



Article Application of Canonical Variate Analysis to Compare Different Groups of Food Industry Companies in Terms of Financial Liquidity and Profitability

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Abstract: Financial liquidity and profitability are two critical phenomena present in the financial economy of a company, whose relations depend on each other and may course in different directions. At the same time, they are an example of the complexity of the problem, which demands a proper approach, allowing one to reconcile two opposing objectives of any enterprise, i.e., maximizing the benefits for the owners and minimizing the risk of losing financial liquidity. Until now, the relationship between liquidity and profitability has not been examined explicitly, using multidimensional methods in particular. Nevertheless, the links between profitability and financial liquidity maintenance ensure the sustainable development of enterprises in different branches. This paper formulates two aims: scientific and practical. The scientific one concerns adopting the canonical variate analysis method to visualize the differences and relationships between food industry companies regarding financial liquidity and profitability. The practical one relates to indicating the relationship between financial liquidity and profitability in different groups of food industry companies. To study the relationships between the selected groups of enterprises and describe them, the liquidity and profitability ratios were utilized, involving canonical variate analysis based on transformation by linear combination and singular value decomposition. The analysis found that the most important feature highlighting the group of the examined entities regarding financial liquidity was the cash conversion cycle. The research results showed the existence of multidirectional relationships between liquidity and profitability. The research indicates that they depend on indicators describing financial dependencies and the industries in which they operate. This led to a much deeper and broader interpretation of the assessment of the financial situation of companies to support their sustainable development.

Keywords: financial liquidity; profitability; food industry companies; canonical variate analysis

1. Introduction

Increasing benefits for the owners and ensuring the continuation of the business are currently two integral objectives of every business entity, regardless of its legal form, type of business, or size. Many stakeholders are interested in their achievement, including owners, managers, banks, contractors, and customers. The ability to continue operations and the possibility of sustainable development is especially important in food industry enterprises, as they contribute to food security and human health and, additionally, generate positive effects in terms of the rational energy-oriented development of raw materials supplied from agriculture. Furthermore, it indirectly generates positive external effects in terms of biological diversity, energy, climate, and environment [1]. Their proper management



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Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). allows for generating profits that ensure growth and development on the one hand and the ability to settle liabilities on the other hand, i.e., financial liquidity. However, the efficiency of company operations is not evidenced by the nominal value of the financial results but its relation to the incurred expenses, as similar profit can be earned with different levels of involved resources. The proportion between profit and different input categories is called profitability. Profitability must be pursued within the framework of liquidity security. Maintaining financial liquidity is the essential condition for achieving profitability. This dependence is not unequivocal, as financial liquidity ratios should be at such a level that they are neither higher nor lower than the liability payment status.

If this balance is disturbed, there is either overflowing—high liquidity—or a lack of liquidity. Both phenomena occur in the financial economy and may affect profitability differently. High financial liquidity may lead to limited profitability and development possibilities of an enterprise because it contributes to the improper structure of assets, ineffective use of capital, and the underutilization of financial leverage [2]. Occasionally, maintaining high liquidity is treated as a kind of benefit, ensuring financial stability and security. Lack of liquidity, in turn, leads to greater demand for external financing, lack of financial flexibility, and dependence on capital providers, which may result in the loss of credibility with further negative consequences.

Financial liquidity and profitability are two critical phenomena present in the financial economy of a company, whose interconnections depend on each other and may run in different directions. Therefore, both issues occupy a significant place in the hierarchy of company objectives. At the same time, they are an example of the complexity of the problem, which demands a proper approach, allowing one to reconcile two opposing goals of any enterprise, i.e., maximizing the benefits for the owners and minimizing the risk of losing financial liquidity. For this reason, numerous studies have been conducted in Poland and worldwide in this area. The nature and directions of these relationships have been studied, among others by Gentry [3], Deloof [4], Eljelly [5], Lazardis and Tryfondidis [6], Mensch [7], Ramachandran and Janakiraman [8], Bolek and Wiliński [9], Kandpal and Kavidayal [10], Jaworski et al. [11], Czerwińska-Kayzer [12], Kobika [13], and Gołaś [14]. The referred works are undoubtedly cognitive in nature and provide many essential conclusions; however, in most of them, the relationships between the studied phenomena are described using multiple regression or linear correlation analysis. Generally, these analyses concern a two-character series, making it possible to formulate conclusions to study relationships between two variables. Unfortunately, there are no studies on the relationships between the selected groups of companies and many liquidity (traditional and cash flow ratios) and profitability ratios and describing them using multidimensional methods based on the between-group and within-group sums of squares and product matrices.

In this paper, the relationship between liquidity and profitability was investigated, taking into account the division of enterprises into branches and applying the methods resulting from this assumption. The research was conducted on an example of three groups of enterprises-branches of the food industry. The food industry was selected for this study because it is considered a linkage in the food chain that integrates other links of the chain, i.e., agriculture, the purchase and trade of agricultural products and food trade [15,16]. The food industry sector includes twenty-four agri-food manufacturing industries [17], which differ in terms of produced products, industry linkage, operating efficiency, financial position including liquidity, debt level, and profitability [14,18]. The effect of liquidity loss in one group of entities may cause financial problems in the next link of the branch. It is necessary to determine the relationship between financial liquidity and profitability in these groups because it would imply the sustainable development of the company, as well as the entire branch. It is based on obtaining stable, economically and socially acceptable production in a way that does not threaten the environment [19,20] and meets the needs of present generations without compromising the ability of future generations to meet their own needs [21]. It assumes that human socio-economic needs can be met in harmony with

environmental concerns [22] and that society's production base per capita does not decline with time [23].

The novelty of this paper is the presentation of analyses of the relationships between the selected groups of enterprises and describing their ratios using two kinds of canonical variate analysis leading to the best single direction in which to view the differences between groups. The first method is based on transformation by a linear combination of variables, while the second one is based on a single value decomposition of the data set matrix. This can lead to much deeper and broader inference from the financial assessment carried out.

The scientific aim of the study is to compare groups of selected companies in terms of adopting the canonical variate analysis method to visualize the differences and possible relationships between food industry companies regarding financial liquidity and profitability. The practical aim is to indicate the relationship between financial liquidity and profitability in different groups of food industry enterprises.

This paper is organized as follows: firstly, a related literature review regarding the relationship between financial liquidity and profitability and the need for studies in this area are presented. Then, research methodology, described in detail, including the data collection method, the selection of financial characteristics, and financial ratios, are shown. The following section describes two kinds of canonical variate analysis. The paper continues with the presentation of results and discussion of the results compared to the findings of other authors. The last section of this paper includes conclusions, research limitations, and suggestions for future studies.

2. Literature Review

Liquidity and profitability are intertwined but not always parallel. Both financial liquidity and profitability are the core categories of enterprise activities, which, in order to function efficiently, the company should treat as equally important [9,24,25]. The maintenance of financial liquidity in a company affects its viability. It is a factor enhancing its existence, but, on the other hand, profitability itself does not ensure liquidity and viability. Hence, management must decide whether to opt for a policy of high profitability or a policy that maintains high liquidity [26–29]. Numerous studies describe the relationship between these financial categories in literature, but the nature and direction of these relationships are still debatable. One of the views present in these studies concerns the presence of a negative relationship between profitability and liquidity. This opinion can be found in the paper by Bolek and Wiliński [9], who, using an example of Polish construction companies, showed that lower financial liquidity is accompanied by higher return on assets and equity. Similar conclusions are drawn by Eljelly [5], who, in a sample of joint-stock companies in Saudi Arabia, showed a significant negative relationship between a firm's profitability and liquidity level, as measured by the current ratio. This relationship was more evident in enterprises with high current ratios and longer cash conversion cycles. The negative relationship between liquidity and profitability was shown by Kobika [13], who carried out a study on the example of manufacturing companies in Sri Lanka. This negative relationship between liquidity and profitability of trading companies in Sri Lanka was also confirmed by Ajanthan [30].

In their research on chemical and pharmaceutical companies in Bangladesh, Hamid and Akhi [31] showed that the negative relationship between liquidity and profitability concerns current liquidity and return on assets and equity. However, this relationship is positive when measured using quick ratio, working capital, and return ratios. Kandpal and Kavidayal [10] and Mitra and Kartik [32] reported similar results.

A positive relationship between liquidity and profitability was shown by Deloof [4], Lazardis and Tryfondidis [6], and Gołaś et al. [14,33,34]. Correlation and regression analysis were used in the studies mentioned above, based on the relationship between the cash conversion cycle and return rates. Deloof [4], who researched Belgian companies, and Lazardis and Tryfondidis [6], who analyzed Greek companies, demonstrated that an extended cash conversion cycle results in a decrease in return on capital. On the other hand, Gołaś

et al. [33], in their research on Polish food companies, found that a shorter cycle of cash conversion and operating cycle positively impacted the profitability of assets and equity. It means that shortening the cash conversion cycle (aggressive management of working capital) is beneficial for the performance of enterprises due to increased return on capital. Based on the study using multiple regression analysis for one energy industry, strong evidence was obtained for a positive relationship between corporate debt and tangibility and size and a negative relationship for profitability and liquidity. Growth and non-debt tax shields were found to be factors that also affect debt-to-capital ratio [35]. According to Mensch [7], the different relationship directions between liquidity and profitability should be linked to the time criterion. When considering long-term development decisions, profitability is more important because, over extended periods, the revenues equal the influence of the cash, and costs equal cash expenditures. Viable enterprises are, therefore, the primary source of cash inflows. On the contrary, liquidity is more important for current short-term decisions, and greater importance is attributed to financial liquidity [7]. Gentry [3] presented another view on the relationship between financial liquidity and profitability. The increase in financial liquidity is accompanied by a certain level of liquidity and by a rise in profitability. Reaching this threshold, the company continues to achieve the positive effects of increased profitability. Still, there comes a time when a decrease in liquidity is accompanied by an increase in profitability, thus showing a negative link.

These relationships were confirmed by Kobika [13], who stated that there are two schools of thought on the topic: one postulating that liquidity is not a factor in improving profitability and that there may be a negative relationship between them. According to the other school, liquidity plays a vital role in enhancing corporate profitability, and, unless there is a minimum level of investment of working capital, output and sales cannot be maintained. In fact, the inadequacy of working capital would keep fixed assets inoperative.

It is worth noting that few authors [36,37], who commented on the interconnection discussed in this paper, stated that there is no significant statistical correlation between liquidity measured by static indicators and rates of return. Therefore, the relationship between liquidity and profitability shown above is not clear and indicates difficulties in determining their direction. Consequently, it is necessary to continue to search for a solution to this problem to support management in achieving the primary objectives of any company, i.e., maximum profitability, optimal liquidity, and sustainable development.

3. Materials and Methods

3.1. The Data Collection

A comparison of entities in terms of financial characteristics was carried out based on annual statutory financial statements of food industry companies. Enterprises producing dairy products, dairy cooperatives (DC); enterprises producing meat products, meat enterprises (ME); and enterprises producing livestock feed, feed factories (FE) were selected for analyses. Branches mentioned above on the one hand differ in their production profile and on the other hand are interrelated and interdependent (Figure 1). Feed companies are purchasers of raw materials produced in farms, and, on the other hand, they supply feeds to these farms [38], whereas, dairy and meat companies are purchasers of agricultural raw materials [39]. The juxtaposition of these industries allowed, at the same time, one to indicate relations between liquidity and profitability in different groups of economic entities (group of enterprises), whose common stakeholder is an agricultural farm (Figure 1). A study by Florek and Czerwińska-Kayzer [40] showed that the selected branches in the years studied were not characterized by high variability in their financial situation. Using the TOPSIS method, the analyzed companies had comparable results of financial situation assessment in different years of the studied period.



Figure 1. Diagram of relationship between the studied branches.

Dairy cooperatives, feed, and meat industry enterprises, which in the years 2008–2013 continued their business activity uninterruptedly and prepared and published full financial statements available in the National Court Register, were studied. Moreover, only entities engaged in production activity in one of the analyzed branches were studied. To capture the relationships studied in this analysis, the year 2013 was chosen, which is the beginning of a period of stable economic development. This selection allowed the study to include entities that have been subjected to the effects of the economic crisis, such as the reduction of sales volume, the inability to finance through the credit, the lack of liquidity, the significant reduction of human resources, and the inability to maintain market share in the international market [41]. This choice made it possible to properly test the application of the method of canonical variables in the assessment of the financial situation of different groups of companies—branches. The surveyed sample excludes entities that in, 2013, had negative operating cash flow and loss. The financial assessment of companies based on reports for this particular year may provide a starting point for estimating the possibility of continuing and developing the business activity.

3.2. Financial Analyses

The main vectors of information about the company's financial performance are financial indicators [42]. According to the presented literature, in assessing the relationship between financial liquidity and profitability, traditional liquidity ratios and profitability ratios are primarily used.

From the group of traditional liquidity ratios in this study, two fundamental ones were used, namely the current ratio (y_1) and the quick ratio (y_2) . The former is determined by dividing total current assets by total current liabilities [43]. The latter provides a more narrow focus and concerns only such items of current assets as accounts receivable, cash, and marketable securities. This reduced amount is divided by the total current liabilities [44].

These traditional ratios rely on the values identified as current assets and current liabilities in the statement of financial position. Research carried out by Kirkham [44], Atieh [45], Cheng et al. [46,47], Sharma [48], and Czerwińska-Kayzer [12] suggests that to be complete, the assessment of liquidity and profitability should include both accrual- and cash-based indicators. In order to obtain a comparative perspective, the traditional ratios

may be compiled in cash flow ratios. Cash flow ratios are useful to measure a company's strength and security on an ongoing basis [49]. From the statement of cash flows, several ratios may be compiled into the traditional ratios to obtain a comparative perspective. This paper focuses on the ratios that are most comparable with regards to the short-term liquidity and profitability indicators, specifically the operating cash flow sufficiency ratio (y_3) and the ratio of cash flow to sale (y_4).

The operating cash flow sufficiency ratio is determined by dividing cash flows from operations by current liabilities [49]. This ratio measures the ability to generate cash resources to meet current liabilities. Barua and Saha [50] opined that a cash flow sufficiency ratio could be used to construe a firm's ability to generate a sufficient amount of cash to meet essential financial obligations. The higher the ratio is, the greater the liquidity [51].

The ratio of cash flow to sale gives analysts and investors indications about the ability of a company to generate cash from sales. In other words, it shows the capacity to turn sales into cash. Although there is no standard guideline for this ratio, a consistent and/or increasing trend of this ratio is a positive indication of good debt management [52].

In addition to traditional indicators and cash-flow-based indicators, in practice, the cash conversion cycle ratio (y_5) is often used to assess financial liquidity. This ratio shows the time it takes for an entity to convert inventory and other resources into cash. In principle, the ratios indicate how efficiently management is using short-term assets and liabilities to generate cash. This allows an investor to evaluate the company's overall health. The cash conversion cycle (in days) is the difference between the days of the operating cycle and the days of the debt repayment cycle [53]. The operating cycle is defined as the days' sales of inventory plus days' sales outstanding [14]. Generally, the lower the cycle is, the better for the company [14,54,55].

In order to stay on the market and ensure stable development, companies must also benefit from long-term outside capital, which must be repaid on an ongoing basis [56]. Lenders, investors, and credit-rating agencies show great interest in the ability to meet all commitments [57]. Therefore, in the full assessment of payment capacity, companies should also use solvency ratios to assess the ability to pay bills in the long term. One of the fundamental solvency ratios is the total debt (y_6)—leverage ratio that defines the share of short-term and long-term debt (total debt) relative to assets owned by a company [43]. Using this metric, one can compare a company's leverage with other companies in the same industry. This information can reflect financial stability. The higher the ratio is, the higher the risk of financing and worse security.

The general debt ratio is supplemented by the shareholder equity ratio (y_7). This is calculated by dividing total shareholder equity by the total assets of the company. The higher the ratio result, the lower the company debt and the safer its financial situation [58].

Profitability ratios are used to examine the ability to generate profits and reflect success or failure. Of the many profitability indicators in this work, gross profit margin ratio, return on assets, and equity were used. The gross profit margin ratio (y_8) refers to companies' ability to generate a profit from sales. This ratio is determined by dividing the gross profit from sales by the total sales [58]. A high ratio refers to high selling prices and low production costs. The high selling prices refer to the company's products having a competitive advantage. The competitive advantage of the product, either from cost or quality, helps the company increase profitability [59]. Return on assets (y_9) refers to the relationship between net profit and assets. This ratio measures the rate of return from the business on all existing assets [60]. The increase in the ratio refers to the effectiveness of the employment of assets by the company. The bigger the ratio is, the better the financial condition [59]. Return on equity (y_{10}) is a measure of financial performance calculated by dividing net profit by shareholder equity. This ratio is considered a measure of how effectively management uses financing from equity to create profits and grow the business [58]. The formulas of the utilized indicators are shown in Table 1.

Name of the Indicator	Mark	The Formula of the Indicator			
Current ratio	y_1	$=\frac{CA}{CL}$			
Quick ratio	y_2	$= \frac{CA - I - AC}{CL}$			
Cash flow sufficiency ratio	<i>y</i> ₃	$=\frac{CF}{CL}$			
Cash flow to sale	y_4	$=\frac{CF}{S}$			
Cash conversion cycle	y_5	$= \left(\frac{I \times 365}{S} + \frac{CR \times 365}{S}\right) - \frac{CL \times 365}{S}$			
Total debt ratio	y_6	$=\frac{TD}{TA}$			
Shareholder equity ratio	y_7	$=\frac{EC}{TA}$			
Gross profit margin	y_8	$=\frac{GPS}{S}$			
Return on assets	y_9	$=\frac{NP}{TA}$			
Return on equity	y_{10}	$=\frac{NP}{EC}$			

Table 1. Name and construction of the indicators.

CA—total current assets, CL—total current liabilities, I—inventory, AC—accruals of costs, CF—net operating cash flow, S—sales revenue, CR—current receivables, TD—total debt, TA—total assets, EC—equity capital, GPS—gross profit on sales, NP—net profit.

3.3. Statistical Analyses

Due to the correlations between financial indicators, multivariate methods were used to analyze the group structure of enterprises. Canonical variate coordinates are directions in multivariate space that maximally separate the predefined groups of interest specified in the dataset [61–63]. It is similar to discriminant analysis, where datasets for n enterprises (here n = 43) and p ratios (here p = 10) are in the matrix $\mathbf{Y}' = \left| \mathbf{y}_{1,1} \dots \mathbf{y}_{1,N_1} \mathbf{y}_{2,1} \dots \mathbf{y}_{g,N_g} \right|$, and the *n* units are grouped into *g* classes (here g = 3), where $\mathbf{y}_{i,i}$ denotes the $p \times 1$ vector of calculated ratios coming from the *i*th enterprises for the *j*th group of companies. In investigating the relationships between financial ratios and food industry companies, this method consists of transforming the matrix Y, maximizing between-groups variances [64], into a set of new variables, which carry similar information but are distributed in multivariate Euclidean space [62,65]. Following the transformation, the vector $\mathbf{y}_{i,i}$ is converted into a vector $\mathbf{x}_{i,j} = \mathbf{A}' (\mathbf{y}_{i,j} - \mathbf{b})$, where the vector **b** shifting the input data set is: $\mathbf{b} = (g)^{-1} \sum_{i=1}^{g} \overline{\mathbf{y}}_{j}$, where $\overline{\mathbf{y}}_{j} = (n_{j})^{-1} \sum_{i=1}^{n_{j}} \mathbf{y}_{ij}$ is a vector of financial ratios means for the *j*th group of companies. The vectors \mathbf{a}_{k} as the columns of matrix \mathbf{A} are determined by the following equations: $\mathbf{W}^{-1}\mathbf{B}\mathbf{a}_k = \lambda_k \mathbf{a}_k$, where: $\mathbf{B} = (g-1)^{-1}\sum_{i=1}^g n_i(\overline{\mathbf{y}_i} - \overline{\mathbf{y}})(\overline{\mathbf{y}_i} - \overline{\mathbf{y}})'$ is the between-group covariance matrix; $\mathbf{W} = (n-g)^{-1} \sum_{i=1}^{g} \sum_{j=1}^{n_i} (\mathbf{y}_{ij} - \overline{\mathbf{y}_l}) (\mathbf{y}_{ij} - \overline{\mathbf{y}_l})'$ is the within-group covariance matrix, and $\overline{\mathbf{y}} = n_j \sum_{i=1}^{g} \overline{\mathbf{y}_i}$. Using the normalization $\mathbf{A}'\mathbf{W}\mathbf{A} = \mathbf{I}$, the canonical variates are arranged to be uncorrelated and have equal within-group variance [64].

On the other hand [66], canonical variate coordinates, which determine the relationship between financial ratios, made it possible to present the position of selected enterprise groups and describe their indicators in the space of the canonical variates. In this case, analysis was based on singular value decomposition of the data set matrix $\mathbf{\Omega} = \mathbf{C} \left[\overline{\mathbf{y}_1} \dots \overline{\mathbf{y}_g} \right]'$, where $\mathbf{C} = \mathbf{I}_g - \frac{1}{g} \mathbf{1}_g \mathbf{1}'_g$. The rows of this matrix are differences in financial ratios between the means of individual enterprise groups and the vector $\overline{\mathbf{y}}'$. Following the transformation, the matrix $\mathbf{\Omega}$ is: $\mathbf{\Omega} = \sum_{k=1}^h \lambda_k^{-1/2} \Psi_k \mathbf{\varphi}'_k$, where $h = \min(p, g - 1)$, and the vectors Ψ_k , $\mathbf{\varphi}_k$ and scalars λ_k are determined by the following equations: $\mathbf{\Omega}\mathbf{S}^{-1}\mathbf{\Omega}'\mathbf{D}^-\Psi_k = \lambda_k\Psi_k$ and $\mathbf{BW}^{-1}\mathbf{\varphi}_k = \lambda_k \mathbf{\varphi}_k$, where $\mathbf{D} = \mathbf{C} diag(1/n_1, \dots, 1/n_g)\mathbf{C}'$ and \mathbf{D}^- stand for a generalized inverse of \mathbf{D} . The vectors Ψ_k and $\mathbf{\varphi}_k$ are standardized as follows: $\Psi'_k \mathbf{D}^- \Psi_k = \lambda_k$ and $\mathbf{\varphi}'_k \mathbf{S}^{-1} \mathbf{\varphi}_k = \lambda_k$. The vectors Ψ_k are called the *k*th canonical coordinates, and the vectors $\lambda_k^{-1/2} \mathbf{\varphi}_k$ are called the *k*th dual canonical coordinates [67–70]. Dividing dual coordinates by the inverse of the roots of the eigenvalues and shifting using vector \mathbf{b} means that the averages of financial indices for particular food enterprises have the same values in both considered canonical spaces.

4. Results of Empirical Research

The results of the analysis of canonical variates, based on the search for linear combinations of financial ratios, which have the greatest influence on within-group variability, are presented in Figure 2. The individual distribution of discriminatory scoring frequencies in the first and second canonical variables, which together consider the total variability for groups of corporations, clearly shows that meat enterprises overlap with two others on both axes. The first two variables discriminated against dairy cooperatives and feed companies, which kept considerable distances from each other with respect to financial ratios (Table 2), which suggests clear boundaries for these groups.



1st coordinate (79.0%)

Figure 2. Results of canonical variate analysis of financial ratios concerning the variability of food enterprises. Explanation: DC—dairy cooperatives, FE—feed companies, ME—meat enterprises.

Results of canonical variate analysis based on singular value decomposition of the selected financial ratios describing the financial condition of the companies according to different corporation groups are shown in Figure 3. The analyses found that the cash conversion cycle (y_5) was the variable that most significantly differentiated the entire population of studied food businesses. In the next step, variables that most visibly differentiated similarity between the distinguished groups of companies were: current ratio (y_1), quick ratio (y_2), and total debt ratio (y_6). This means that financial liquidity and solvency ratios make it possible to differentiate to a greater extent the entities, characterized by payment difficulties, on the one hand, of an overflowing nature and, on the other hand, by a lack of ability to settle liabilities in a timely manner. The variables that differentiated the analyzed groups of entities to the least extent were cash flow to sale (y_4), gross profit margin (y_8), return on assets (y_9), and return on equity (y_{10}). This indicates that financial efficiency, measured by profitability, and cash efficiency ratios were less characteristic for the analyzed groups.

Statistics	y_1	<i>y</i> 2	y 3	y4 (%)	<i>у</i> 5 (day)	y ₆ (%)	у ₇ (%)	y ₈ (%)	у ₉ (%)	У10 (%)	
DC											
minimum	1.04	0.67	0.00	0.0	-4	13.2	34.8	-3.2	0.1	0.1	
maximum	4.46	3.11	1.43	11.6	47	57.8	78.8	7.5	22.6	32.1	
mean	1.94	1.48	0.34	3.7	17	37.0	54.3	1.6	4.8	8.2	
standard deviation	0.75	0.61	0.32	2.8	13	12.1	11.8	2.6	5.4	8.1	
FE											
minimum	0.57	0.20	-0.18	-4.1	-18	11.5	4.9	-0.8	-5.3	-32.0	
maximum	3.06	2.21	1.74	23.0	86	84.0	87.4	20.2	17.7	27.6	
mean	1.51	1.01	0.42	5.1	40	52.1	43.7	4.2	5.6	7.4	
standard deviation	0.63	0.52	0.54	6.3	30	22.4	21.6	5.0	6.1	17.0	
ME											
minimum	0.95	0.44	0.00	-0.2	-5	32.7	12.0	-1.6	-6.1	-18.9	
maximum	1.87	1.36	0.71	6.5	45	88.0	64.2	4.0	9.7	41.1	
mean	1.20	0.84	0.17	1.8	22	64.6	28.6	1.6	3.1	11.2	
standard deviation	0.30	0.30	0.24	2.4	14	18.0	15.2	1.8	4.6	15.8	

Table 2. Descriptive statistics of the data sample used.

Explanation: DC—dairy cooperatives, FE—feed companies, ME—meat enterprises.



1st coordinate (79.0%)

Figure 3. Results of canonical variate analysis showing the relationship between food enterprises and financial ratios (rescaled dual coordinates). Explanation: DC—dairy cooperatives, FE—feed companies, ME—meat enterprises; y_1 —current ratio, y_2 —quick ratio, y_3 —cash flow sufficiency ratio, y_4 —cash flow to sale, y_5 —cash conversion cycle, y_6 —total debt ratio, y_7 —shareholder equity ratio, y_8 —gross profit margin, y_9 —return on assets, y_{10} —return on equity.

According to the localization of corporate groups, it was found (Figure 3) that findings concerning dairy cooperatives were different from the rest of the results. This was primarily related to the changes of indicators such as current ratio (y_1), quick ratio (y_2), and shareholder equity ratio (y_7), which were very high (Table 2). In turn, they had low values of cash conversion cycle (y_5) and total debt ratio (y_6). This means that the entities from this group show high financial liquidity. The average current liquidity ratio in this group was 1.94. Data show that, in 30% of the firms in this group, the size of this ratio exceeded the upper level of an adopted standard equal to 2.0 [71,72]. In turn, the average value of the quick ratio was equal to 1.48. Assuming that the values of this index should be within the range of 1–1.2 [71–73], the results may indicate overflowing in companies from this group.

This phenomenon can also be regarded as a characteristic feature of these entities. This specificity may result from their position on the market and may also be associated with shorter collection periods from payment dates of liabilities.

Dairy cooperatives also demonstrated a short period of external capital requirements, necessary for the timely payment of liabilities. This is evidenced by the short cash conversion cycle (y_5). The average length of this period in this group was 17 days, and the longest cycle was 47 days. Thus, the average length of the cash conversion cycle in the entire surveyed population was 10 days longer than in dairy cooperatives. The result shows that dairy cooperatives are characterized by a safe and conservative financing policy. This conclusion is supported by two other significant variables: the total debt ratio (y_6) and shareholder equity ratio (y_7).

The literature assumes that, from the point of view of financial security, the total debt ratio should be in the range of 57–67% [71]. In this group, the level of debt was lower than the lower boundary of the mentioned range in all the examined firms. The maximum value of this ratio in this group was 57.8%, and the average was 37.0%. High shareholder equity ratio values confirmed the substantial involvement of equity in financing these entities. At this point, it is worth emphasizing that the variables illustrating profitability did not turn out to be significant in this group, and their size was at a relatively low level. As a result, it can be said that dairy cooperatives demonstrated high liquidity, either in terms of assets or cash, short periods of external financing needs, high financial stability, and a relatively low profitability level compared to other groups of companies.

The localization of corporate groups (Figure 3) indicated that findings concerning meat enterprises were different from the rest of the results. This was primarily related to the changes of indicators like total debt ratio (y_6) and return on equity (y_{10}), which were very high (Table 2). On the other hand, low values were characteristic of current ratio (y_1) , quick ratio (y_2) , operating cash flow ratio (y_3) , shareholder equity ratio (y_7) , and return on assets (y_9) . This shows a different situation in comparison to dairy cooperatives. Meat enterprises showed low liquidity. The average current ratio (y_1) and quick ratio (y_2) were 1.2 and 0.8. The values of the ratios in a significant part of the firms in this group were below the accepted standards and thus, indicated difficulties with the timely repayment of current liabilities. In this group of companies, the operating cash flow ratio (y_3) was also significant in terms of the low value. This ratio belongs to the cash flow ratios, which determine the degree of short-term liabilities with cash flows from the operating activities. No limit values are given for this indicator. Still, it is assumed that a lower ratio value means a lower possibility of the timely repayment of liabilities and limited financial liquidity. The average size of this indicator for meat enterprises was equal to 0.17, while for dairy cooperatives, it was 0.34, and for feed enterprises, it was 0.42 (Table 2). Another important low-value feature in this group was the variable shareholder equity ratio, which indicated little involvement of equity capital in financing assets, which in turn resulted in lower financial security. In this group of companies, the return on assets was variable (y_9) and significant at low-level values. In contrast, return on equity (y_{10}) was a significant variable with high values compared to other groups. The average return on equity for meat enterprises was 11.2%, with 8.2% for dairy cooperatives and 7.6% for feed enterprises. Components of return on equity are net profit margin, total asset turnover, and equity multiplier [74,75]. This analysis shows that the return on equity for meat enterprises was largely dependent on the equity multiplier, expressed in this study as the total debt ratio (y_6) .

Based on the results, it can be concluded that meat enterprises experienced difficulties in maintaining liquidity. At the same time, a high debt had a positive impact on the return on equity, thus creating the potential to continue and develop the business.

The localization of feed enterprises shown in Figure 3 led to the conclusion that the findings concerning feed enterprises were different from the rest of the results. It

was related mostly to the changes of indicators like operating cash flow ratio (y_3), cash conversion cycle (y_5), and gross profit margin (y_8), which were very high (Table 2). The return on equity showed relatively low values.

The average length of the cash conversion cycle of the group of feed enterprises was 40 days, and the average in the studied population was 14 days shorter and reached 26 days. The operating cash flow ratio in these entities was also relatively high, averaging 0.42 and 0.32 in the entire study group. It means that entities of this group secured 42% of their current liabilities with cash generated from operating activities. The high level of cash sufficiency and the long cash conversion cycle indicate that these firms have a greater need for external financing. High values in this group of entities were also found in gross return on sales. Therefore, it could be said that companies from this group achieved financial results using a high sales-margin policy. It is worth noting that the lowest average return on equity was recorded (7.4%) in this group of entities. For dairy cooperatives, it was 8.2%, and for meat enterprises, it was 11.2%.

In conclusion, firms representing feed companies showed a relatively long cash conversion cycle whilst maintaining traditional liquidity ratios according to adopted standards and relatively low return on equity. In this case, the level of return on equity was determined mainly by high sales margins.

5. Discussion

Different statistical analyses present the relationship between one financial indicator and other ratios. Using multidimensional regression, correlations were often explored to find connections between economic indicators. After making predictions for a single financial ratio and assuming a uniform dataset structure, the advantage of this method is an indication of the direction and strength of independent variables that affect the dependent variable [35,76]. In addition, some methods develop a linear model, such as Logit and Probit application modeling [77,78] or artificial neural networks [79,80], which improve the overall prediction accuracy. On the other hand, the disadvantage of this approach is the assumption that the variables from which the explanatory variable values are estimated are independent. One method that can solve this problem is the linear transformation of the original variables into principal components, which are uncorrelated with each other and contain most of the information on the studied phenomenon [81]. If several groups are analyzed simultaneously, similar to principal component analysis, the canonical variate analysis should be used [64]. Then, the relationships between selected variables and analyzed groups of enterprises are examined [53]. On the other hand, once it has been established that the groups under investigation are separate, a discriminatory function can be assigned to companies assigned to selected classes, e.g., companies that have gone bankrupt or are still operating [78,82–84].

Our results concerning a comparison of different groups of enterprises indicate that the most important area differentiating the food industry companies investigated was liquidity. To a lesser extent, these entities were differentiated in terms of profitability. The cash conversion cycle was the measure with the highest significance in the financial liquidity ratios. Similar results were presented for an example of Belgian companies by Lazaridis and Tryfonidis [6]. Moreover, the importance of this ratio in the financial assessments of Polish food industry companies was indicated by Gołaś et al. [34]. The importance of the cash conversion cycle was also confirmed by Ukaegbu [28], who showed a strong negative relationship between profitability, measured through net operating profit and the cash conversion cycles across different industrialization typologies. Studies were carried out using balanced panel data of manufacturing firms in Egypt, Kenya, Nigeria, and South Africa. The literature review indicated a lack of agreement on the nature and direction of the liquidity and profitability relationship. The research shows the character of the relationship between liquidity and profitability, which depends on the type of indicators describing the examined financial areas. Similar interconnections were found by Kandpal and Kavidayal [10], Hamid and Akhi [30], Jaworski and Czerwonka [35].

This analysis proved that companies with high values of current ratio (y_1) , quick ratio (y_2) , and shareholder equity ratio (y_7) demonstrated low gross profit margin (y_8) and a relatively average return on assets (y_9) and equity (y_{10}) . On the other hand, the companies with low values of traditional liquidity ratios showed a relatively high return on equity (y_{10}) and low gross profit margin (y_8) . Therefore, it can be stated that there is a negative relationship between liquidity measured by current ratio, quick ratio, and shareholder equity ratio (y_7) and return on assets (y_9) and equity (y_{10}) .

In their research of Pakistani companies, Saleem and Rahma [85] also described the significant impact of the current ratio and quick ratio to return on assets. But they found no correlation between traditional liquidity ratios and return on equity. Similar results were reported by Eljelly [5] and Mendoza [86]. In this analysis, in the group of companies maintaining financial liquidity within accepted norms, return on assets (y_9) and return on equity (y_{10}) remained at a comparatively average level.

Based on the analyses, it can be considered that the results partly confirm Gentry's theory [3], stating that the relationship between liquidity and profitability is not linear and takes the shape of an 'inverted cup' (it has the shape of an inverted tea cup). According to this theory, companies with a certain level of liquidity can positively affect their profitability. In the studied group, this phenomenon occurred in feed companies (Figure 3). On the other hand, low financial liquidity was associated with high profitability, and inversely, high liquidity was accompanied by low profitability, which indicated a negative relationship between liquidity and profitability. Such directions of relationships were observed for dairy cooperatives and meat companies (Figure 3).

It is worth noting that this study found no significant correlation between the conversion cycle, which is clearly differentiated, and return rates and cash efficiency. Similar results were reported by Kandpal and Kavidayal [10].

6. Conclusions

This study aimed to compare groups of companies in terms of their financial characteristics to assess profitability and financial liquidity. In order to achieve the goal expressed in this way, a canonical variate analysis was used, based on a comparison of financial indicators that characterize the surveyed entities in the area of profitability and financial liquidity. In addition, the relationships between the groups of companies and financial ratios were analyzed.

Multidimensional methods showed that:

- Financial liquidity ratios are measures that better differentiate business companies compared to profitability ratios;
- The cash conversion cycle was the most important differentiating feature in the group of studied firms;
- The cash conversion cycle was reversely proportional to classical liquidity ratios (i.e., current ratio and quick ratio);
- There was a negative relationship between liquidity measured by current ratio, quick ratio, shareholder equity ratio, and return on assets and equity. Such a direction of relationships was observed in the examined dairy cooperatives and meat companies;
- In the case of feed companies, a positive relationship was observed between studied characteristics;
- No significant relationship was observed between the cash conversion cycle, cash efficiency, and return rates.

The research showed the existence of multidirectional relationships between liquidity and profitability. It confirmed the relationships described in the literature while showing that this relationship depends on the sector in which the companies operate. The originality of our work based on the simultaneous study of the relationship between different profitability and liquidity ratios, described both in traditional and cash flow ratios, including intra- and inter-group variability. Such solution is the first approach in analyzing the relationship between liquidity and profitability, which allows a deeper and broader assessment of the financial situation of the studied entities. It will allow management to incorporate the concept of sustainable practices into management strategies to enhance environmental and social responsibility, while maintaining liquidity and improving profitability ratios and creating stronger interactions with various stakeholders. This approach should enable the rational energy conversion of raw materials supplied from agriculture and the efficient use of energy required to produce food products. As only three groups of firms were included in the study, it is necessary to extend the analysis to other sectors. Moreover, the question arises whether the indicated relationships would be maintained in different periods. Another important direction of our research will be to apply the method of canonical variables to study the relationship between the different indicators analyzed over a longer study period and a larger number of branches.

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