and then it fell to 58% in 2020. Overall, except the last year, the efficiency of food companies is higher than the average. The different distribution between efficiency groups may be caused by the fact that the investigated food industry companies are quite diverse in terms of used technologies, production processes and factors, and used resources. It is not easy to compare the technology and production process of a bakery products company and those of companies processing and preserving fish and crustaceans.

Because of the significant differences between the sub-sectors within the food industry, some sub-sectors with a larger number of companies were also analysed

separately. According to the classification of the National Institute of Statistics, the Romanian food industry can be divided into nine sub-sectors. Among these, we chose four sub-sectors: production, processing, and preservation of meat and meat products (252 firms); manufacture of vegetable and animal oils and fats (110 firms); manufacturing and processing of milk and dairy products (120 firms); and manufacturing of bakery and farinaceous products (680 firms). The selected sectors represent around 80% of the total sample.

Meat processing companies represent 17.20% of the investigated enterprises. Compared to the whole sample chart, the efficiency classification groups show a different distribution in the case of meat processing companies. The upward shift in the efficiency groups has resulted in the disappearance of the least efficient groups (Figure 2).

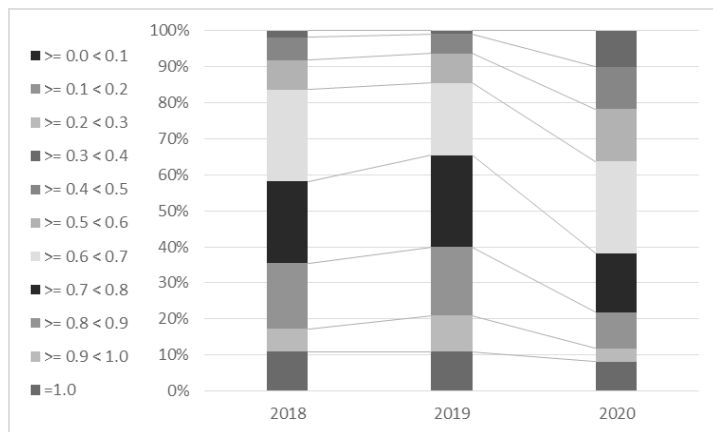


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Figure 2. Performance analysis results for meat processing companies using DEA (2018 - 2020)

In the first two years, around 11-12% of meat processing companies achieved efficiency coefficients of 1. In 2020, the number of high-performance companies (efficiency coefficient = 1) fell to 8.7%. Over 92% of meat processing enterprises achieved at least a 50% efficiency level in the first two years. In 2020, companies' efficiency weakened. Only 81% of the analysed companies fell into this efficiency score range. Nearly 55% of enterprises fit into an efficiency range of 0.6 to 0.9, after falling within a 0.5-0.8 efficiency range in the previous two years. Last year,

the average efficiency coefficient fell from 74% to 66% in the meat processing sub-sector.

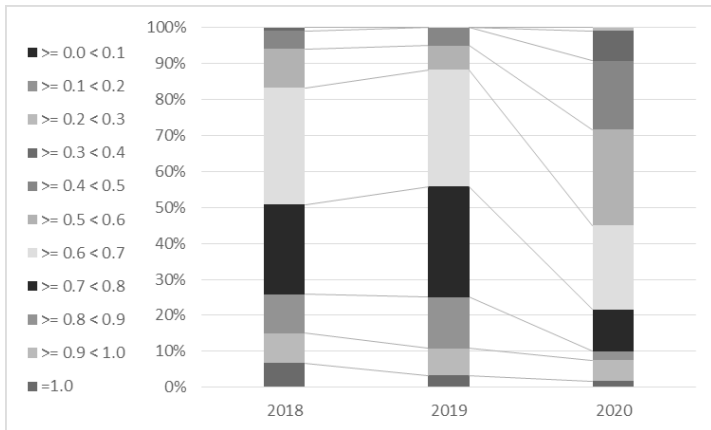


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Figure 3. Performance analysis results for vegetable and animal fat manufacturing companies using DEA (2018 - 2020)

Vegetable and animal fat manufacturing companies represent 7.51% of the investigated companies. Compared to the efficiency scores of meat processing companies, we can observe a different distribution and various tendencies (Figure 3). In 2019, the proportion of companies with an efficiency level of at least 0.5 (93%) increased and then significantly decreased to 78%. The share of high-performance companies (efficiency score = 1) also decreased from around 11% in 2018 and 2019 to 8% in 2020. Despite the negative impact of the coronavirus crisis, in this sub-sector, the results suggest that firms can maintain their efficiency. This means that this sub-sector is less sensitive to external economic shocks. Overall, the average efficiency of this group increased to 76% in 2019 and then decreased to 66% in 2020.

Milk and dairy manufacturing and processing companies represent 8.19% of the investigated enterprises. However, the share of high-performance companies steadily decreased in the analysed period from 6.67% in 2018 to 3.33% in 2019 and to 1.67% in 2020 (Figure 4).



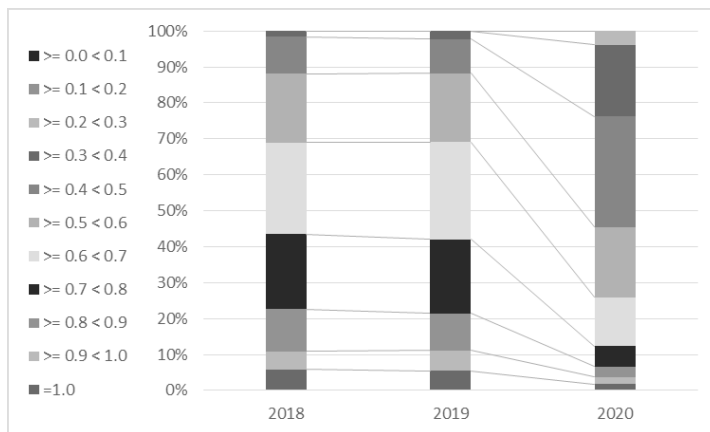
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Figure 4. Performance analysis results for milk and dairy manufacturing and processing companies using DEA (2018 - 2020)

It can be seen from Figure 4 that, in the first two years, over 94% of milk and dairy processing enterprises achieved at least a 50% efficiency level. In 2020, the share of companies with this efficiency level decreased to 72%. This efficiency decline is visible in the chart as a downward trend in the greater value ranges. The average efficiency coefficient slightly increased (2%) in 2019, then it decreased sharply to 60% in the case of milk and dairy manufacturing companies.

Bakery and farinaceous product manufacturing and processing companies represent 46.42% of the investigated enterprises. Compared to other sub-sectors, the group of high-performance companies (efficiency score = 1) is much smaller in the case of this sub-sector (5.88% in 2018, 5.44% in 2019), and a downward trend can also be observed in the examined period (1.76% in 2020). In the first two years, the proportion of companies with an efficiency level of at least 0.5 was relatively constant (88%) and it sharply decreased to 45% in the last year. The declining performance is probably due to the impact of the coronavirus crisis.

The results suggest that firms in this sub-sector are most sensitive and vulnerable to external economic shocks. Overall, the average efficiency of this group was relatively constant in the first two years (69%) and then it decreased to 52% in 2020.



Source: Own editing

Figure 5. Performance analysis results for bakery and farinaceous product manufacturing and processing companies using DEA (2018 - 2020)

Comparison of Romanian food companies using several impacting factors

It was examined whether the selected factors impacted the profitability indicators of food companies (Table 2). The analysis was conducted to determine whether the factors to be used in the efficiency analysis affected the profitability ratios of the companies examined. Based on Table 2, it can be concluded that only the County factor and one of the two size factors (Ranking by Total Assets) have a statistically significant effect on all profitability indicators. However, it can also be stated that if all profitability indicators are included together, the significant effect of all factors can be demonstrated. It can also be seen from the table that all the other factors have a significant impact on both value-added ratios, except for the year factor.

The efficiency coefficients calculated for the Romanian food industry may not only be affected by different financial characteristics but also by different quality factors. Such quality factors may include CAEN codes, counties, workforce categories, company size, and year. A multifactorial analysis of variance was performed to examine the qualitative effects, which are shown in Table 3. Based on the table, it can be concluded that all the analysed factors have a statistically significant impact on efficiency coefficients.

The table also shows that, by decomposing the sum of squares, the examined factors can explain 31.13% of the total variance of efficiency coefficients. Among the selected factors, the total revenue ranking (9.4%) affects efficiency scores at the highest level.

Table 2. Multivariate and multifactorial analysis of variance of profitability ratios in the Romanian food industry

Variables	CAEN code	County	Employee category	Ranking by Total Assets	Ranking by Total Revenue	Year
All variables	***	***	***	***	***	**
Operating ROS	***	***	***	***	--	--
Operating ROA	--	***	--	***	***	--
Value added / Total Revenue	***	***	***	***	***	--
Value added / Total Assets	***	***	***	***	***	--
ROS	***	***	**	***	*	--
ROA	--	***	--	***	***	--
ROE	--	***	--	***	***	*

Source: Own editing

We can also state that the effect of the year is quite significant (9.03%), just like the other company size characteristic (ranking by total assets) (6.85%). The workforce categories caused the slightest effect (0.23%).

Table 3. Multifactorial analysis of variance of efficiency coefficients in the food industry

Factors	SS ⁺	Distribution of SS	Distribution of factors' SS	Significance levels
CAEN codes	1.83	1.26%	4.06%	***
Counties	6.30	4.35%	13.98%	***
Workforce categories	0.34	0.23%	0.75%	***
Total assets ranking	9.91	6.85%	21.99%	***
Total revenue ranking	13.61	9.40%	30.20%	***
Year	13.07	9.03%	29.01%	***
Total factors' SS	45.06	31.13%	100.00%	
Residuals	99.68	68.87%		
Total SS	144.74	100.00%		

SS⁺ - sum of squares

Source: Own editing

Conclusion

Based on the DEA efficiency analysis of Romanian food companies, we can conclude that more than 50% of the investigated companies operated with at least 50% efficiency in all three years that we examined. While 90% of food enterprises achieved at least a 50% efficiency in the first two years, in 2020, this rate fell to 60% as a negative consequence of the coronavirus epidemic. The results of the sub-sector analysis show that, in the first two years, the average efficiency coefficient was above 0.7 in the case of the three investigated sub-sectors. The weakest efficiency can be observed in the case of bakery and farinaceous product manufacturing companies, in all three years. However, it can also be seen that all sub-sectors were negatively impacted by the coronavirus epidemic, but the above-mentioned sub-sector seems to be the most affected one because the average efficiency fell around 17%. In 2020, the share of companies with an at least 50% efficiency halved. The meat processing companies are less sensitive to coronavirus epidemic shocks, and their average efficiency ratios fell only around 7%.

Beyond quantitative factors, the effect of qualitative factors can be adequately demonstrated with the help of a multifactorial analysis of variance. It can also be seen that company size can significantly impact the efficiency score. The relatively strong annual impact is likely to be due to the COVID epidemic in 2020.

Given the relatively large number of companies, it is advisable to perform analyses in the future using the stochastic frontier analysis and compare the results with those of the DEA.

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