ASSESSMENT OF THE FINANCIAL SITUATION OF SELECTED COMPANIES OF THE POLISH SUGAR INDUSTRY 2016-2022

Chrystian FIRLEJ[1], Dagmara ZUZEK[2*], Lidia LUTY[3], Krzysztof Adam FIRLEJ[4]

[1] Department of Management and Economics of Enterprises, University of Agriculture in Krakow; chrystian.firlej@urk.edu.pl, ORCID: 0000-0001-7724-5717
[2] Department of Statistics and Social Policy, University of Agriculture in Krakow; dagmara.zuzek@urk.edu.pl, ORCID: 0000-0002-7620-1621
[3] Department of Statistics and Social Policy, University of Agriculture in Krakow; lidia.luty@urk.edu.pl, ORCID: 0000-0001-8250-8331
[4] Department of Microeconomics, Krakow University of Economics; kfirlej@uek.krakow.pl, ORCID: 0000-0002-5491-273X
* Correspondence author

Purpose: The main objective of the article is to analyze and evaluate the financial situation of selected companies operating in the sugar industry and belonging to the WIG Food index for the years 2016-2022. The secondary objective is to verify the relationship (correlation) between financial liquidity and company profitability and to try to indicate the direction of this relationship if it occurs.

Design/methodology/approach: The article uses a literature review, analysis of financial data from the financial reporting of companies using statistical methods. Four models of multidimensional discriminant analysis were applied (model D. Hadasik, model J. Gajdka and D. Stos, D. Wierzba and the 'Poznań' model). The analysis was extended to the calculation of three financial liquidity ratios and three profitability ratios of the company. Data from 2016-2022 were analysed in order to illustrate how the situation of the selected companies developed in the period before and after the COVID-19 pandemic.

Findings: All the analysed companies were in a good financial position during the analysed period. The most rigorous multivariate discriminant analysis models were those of J. Gajdka and D. Stos and D. Wierzba, which indicated deteriorating financial performance in selected years. Moreover, the analysed companies were characterised by high liquidity and profitability in 2016-2022. Only ZPC Otmuchów SA achieved negative values of profitability indicators in the analysed period, which was a result of negative net profit.

Practical implications: A practical application of the presented research could be to draw the attention of companies operating in the food industry to methods of assessing their financial health using appropriate tools and to verify the relationship between liquidity and profitability in these companies.

Originality/value: The article presents an analysis and evaluation of the financial condition of selected companies from the WIG Food index. Correlation analysis was used, and the reasons for the financial performance are indicated.

Keywords: Liquidity, profitability, discriminant analysis, confectionery industry, COVID-19 pandemic.

Category of the paper: research paper.

1. Introduction

The world sugar market is characterised by volatility caused by political events and economic cycles. Price increases in this market are closely linked to major historical political and economic events: the Great Depression of the 1920s, the Cuban missile crisis of 1962 or the energy crisis of the 1970s (The Sweet and Sour History of Sugar Prices, 2023). Since 2000, the world sugar market has been subject to cyclical fluctuations. From a research and economic analysis perspective, it is important to identify the strength of the impact of these fluctuations and the determinants that cause them. In addition, the literature lists factors that influence global sugar prices, such as rising diesel prices, weather conditions, global sugar consumption trends or market regulations (Rumánková, Smutka, 2013). Between 2016 and 2022, we had to deal with important events that could affect the operation of companies in the global and European market: the COVID-19 pandemic, Brexit and the military conflict in Ukraine.

Countries that are part of the European Union have brought sugar production under a common market organisation. It has many functions: it creates opportunities for cooperation between producer organisations and inter-branch organisations, sets minimum quality requirements for producers and secures agricultural markets. Very importantly, Member States provide voluntary production support to specific sectors in difficulty, such as sugar beet and cane production. The sugar market within the European Union is covered by two EU policies: market measures (e.g. private storage aid) and trade measures (e.g. international trade agreements as a whole) (Agriculture and rural development, 2023).

The Polish sugar sector has been dependent on the world market for many years. The production potential of the Polish sugar industry is greater than the demand on the domestic market, which means that the production surplus is exported (Szajner, 2019).

The scale of the agri-food industry in Poland has developed significantly in recent times, both in terms of subject, object and quality. Despite the fact that the industry in Poland is often classified as a so-called low-tech sector (e.g. in terms of innovation), it is an important part of the Polish economy. The confectionery industry in Poland is one of the most innovative branches of the food industry with a high growth potential. This is reflected in the fact that the consumption of chocolate and confectionery in Poland is almost three times higher than in Switzerland, Belgium or the UK (Kopyra, Firlej, Luty, 2020). The improved competitiveness of Polish agri-food companies is influenced by the fact that producers are rapidly adapting to changes in consumer behaviour and preferences in terms of the quality of products consumed and their growing awareness of food (Szczepaniak, 2016).

The COVID-19 pandemic had a greater or lesser impact on the agri-food industry in Poland, depending on the sector/industry concerned. The impact on the confectionery industry can be divided into two periods: short (up to 3 months) and long (more than 3 months). In the short term, the following factors can be distinguished: decrease in employment in the industry,

limited range of production and products, decrease in sales revenue due to restrictions (lockdown), e.g. in the entertainment sector, temporary closure of business premises (e.g. confectionery shops) or inability to fully compensate for lost revenue despite attempts to sell products via e-commerce. Longer term factors include: obstacles to exports and, in addition, a decline in domestic demand for premium products, a decline in sales associated with limited employment, the collapse of the most economically vulnerable businesses, particularly in the SME sector (Szczepaniak et al., 2020).

Companies in the sugar and confectionery industry most often organise their activities by combining the processes of raw material procurement, production, distribution and trading. Sugar and the products in which it is used are most often purchased by consumers in shopping centres, while the distribution of products through the e-commerce channel is developing.

Although Polish foreign trade in agri-food products faced many difficulties in 2016-2022 (e.g. COVID-19 pandemic, Brexit, military conflict in Ukraine), an increase in the value of food exports was still recorded. Restructuring and modernisation changes that took place in the Polish agri-food industry after Poland's accession to the European Union in 2004 positively influenced the growth of competitiveness of the Polish food industry and strengthened its competitive position on the international arena. A systematic increase in the value of Polish agri-food exports makes it possible to manage food surpluses, which is an important source of revenue for the Polish agri-food industry (Polski handel zagraniczny, 2023).

The value of exports, imports and the balance of Polish foreign trade in agri-food products increased between 2016 and 2022 (Figure 1). The dynamics of Polish foreign trade in agri-food products in 2016-2022 is as follows: exports - 196%, imports - 185%, balance - 221%.
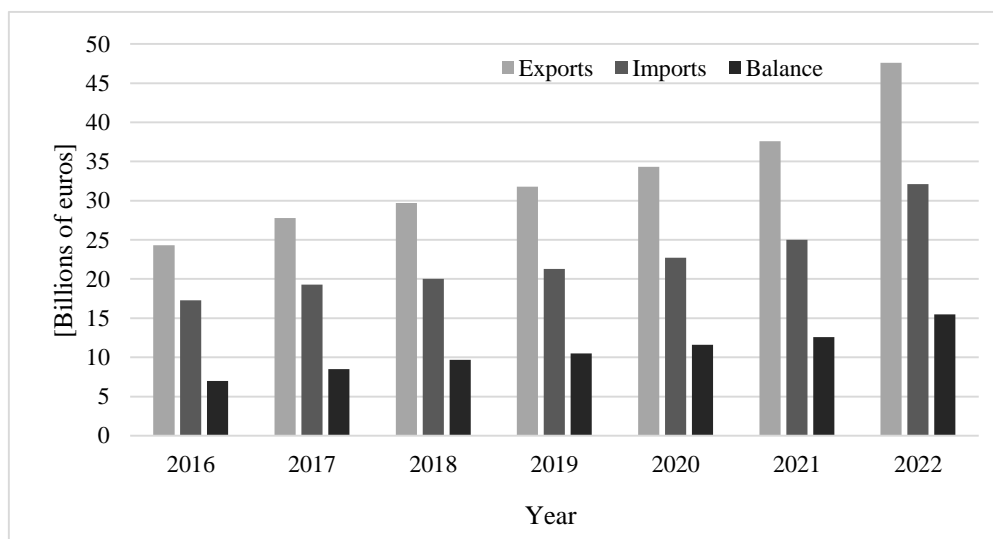
Figure 1. Value of Poland's foreign trade in agri-food products 2016-2022 (in EUR billion).

Source: own elaboration based on: Foreign trade in agri-food products. Retrieved from:
https://www.gov.pl/web/kowr/handel-zagraniczny-produktami-rolno-spozywczymi, 12.08.2023.

The year 2022 turned out to be a record year in terms of Polish agri-food exports, the value of which amounted to EUR 47.6 billion (PLN 223 billion). This represented an increase of 26.7% compared to 2021 (EUR 37.4 billion [PLN 170.8 billion]). In 2016-2022, Germany remained Poland's main trade partner, to which exports of products in 2022 amounted to EUR 11.9 billion and were 25% higher than in 2021. The vast majority of Polish agri-food products are exported to EU countries (in 2022, the value of exports with these goods amounted to EUR 35.3 billion, which accounted for 74% of the value of total exports) (Wyniki polskiego handlu zagranicznego, 2023).

In the most turbulent period of the analysis carried out (2019-2021), 'sugar and confectionery' as a group of export commodities was invariably ranked fourth in terms of export value in the commodity structure of Polish agri-food exports. In 2022, the aforementioned product group dropped to fifth place reaching a value of EUR 3.2 billion which still represented an increase of 14% compared to 2021 and 7% of the total 2022 agri-food exports (EUR 47.6 billion) (Wyniki polskiego handlu zagranicznego, 2023).

The purpose of this paper is to assess the financial situation of selected companies operating in the sugar industry in Poland under the crisis conditions caused by the COVID-19 pandemic by means of discriminant analysis, and to analyse their liquidity and profitability. The paper focuses mainly on the COVID-19 pandemic period (2019-2021). In addition, the study attempts to establish links (correlations) between the liquidity and profitability of the analysed companies.

The article adopts a hypothesis (H1) stating that the selected models of multidimensional discriminant analysis are a valid tool for verifying and assessing the financial situation of the analysed sugar companies in Poland. In addition, a second hypothesis (H2) was formulated, which states that there is no statistically significant relationship between financial liquidity and financial profitability of the analysed companies.

2. Literature Review

Relationship between liquidity and profitability of the company

A company's liquidity and profitability are considered to be very important areas in terms of its assessment (e.g. financial health). The continuity of a company's operations and development is determined by the maintenance of liquidity. The company's profitability, on the other hand, is an essential source of asset and capital growth. Maintaining liquidity and profitability at an appropriate level is high on the hierarchy of corporate financial management objectives. Moreover, the relationship between a company's liquidity and profitability is a complex issue that requires an appropriate approach to reconcile these two conflicting

objectives - minimising liquidity risk and maximising value for owners (Kuciński, 2018). It is important to compare the values of individual financial ratios (e.g. the relationship between a company's liquidity and profitability) when assessing the financial position of companies (Lisek, Luty, Zioło, 2019). The issue of a company's liquidity and profitability and the relationship between them has been addressed by many researchers. In the foreign literature, the issue of the relationship between a company's liquidity and its profitability has been analysed several times (Table 1).

Table 1.
Foreign studies analysing the relationship between liquidity and corporate profitability

Author (year)	Results of the analysis
K.V. Smith (1980)	Failure to maximise liquidity and profitability simultaneously. The analysis showed that the decision to increase profitability does not mean increasing the company's liquidity at the same time.
M.L. Jose, C. Lancaster, J.L. Stevens (1996)	Research in the US market has shown that the lower the liquidity, the higher the profitability of the company.
H. Shina, L.A. Soenena (2000)	Research conducted on a sample of 1000 companies, which showed a negative correlation between profitability and liquidity.
A. Blatt (2001)	Analysis of 1555 Japanese and 379 Taiwanese companies. The study found no relationship between liquidity and profitability as measured by the dynamic model.
Y.J. Wang (2002)	Research has shown that an excessive reduction in liquidity can contribute to a company's reduced profitability.
I. Lazaridis, D. Tryfonidis (2006)	The analysis was conducted on the Greek market (Athens Stock Exchange). The study used operating profit margin as a measure of profitability and cash conversion cycle as a measure of liquidity. A statistically significant relationship was found to exist between the two.
Q. Saleema, R.U. Rehmana (2011)	A study of Pakistani listed companies. A similar relationship to the analysis done by Y.J. Wang.
C.K. Ashraf (2012)	Analysis of 16 Indian companies. Research on the impact of working capital on profitability. Results identified a negative relationship between working capital and firm profitability.

Source: own study based on a literature search on the subject.

In the Polish context, the relationship between liquidity and profitability has also been addressed by many authors (Table 2).

Table 2.
Studies analysing the relationship between liquidity and profitability of companies in Poland

Author (year)	Results of the analysis
A. Bieniasz, D. Czerwińska-Kayzer, Z. Gołaś (2007)	A study of 30 branches of food companies in Poland showed that the length of inventory and accounts payable cycles has a strong impact on profitability.
P. Szczepaniak (2009)	The analysis of non-financial sectors in Poland showed that there is a moderate linear relationship between profitability and liquidity for most sectors.

Cont. table 2.

M. Bolek, R. Wolski (2010)	The correlation analysis showed that as liquidity decreases, neither the return on capital nor the company's assets increase.
T. Pawlonka (2011)	Correlation analysis in the meat industry (purposive sample of 12 companies). The majority of companies (9 out of 12) showed a low, medium and high correlation between the indicators analysed. This correlation was defined as positive and parabolic.
M. Soliwoda (2011)	The correlation between liquidity and turnover profitability (or total costs per employee) was analysed. Small enterprises had the highest levels of gross turnover profitability and quick liquidity ratio. The research showed a significant correlation between gross turnover profitability and quick liquidity (small enterprises) and between total costs per employee and quick liquidity (medium enterprises).
D. Zawadzka, R. Ardan, E. Szafraniec-Siluta (2011)	Analysis of entities operating in agriculture. The research showed a link between an increase in asset profitability and an increase in the quick ratio.
M. Bolek, W. Wiliński (2012)	Research based on construction companies on the Warsaw Stock Exchange (WSE) has shown the negative impact of liquidity on profitability.
J. Pawlak, D. Paszko (2014)	Analysis of fruit and vegetable processing enterprises. Conclusions similar to those of D. Zawadzka, R. Ardan and E. Szafraniec-Siluta.
J. Jaworski, L. Czerwonka, M. Mądra-Sawicka (2018)	The analysis of indicators for food-producing enterprises (sample 1 046) did not show a statistically significant relationship between profitability and liquidity.
A. Kuciński (2018)	The analysis covered capital companies in the clothing and footwear sector (Warsaw Stock Exchange). The correlation coefficients between the indicators were not statistically significant.
E. Szymańska, X. Lukoszová (2021)	Purposeful selection of companies in the meat industry. The study showed a significant correlation between current and quick financial liquidity and profitability of assets and equity.

Source: own study based on a literature search on the subject.

The financial liquidity and profitability of an enterprise are important to both owners and investors. In areas of the economy with higher rates of return, greater financial liquidity may indicate a strong position for the company due to its ability to secure new contracts. Profitability is particularly important in traditional industries with stable relationships between the company, subcontractors, and customers. When evaluating companies in the Polish market, investors place greater importance on profitability than financial liquidity due to the prevalence of traditional enterprises (Szymańska, Lukoszová, 2021).

Discriminant analysis in scientific research

Further research is required to investigate the relationship between financial liquidity and company profitability, due to differences in the results of foreign and Polish researchers. Polish literature on the subject, specifically related to discriminant analysis and bankruptcy prediction of companies in the confectionery and sugar industry, clearly indicates the popularity of using multidimensional discriminant analysis models to assess their financial situation. The research analysed various entities over a specific period and used a diverse selection of discriminant analysis models (refer to Table 3).

Table 3.

Research using multidimensional discriminant analysis to evaluate enterprises in the confectionery (and sugar) industry in Poland

Author (year)	Analyzed entities	Models employed
Zdunek E. (2010)	WIG Food index companies (a.o. ASTARTA HOLDING N.V. and Wawel SA)	linear
Dąbrowski B.J., Boratyńska K. (2011)	Selected companies from the WIG Food index (a.o. Wawel SA)	Z6 INE PAN*; Z7 INE PAN; 'Poznań' model; Prusak B. Z_{BP1}
Firlej K., Bargieł A., Szymański M. (2014)	WIG Food index companies (a.o. ASTARTA HOLDING N.V., Wawel SA, ZPC Otmuchów SA)	Wierzba D.; Z7 INE PAN; 'Poznań' model; Przemysł NBP
Zielińska-Sitkiewicz M. (2016)	Selected companies from the WIG Food index (a.o. Wawel SA i ZPC Otmuchów SA)	'Poznań'; Prusak B. Z_{BP1}; Z7 INE PAN
Kopczyński P. (2017)	Food industry enterprises (a.o. Wawel SA)	Zulkarnaina, Shamshera and Ali Mohammada (Malezja); Altmana; Lugovską (Rosja); Mączyńska; Hadasik; 'Poznań' model; Gajdka and Stos II; Prusak B.I.
Zdunek-Rosa E., Huterska A. (2018)	Confectionery industry enterprises (a.o. ASTARTA HOLDING N.V. and Wawel SA)	Hadasik
Olszewska K., Turek T. (2018)	Selected companies (a.o. Wawel SA)	Mączyńska; Hadasik; 'Poznań' model
Firlej Ch. (2022)	WIG Food index companies (a.o. ASTARTA HOLDING N.V., Wawel SA, ZPC Otmuchów SA)	Hadasik; Z6 INE PAN; Z7 INE PAN; 'Poznań' model

* INE PAN: Instytut Nauk Ekonomicznych PAN.

Source: own study based on a literature search on the subject.

The literature on multidimensional discriminant analysis does not yet provide answers to important questions, such as the universality of discriminatory models across sectors, the period of diagnostic reliability of a given model, and whether the number of variables used in the model affects the quality of the study. Similar observations can be found in foreign literature (Balcaen, Ooghe, 2006; Agarwal, Taffler, 2007).

3. Materials and Methods

The research process involved a literature search, analysis of financial data from the balance sheets of selected companies in the sugar industry between 2016 and 2022, and the use of selected statistical methods. The analysis covered companies listed on the Warsaw Stock Exchange (WSE) that belong to the WIG Grocery index from 2016 to 2022 (t = 1, 2, …, 7) and are assigned to the 'food products' sector. Three companies were selected: Astarta Holding N.V, Wawel SA, and Zakłady Przemysłu Cukierniczy Otmuchów SA. Although the number of employees increased only in Wawel SA (by 91 employees) between 2016 and 2022,

all examined entities continued to operate on the Warsaw Stock Exchange and remained in the indicated indices during the analyzed years (see Table 4).

Table 4.
Characteristics of the analyzed entities in 2016-2022

Analyzed entities	Country	Share in indexes on the Warsaw Stock Exchange*	Number of employees	
			year 2016	year 2022
Astarta Holding N.V.	Ukraine	WIG, WIG-CEE, WIG Food index, WIG Ukraine, sWIG80, sWIG80dvp, sWIG80TR, WIG140	9 602	6 591
Wawel SA	Poland	WIG, WIG Poland, WIG Food index, sWIG80, sWIG80dvp, sWIG80TR, WIG140	908	999
ZPC Otmuchów SA	Poland	WIG, WIG Poland, WIG Food index	502	482

* As of 11.12.2023.

Source: own study based on the financial statements of the analyzed entities in the years 2016-2022.

During the initial stage of assessing the financial condition of enterprises, various discriminatory models were employed, including those developed by D. Hadasik, J. Gajdka and D. Stos, D. Wierzba, and the 'Poznań' model. The entity was classified as having either a good or bad financial condition based on the value of the discriminant function Z.

The term 'financial situation' can be used interchangeably with 'financial standing', which refers to 'the company's competitive position, credibility, and economic strength' (Bień, 1999). The literature treats the company's financial situation as identical to the concept of its financial condition (Urbańczyk, 1998; Wypych, 1998; Smithson, Smith, Wilford, 2000). The financial condition is shaped by both internal (quantitative and qualitative) and external factors (Bombiak, 2010). Models of multidimensional discriminant analysis focus solely on the first group of quantitative factors, neglecting the crucial aspect of industry specificity. This oversight may have a negative impact on their effectiveness in certain economic sectors (Rusek, 2010; Wysocki, Kozera, 2012). It is worth noting that all models selected for analysis are highly regarded among researchers who have examined the financial situation of the entities they selected, as well as the probability of bankruptcy risk. Discriminatory models assess solvency and enable early recognition of insolvency risk, which may lead to bankruptcy (Antczak, 2023).

For the three selected models of multidimensional discriminant analysis, namely D. Hadasik's model, the 'Poznań' model, and D. Wierzba's model, the limit value is set to zero. This means that for the indicated models, a Z function value higher than zero indicates a good financial situation of the entity, while a value below zero indicates a difficult financial situation. The only exception is the model of J. Gajdka and D. Stos, where the limit value of the Z function is 0.494549 (Jagiełło, 2013).

Table 5.

The build up of selected discriminatory models

Model/ Function form/ interpretation
Hadasik: $Z_H = 2,36261 + 0,365425X_1 - 0,765526X_2 - 2,40435X_3 + 1,59079X_4 + 0,00230258X_5 - 0,0127826X_6$

X_1 = current assets/current liabilities

X_2 = (current assets – inventories)/current liabilities

X_3 = total liabilities/total assets

X_4 = (current assets – short-term liabilities)/total liabilities

X_5 = receivables/sales revenues

X_6 = inventory/sales revenue

$Z_H < 0$ difficult financial situation

$Z_H > 0$ good financial situation

| Gajdka and Stos: $Z_{GS} = 0,7732059 - 0,0856425X_1 + 0,0007747X_2 + 0,9220985X_3 + 0,6535995X_4 - 0,594687X_5$ |

X_1 = sales revenues/balance sheet total

X_2 = liabilities x 365/manufacturing costs of products sold

X_3 = net profit/balance sheet total

X_4 = gross profit/sales revenues

X_5 = total liabilities/assets

$Z_{GS} < 0,45$ at risk of bankruptcy

$Z_{GS} > 0,45$ good financial situation

| Wierzba: $Z_W = 3,26 X_1 + 2,16 X_2 + 0,3X_3 + 0,69X_4$ |

X_1 = (operating profit – depreciation)/total assets

X_2 = (operating profit – depreciation)/product sales

X_3 = current assets/total liabilities

X_4 = working capital/total assets

$Z_W < 0$ difficult financial situation

$Z_W > 0$ good financial situation

| 'Poznań' model: $Z_P = 3,562 X_1 + 1,588 X_2 + 4,288X_3 + 6,719X_4 - 2,368$ |

X_1 = net financial result/total assets,

X_2 = current assets - inventories)/short-term liabilities,

X_3 = constant capital/total assets,

X_4 = financial result from sales/sales revenues

$Z_P < 0$ difficult financial situation

$Z_P > 0$ good financial situation

Source: own study based on: Gajdka, Stos, 1996a; 1996b; Hadasik, 1998; Wierzba, 2000; Hamrol, Czajka, Piechocki, 2004; Śnieżek, Wiatr, 2014.

During the second stage, we analysed selected liquidity and profitability indicators. We used dynamic measures to describe the time series and performed correlation analysis using Pearson's correlation coefficient.

The liquidity and profitability of a company are economic categories that largely assess its financial condition (Gołębiowski, Tłaczała, 2009; Bąk, Dawidowicz, 2023). To manage a company's financial liquidity, it is important to plan and control the level of current assets and liabilities.

The most important short-term financial liquidity indicators include: the first-degree financial liquidity ratio, also known as the cash payment ratio (Cash ratio); the second-degree financial liquidity ratio, also known as the quick liquidity ratio (Quick ratio); and the third-degree financial liquidity ratio, also known as the current liquidity ratio (Current ratio). Please refer to Table 6 for their characteristics. In the literature (Stickney, 2009; Bragg, 2002), there is no clear definition of the level of financial liquidity indicators that would be universal for individual industries and sectors of the economy (with a breakdown by type of company

activity). Therefore, Table 6 provides proposed values of the applied liquidity indicators based on a literature review.

Table 6.
Characteristics of selected financial liquidity indicators

Indicator name	Formula	Optimal value
Cash ratio (CC)	$\dfrac{current\ assets\ -\ inventory\ -\ short-term\ interperiod\ settlements\ -\ short-term\ liabilities}{short-term\ obligations}$	0,2
Quick ratio (QR)	$\dfrac{surrent\ assets\ -\ inventory\ -\ short-term\ interim\ settlements}{short-term\ obligations}$	1,0-1,2
Current ratio (CR)	$\dfrac{current\ assets}{short-term\ obligations}$	1,5-2,0

Source: Gabrusewicz, 2002; Dresler, Czekaj, 2008; Soliwoda, 2011.

A company's profitability, also known as earning power, is higher when the company has a greater ability to generate profits. At the same time, the use of equity capital should be as low as possible. A profitable company is one whose income exceeds its costs. One of the objectives of any business is to generate a surplus of income over costs (Waśniewski, Skoczylas, 2004). Maximising profitability is considered necessary due to the increasing competition between companies (Arulanandam, Glinkowska-Krauze, Tan, 2023). As already mentioned, the main area of company profitability concerns the analysis of the profitability of equity, assets and sales (Dresler, Czekaj, 2008; Sierpińska, Jachna, 1997). This makes it possible to analyse the financial effects achieved by the company in relation to the value of the capital employed by the owners of the business unit, the assets and the volume of sales (Walczak, 2007). In the course of further analysis, the company's own research was extended to include profitability ratios in the areas of return on equity (ROE), return on assets (ROA) and return on sales (ROS). The basic formulae used to calculate the profitability ratios are shown in Table 7.

Table 7.
Characteristics of selected profitability indicators

The name of the indicator	Formula	Interpretation
Return on equity (ROE)	$\dfrac{net\ profit}{equity\ capital}$	return on equity employed
Return on assets (ROA)	$\dfrac{net\ profit}{total\ assets}$	asset management efficiency
Return on sales (ROS)	$\dfrac{net\ profit}{net\ sales}$	level depends on the industry

Source: Skoczylas, 2004; Witkowska, Witkowski, 2012; Misztal, 2015.

4. Results

Figure 2 shows the values of the individual discriminant analysis models used to analyse the three companies in the selected industries for the period 2016-2022.
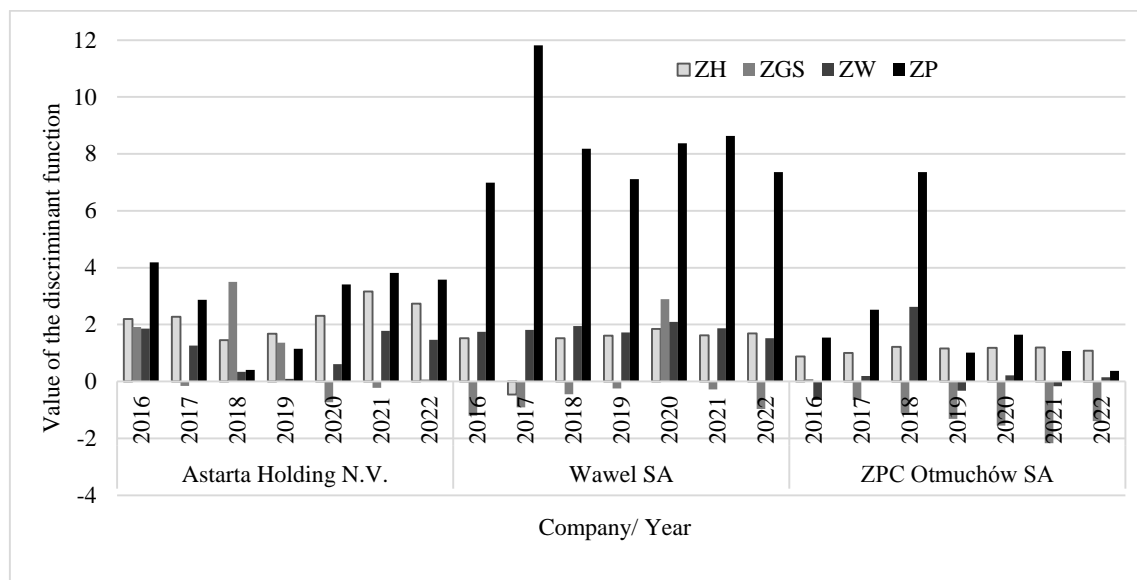

ZH: model Hadasik; ZGS: model Gajdka and Stos; ZW: model Wierzba; ZP: 'Poznań' model.

Figure 2. Discriminant function values from 2016-2022.

Source: Own study based on analysis of financial statements of selected companies.

As can be seen in Figure 2, Dorota Hadasik's model did not indicate any companies that could be at risk of bankruptcy in the period 2016-2022. The exception is Wawel SA, which reached a value below the threshold of -0.46 in 2017. This was due, among other things, to a decline in sales revenues in 2016-2017. The model of J. Gajdka and D. Stos turned out to be the most stringent. This is due to the fact that the authors of the model set its limit at 0.45. Astarta Holding N.V. achieved a result above the threshold in 2016 and 2018-2019. In the remaining years of the analysis, the values for the models of J. Gajdka and D. Stos were below the threshold. Wawel SA only achieved a result above the threshold (2.89) in 2020, while ZPC Otmuchów SA did not achieve a result above the threshold throughout the analysis period. Astarta Holding N.V. and Wawel SA under the D. Wierzba model achieved Z(0) function values above the threshold. ZPC Otmuchów SA, on the other hand, achieved values below zero in 2016, 2019 and 2020. This was due to negative values of indicators X1 and X2 in the indicated years (negative values of "operating profit" in the case of both indicators). The 'Poznań' model turned out to be the least rigorous, as all the analysed companies achieved values above the model's threshold in the analysed period. Wawel SA achieved very high scores under the 'Poznań' model. This was the result of maintaining assets and revenues at a high level. It should be noted that, regardless of the results of the discriminant analysis models used, all the companies analysed were listed on the Warsaw Stock Exchange and were not removed from the WIG Food index. The achievement of negative values of individual models (in some

years of the analysis) is caused by a decrease in selected financial indicators, which is a consequence of the outbreak of the COVID-19 pandemic and the partial closure of the economy. The values of profitability and liquidity ratios for the analysed companies in 2016-2022 are presented in Figure 3.
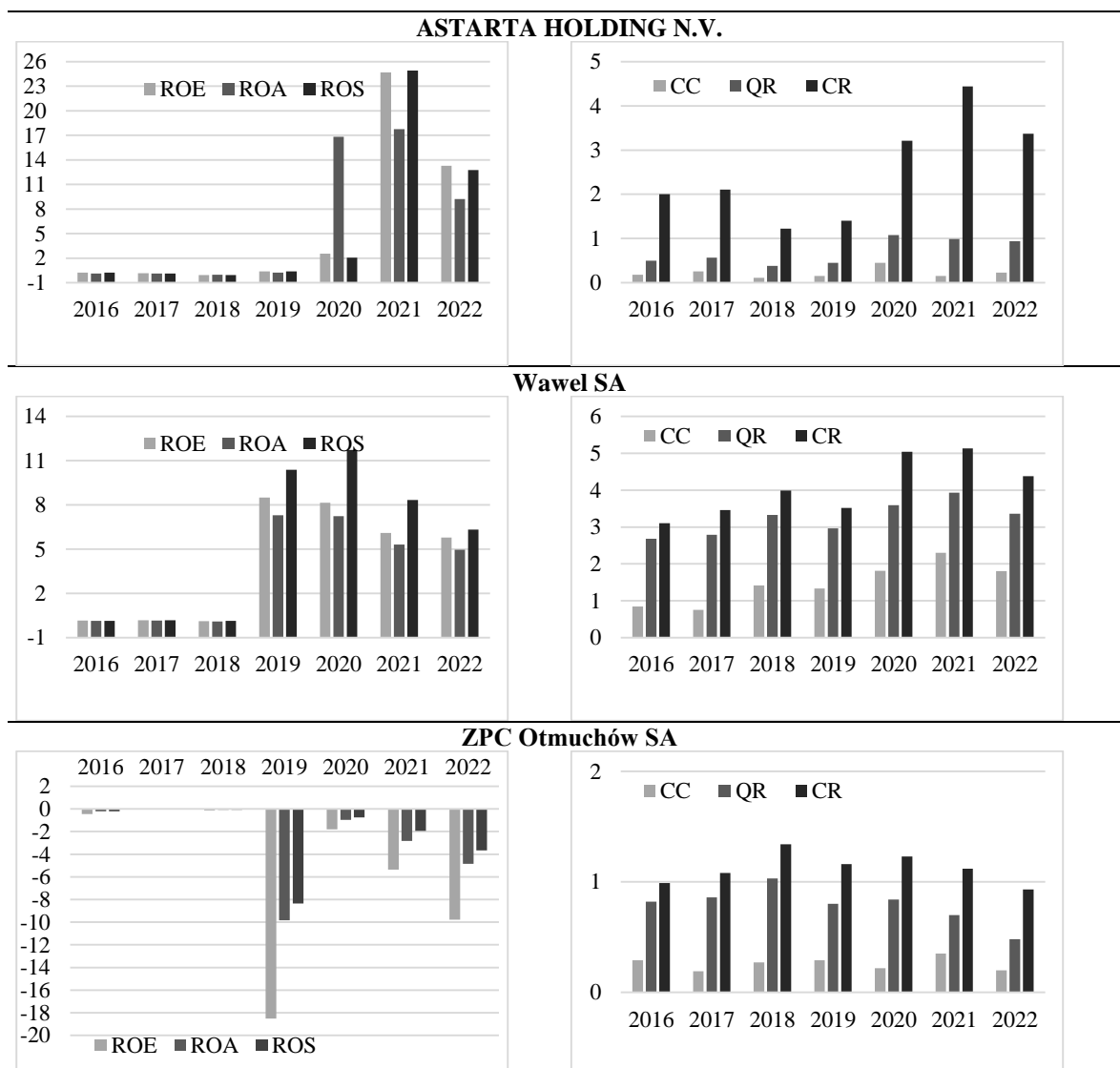
Figure 3. Values of liquidity and profitability ratios of companies in 2016-2022.

Source: Own study based on analysis of financial statements of selected companies.

The presented values of profitability indicators for Astarta Holding N.V. and Wawel SA in the years 2016-2022 indicate that their activities were profitable in terms of equity, assets and sales. Only in 2018 Astarta Holding N.V. reached negative values of all profitability ratios (ROE = -0.06; ROA = -0.03; ROS = -0.06), which was caused by negative net profit in the analysed year (-90777 thousand PLN). The situation is different for ZPC Otmuchów SA, which recorded negative values for all three profitability indicators throughout the period analysed. As in the case of Astarta Holding N.V. in 2018, the reason for this situation was the negative net profit in the analysed period. Analysing the profitability ratios, it can be concluded that in the case of Astarta Holding N.V. and Wawel SA, the profitability (REO, ROA, ROS)

has significantly improved in the years 2016-2022, while in the case of ZPC Otmuchów SA it has significantly deteriorated. The decrease in the profitability of sales of ZPC Otmuchów SA is clearly visible in 2022 (ROE = -0.44; ROA = -0.2; ROS = -0.21) compared to 2016 (ROE = -9.79; ROA = -4.84; ROS = -3.67). Based on the analysis of liquidity indicators, it can be concluded that the surveyed companies were characterised by high financial liquidity in the period under review. It should be noted that only ZPC Otmuchów SA achieved a current liquidity ratio (III degree liquidity) below 1 (in 2016 the value was 0.99 and in 2022 the value was 0.93). None of the examined companies reached the optimal value of the current liquidity ratio (1.5-2.0) in the analysed period. The achieved results were below or above this range. The optimal value of the quick liquidity ratio (2nd degree liquidity) was achieved by Astarta Holding N.V. (1.08 in 2020) and ZPC Otmuchów SA (1.03 in 2018). As for the cash liquidity ratio (liquidity level I), the companies reached the optimal value (up to 0.2) several times. Astarta Holding N.V. reached the optimal value in 2016 (0.18), 2018 (0.11), 2019 (0.15) and 2021 (0.15). Meanwhile, ZPC Otmuchów SA reached the optimum in 2017 (0.19) and 2022 (0.2). Only Wawel SA did not reach the optimal value of 1st degree liquidity in the analysed period. In most years of the period analysed, the net working capital was positive. This fact should be assessed positively, as the risk of losing financial liquidity was low.

In order to assess the degree of relationship between the values of financial liquidity and the profitability indicators of the companies selected for the study, the Pearson linear correlation coefficient was used. The research results make it difficult to establish whether there is a problem between the profitability and control of the analyzed enterprises (Table 8).

Table 8.
Pearson's linear correlation coefficients

Company/coefficient	Coefficient				
	ROE	*ROA*	*ROS*	*CC*	*QR*
ASTARTA HOLDING N.V.					
ROA	0.728				
ROS	1.000***	0.717			
CC	-0.148	0.494	-0.168		
QR	0.665	0.950**	0.648	0.628	
CR	0.879**	0.909**	0.871*	0.322	0.916**
Wawel SA					
ROE	0.735				
ROA	0.733				
ROS	0.701	0.990***	0.992***		
CC	0.886**	0.663	0.666	0.680	
QR	0.785*	0.517	0.525	0.563	0.961***
ZPC Otmuchów SA					
ROA	0.999***				
ROS	0.995***	0.997***			
CC	-0.185	-0.200	-0.192		
QR	0.459	0.433	0.380	0.123	
CR	0.174	0.152	0.125	0.192	0.787*

Statistically significant respectively: *: p value < 0.05; **: p value < 0.01; ***: p value < 0.001.

Source: Own study based on designations as in figure 3.

As an entity within Astarta Holding N.V. it is important to consider the correlation between cash flow and the return on equity ratio. as well as the correlation between cash flow and sales profitability. In both cases. a negative correlation was observed. indicating that an increase/decrease in financial liquidity led to a decrease/increase in return on equity and sales profitability. A statistically significant correlation was found between the sales profitability ratio and the return on equity ratio (1.000) for Astarta Holding N.V. Other correlation relationships for different indicators were positive but statistically insignificant.

In the case of Wawel SA. a statistically significant correlation was found between the turnover profitability ratio and the asset profitability ratio (0.990). as well as the turnover profitability ratio (0.992). Furthermore. a statistically significant relationship was identified for the quick liquidity ratio (0.961). All other correlation relationships were positive. but not statistically significant.

At ZPC Otmuchów SA. there is a negative correlation in three cases: cash liquidity and return on equity (-0.185). cash flow and return on assets (-0.200). and cash flow and return on sales (-0.200). A statistically significant correlation was found within ZPC Otmuchów SA between the return on assets ratio and the return on equity ratio (0.999). as well as between the profitability ratio on sales and the return on equity ratio (0.995). and between the profitability ratio on sales and the return on assets ratio (0.997). The remaining correlation values were positive. but the strength of the relationship was weak and statistically insignificant.

5. Summary

The research on multidimensional discriminant analysis assesses the diagnostic reliability of the used discriminant models. It is important to note that the frequency of use of models does not equate to the ranking of their credibility and sufficiency. The research confirmed hypothesis H1, which states that multidimensional discriminant analysis models are useful for assessing the financial situation of surveyed enterprises in the Polish sugar industry. The selection of enterprises and analysis models was based on various factors. However, it is incorrect to attribute sectoral universality to discriminatory methods. The selected models accurately determined the financial situation of the surveyed enterprises from 2016 to 2022. It is important to note that this research only represents a fragment of reality, and further diagnostic tools should be employed to provide a more comprehensive analysis. This was partially implemented in the presented work. To enhance the analysis of a company's financial condition, it is crucial to consider the industry specificity criterion during the selection of multidimensional discriminant analysis models, particularly from a methodological perspective. The analysis and research presented here address a research gap by using

multidimensional discriminant analysis to verify the liquidity and profitability of selected entities in the food industry in Poland during the COVID-19 pandemic crisis from 2019 to 2022. The COVID-19 pandemic continues to affect the food industry in Poland, and ongoing analysis and research must incorporate new analytical methods. It is highly probable that subsequent analyses of this area will be comprehensive and in-depth, but this study already indicates some problems in selected areas caused by the COVID-19 pandemic.

The results of the research on the financial liquidity of the company, its profitability and the correlation between these areas provided certain grounds for confirming the second research hypothesis (H2), which states that there is no statistically significant relationship between the financial liquidity and the financial profitability of the analysed companies. The values of the Pearson's linear correlation coefficient between financial liquidity and the profitability of the companies analysed turned out to be largely statistically insignificant, therefore it cannot be clearly stated that such a relationship exists. The literature on the subject often indicates a negative correlation between financial liquidity and company profitability. The research results obtained did not allow to establish a clear direction and relationship between these two groups of financial indicators. The lack of reasons to reject the second hypothesis (H2) means that the direction of the relationship tested could not be determined or confirmed.

The relationship between financial liquidity and profitability is reflected in net working capital management strategies. The emerging positive relationship between liquidity and profitability may be the result of better exploitation of emerging business opportunities. A conservative strategy may mean maintaining a high level of financial liquidity, which results in lower profitability. The aggressive strategy is based on achieving high profitability with low financial liquidity. This results in maintaining negative working capital in the company. This means that the choice of an appropriate strategy (together with the nature of net working capital) determines the level of financial liquidity and the level of profitability achieved.

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