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Financial Standing of Selected Enterprises in the Polish Meat Industry – Original Research

Abstract

Theoretical background: The present research is founded on three motives: (1) an analysis of the Polish meat industry from 2014 to 2022 considering development barriers in that period; (2) an analysis and assessment of the financial standing of selected enterprises in the meat industry from the WIG Food index; (3) verification of the effectiveness of the employed discriminant analysis models to predict bankruptcy of the companies of interest.
Purpose of the article: The research objective was to assess the financial standing and the risk of bankruptcy of selected meat enterprises from the WIG Food index from 2014 to 2022.

Research methods: Four multiple discriminant analysis models were employed to assess the potential risk of bankruptcy of the companies and verify their financial standing: Hadasik's model, Model Z6 by the Institute of Economics of the Polish Academy of Sciences (INE PAN), Model Z7 by the INE PAN, and the so-called Poznań model. In an attempt to expand the analysis, we calculated the current ratio, which reflects the company's ability to make payments with its current assets. The sample consists of Polish meat companies listed in the WIG Food index in all quarters of 2014–2022. Data for the analyses come from the annual accounts of the investigated organisations. The methods were supplemented with a literature search on multiple discriminant analysis.

Main findings: The results demonstrate that the number of variables included in a discriminant analysis model does not determine its performance. The models can warn of potential financial problems in the companies somewhat in advance. However, none of the models exhibited any substantial sensitivity to the risk of bankruptcy for the analysed organisations. Two of the models (Z6 by the INE PAN and Z7 by the INE PAN) give very similar results because of significant design similarities. The research advances the state of the art regarding the application of multiple discriminant analysis to assess the risk of bankruptcy and financial standing of meat enterprises in Poland.

Introduction

The meat industry is the main component of the food economy in Poland. More than one-third of the agricultural market output in Poland is the production of animals for slaughter. The meat industry is, in turn, the largest part of the food processing industry. One of the socioeconomic impacts of COVID-19 restrictions was short-lasting, large-scale purchasing of food with longer use-by dates. Beef exports declined by 3–5% in the first half of 2020. Similarly, exports of pork dropped by 28% compared to the first half of 2019 (Mroczek, 2020).

The Polish meat industry is very fragmented. It can be to both advantage and disadvantage. A bankruptcy, failure, or a shutdown in one facility should not throw the entire market off balance even on a local scale. On the other hand, small and medium enterprises are less economically resilient and may be the first to face problems with liquidity and maintaining their market position in times of crisis such as the COVID-19 pandemic (Szczepaniak et al., 2020).

When Poland joined the European Union (EU) in 2004, its meat industry was the national food economy growth leader (Wysocki & Kozera, 2012). Both consumption of meat and domestic demand grew at the time. Meat and meat product exports grew, which forced Polish meat enterprises to adapt their production to EU requirements so they could sell to other member states. This entailed substantial investments, leading to the modernisation of production and an increase in volumes, but also greater debt levels in many Polish companies (Szymańska & Lukoszová, 2021). Meat producers in Poland have to tackle both economic and climate factors. The latter substantially affect the volume and quality of crops. Harvest output depends on the effectiveness of animal production, the quantity and prices of animal raw materials (Wysocki & Kozera, 2012).

An industry is an economic system of organisations with actual and regulatory relationships. Features of companies in a specific industry include earning capacity, liquidity, performance, and structure (Jankowska, 2002). Polish food and agricultural

producers fared very well even in times of COVID-19 restrictions and lockdowns. This is evident from the increase in export income in 2022. The export of agrifood products to the EU and third countries is a way of allocating excess food production in Poland. It is a vital source of income for the Polish agrifood industry, especially enterprises from this branch of the economy (Gov.pl, 2023). The year 2022 set new records for agrifood products exports with EUR 47.6 billion (PLN 223 billion), 26.7% more than in the previous year. Figure 1 shows the value of agrifood exports in Poland from 2014 to 2022.
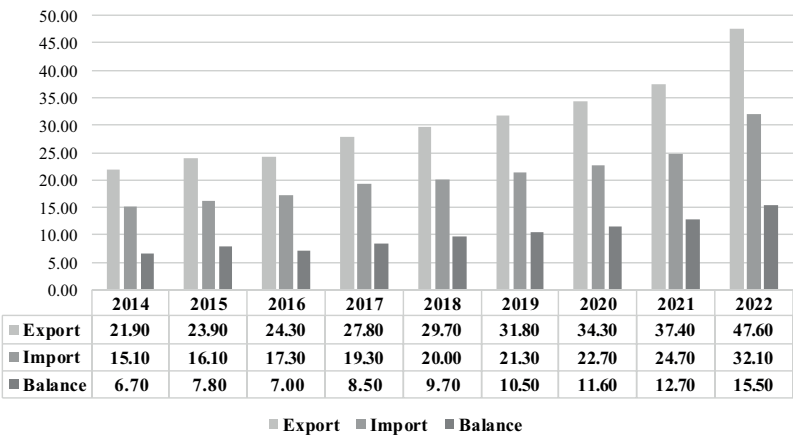

	2014	2015	2016	2017	2018	2019	2020	2021	2022
▪ Export	21.90	23.90	24.30	27.80	29.70	31.80	34.30	37.40	47.60
▪ Import	15.10	16.10	17.30	19.30	20.00	21.30	22.70	24.70	32.10
▪ Balance	6.70	7.80	7.00	8.50	9.70	10.50	11.60	12.70	15.50

▪ Export ▪ Import ▪ Balance

Figure 1. International trade of agrifood in Poland from 2014 to 2022 (in EUR billion)

Source: (Gov.pl, 2023).

As shown in Figure 1, the value of Polish exports of agrifood products grew regularly between 2014 and 2022 (EUR 21.9 billion and EUR 47.6 billion, respectively), which translates into an increase of over 217%. The same applies to imports over this period. Agrifood imports grew by 212.5% from EUR 15.1 billion in 2014 to EUR 32.1 billion in 2022. Good export results in 2022 stemmed from the recovery of the European and global economies after the 2020 lockdown crisis.

In 2022, the European Union was the main market for Polish exporters of agrifood products. Supply to the European Union (EU-27) amounted to EUR 35.3 billion in 2022 (up 29% YoY). It was an increase of 74% in the total agrifood export income. Germany remained the main international trade partner for Poland (Gov.pl, 2023).

Note that the meat industry is the main component of Polish exports. The commodity structure of Polish agrifood exports was dominated by meat and meat products in 2022. The export value for this group of commodities grew by 37% compared to 2021 to reach EUR 9.6 billion, or 20% of the value of entire agrifood exports in Poland. The group was dominated by poultry, 44% (EUR 4.3 billion). Meat products and beef reached 23% (EUR 2.2 billion) and 22% (EUR 2.1 billion), respectively. Pork amounted to 8% (EUR 812 million). Live export and other types of meat were negligible with 2% and 1%, respectively (Gov.pl, 2023).

The Polish food industry is affected also by some external factors that may hinder its operations. Recent years have been difficult for the Polish meat industry due to the spread of ASF, avian flu, 2020 Brexit, and the COVID-19 pandemic. The main constant for the industry seems to be ongoing uncertainty. The industry was hit hard in 2014 by increasing global supply, declining outputs to net exports, and the first cases of African swine fever (ASF) in the country (Kondrakiewicz, 2014). As a result, many states embargoed Polish pork. It led to a complete halt of exports to Russia, Belarus, Kazakhstan, China, Japan, and South Korea and an increase in biosecurity costs (Szymańska & Lukoszová, 2021).

According to Szczepaniak et al., the COVID-19 pandemic could impact the meat industry through the bankruptcy of the economically weakest companies (micro and macro), loss of financial liquidity due to labour shortages, increased demand for tinned and packaged food (change of product range), increased M&A activity of stronger players (leading to the consolidation of the industry), and restricted exports resulting in greater domestic supply (Szczepaniak et al., 2020).

The COVID-19 pandemic situation was the worst in the HoReCa industry. Temporary lockdowns of hotels and restaurants meant that meat producers were unable to sell their products to returning clients. It was a significant problem and a barrier for the meat industry to grow, especially considering the imminent recession and declining purchasing power. Moreover, after 2.5 years, the poultry market was once again hit by avian influenza (31 December 2019, Wielkopolskie Voivodeship). Poland regained the status of a country free from avian influenza on 13 August 2020 (Mroczek, 2020).

The respondents in a survey by Pawlonka considered low earning capacity, poor vertical and horizontal integration, buyer pressure, volatile raw material prices, price pressure, dispersed production, and trouble accessing external capital as key barriers to growth (Pawlonka, 2019).

Therefore, it is necessary to continue research on the identification of barriers for the functioning of the meat industry considering numerous criteria, such as the size of the enterprise, its liquidity, or financial standing. Such an analysis is consistent with global research trends (Gill & Bigger, 2012).

Literature review

Company bankruptcy is a natural and inevitable part of the free market economy with consequences that are both beneficial and adverse (Krzeczewska, 2021). A declaration of bankruptcy affects (positively or negatively) the market value of industry competitors. The domino effect and competition effect mediate the outcomes of the declaration of bankruptcy (Lang & Stulz, 1992). According to Szymański, company bankruptcy theoretically is "part of market self-regulation and can condition market growth. Still, it is disadvantageous from the point of view of the interests of

the enterprise" (Szymański, 2005). Bankruptcy can be considered from legal and economic points of view. In terms of economy, bankruptcy means that the organisation cannot continue operations without external aid. The aid is determined by relationships between the company and its creditors (Sołoma & Plesiewicz, 2011). Company bankruptcy is defined as a loss of capability to pay debts and asset shortage (Hołda, 2006).

Bankruptcy factors come in two flavours, endogenous (internal) and exogenous (external). Endogenous factors include irregular internal trade, improper capital and asset mix, or defective sales. Such factors as volatile business regulations and state fiscal policy are exogenous in nature (Zielińska-Chmielewska, 2015).

Kowalczyk listed the following potential bankruptcy factors for meat enterprises in Poland: foreign exchange rates (very impactful on international trade), changes in regulations, low level of concentration and production scale, dependency on natural conditions, seasonal production and sale, short sale window due to "use by" dates, and low level of product innovation (Kowalczyk, 2009). Identification of the risk of bankruptcy is important for potential stakeholders. It allows them to analyse and assess the company's ability to pay debts and stay afloat. Business bankruptcy forecasts can be verified with discriminant analysis models. They present a single synthetic index composed of a small number of indicators and weights conveying the characters of the indicators to reflect the condition of the business (Antonowicz, 2007, 2010).

Edward I. Altman is considered to have pioneered multiple discriminant analysis with his original corporate bankruptcy risk assessment Z-score in 1968 (Altman, 1968; Mentel, 2013; Pitera, 2018). His model is used to this day by both theoreticians and practitioners around the world. One should consider that the research proposed by Altman involved a sample of 66 enterprises (33 solvent and 33 insolvent) with five financial ratios (Altman, 1968; Kisielińska & Waszkowski, 2010). Nevertheless, Altman's model remains an important step in the evolution of the research on multidimensional analysis to build bankruptcy early warning systems (Antonowicz & Antonowicz, 2022). Since it was first proposed by Altman, the performance and applicability of the Z-score model have been investigated in many countries, such as: Indonesia (Puspitasari et al., 2020; Muzani & Yuliana, 2021), Italy (Altman et al., 2013; Bussoli et al., 2019), Romania (Siekelova et al., 2019), Slovakia (Boďa & Úradníček, 2016; Vavrek et al., 2021), the United Kingdom (Almamy et al., 2016), Poland (Antonowicz, 2008), Serbia (Milašinović et al., 2019), Turkey (Apan et al., 2018; Cındık & Armutlulu, 2021), Ghana (Mahama, 2015), Oman (Mohammed, 2016), Vietnam (Tung & Phung, 2019). However, Altman's model is not a universal model because it can be employed to analyse companies that operate under different economic conditions (Mosionek-Schweda, 2014). This was pointed out by Kitowski, who reported that Altman's model is "mechanically" applied to analyse enterprises from various sectors of the economy, disregarding its applicability and diagnostic reliability. Kitowski noted that the model can be found in the opinions and reports

of independent expert auditors on financial statements of construction or industrial companies, universities, hospitals, mortgage funds, or accounting and bookkeeping companies (Kitowski, 2015).

Moreover, many other authors reported that international discriminant analysis models were ineffective when employed to predict the bankruptcy of Polish enterprises. These include Stasiewski (1996), Gasza (1997), and Koralun-Bereźnicka (2006). These researchers pointed out the need to build models with data from the Polish economy. It is linked directly to financial reporting standards in place in Poland, which vary from those employed in other countries. Financial statement nomenclature is critical when building a model and may even hinder comparison due to diverse financial ratios (Kisielińska & Waszkowski, 2010).

Note further that discriminant analysis models are successfully employed in investigations of enterprises in different sectors of the economy. Magdalena Mosionek-Schweda investigated and evaluated the usefulness of discriminant models for predicting the bankruptcy of companies listed on NewConnect (Mosionek-Schweda, 2014). Mihalovič analysed 236 companies from Slovakia categorised into two groups: those that went bankrupt and those that did not with discriminant analysis and logistic regression (Mihalovič, 2016). Kliestik et al. aimed to devise a model to identify the unhealthy development of enterprises in the Visegrád Group through discriminant analysis (Kliestik et al., 2018). Sfakianakis intended to build a model with a novel set of predictor variables to ensure significant discrimination among listed Greek production companies with multiple discriminant analysis (Sfakianakis, 2021).

Some Polish authors consider selected discriminant analysis models to be universal for multiple sectors of the economy. The methodological framework of the models is often criticised in this regard. Therefore, it is necessary to consider the industry profile and factors that affect it (Kitowski, 2015, 2018). Hence an analysis of Polish firms must utilise models founded on research on companies operating under distinct conditions and considering industry-specific factors (Juszczyk, 2010). Discriminant functions should be limited to the country where the data for the model have been collected. It is directly relevant to different functional business environments and different accounting systems.

There are many tools for assessing and predicting corporate financial risk related to corporate failure or bankruptcy: logit and probit analyses, classical ratio analysis, neural networks, and unidimensional and multidimensional discriminative models (Leszczyński & Skowronek-Mielczarek, 2008).

The literature on discriminant analysis offers numerous cases where researchers employed selected discriminant analysis models to verify enterprises in the food industry in general and companies listed on the Warsaw Stock Exchange under the WIG Food index. Some of them were Zdunek (2010), Dąbrowski and Boratyńska (2011), Śmiglak-Krajewska and Just (2013), Firlej et al. (2014), Zielińska-Sitkiewicz (2016), Kopczyński (2017), Zdunek-Rosa and Huterska (2018), and Firlej (2022). The models were selected due to their performance demonstrated in the literature.

According to Dąbrowski and Boratyńska (2011), the performance of Hadasik's model is 95.08%, Z7 model – 94.82%, Z6 model – 94.20%, and Poznań model – 93.78%. Another important argument for these models is that all four have a threshold value (0 in each case), with which one can unambiguously assess a company's financial standing as good or poor (Zdunek-Rosa & Huterska, 2018). Additionally, each model was developed by Polish researchers using the Polish economic framework, which is relevant because the study concerns Polish enterprises operating in various economic conditions.

Table 1. Research where discriminant analysis models are used to assess meat companies in Poland

Author	Year	Analysed period	Multiple discriminant analysis models
Sołoma and Plesiewicz	2011	2006–2008, 2011	– Altman Z-score – Springate – J. Gajdka and D. Stos – D. Hadasik – A. Hołda
Wysocki and Kozera	2012	2006–2009	– D. Hadasik – Poznań (M. Hamrol, B. Czajka, and M. Piechocki) – B. Prusak – original model
Zielińs-ka-Chmielewska	2015	2005–2011	– D. Wierzba – Z6 by the INE PAN – Z7 by the INE PAN – D. Hadasik

Source: Authors' own study based on the literature review.

Sołoma and Plesiewicz (2011) employed discriminant analysis models to verify four meat companies in 2011. Their analysis focused on 2006–2008 and 2011. The authors founded their research on five selected models of multiple discriminant analysis. Their results indicate ambiguous directions and likelihoods in bankruptcy predictions due to the diverse values of individual discriminant analysis models.

Wysocki and Kozera (2012) assessed the financial standing and risk of bankruptcy in meat companies from 2006 to 2009. They employed three discriminant analysis models. Their sample consisted of 14 businesses. The analysis clearly demonstrated the poor performance of these discriminant analysis models regarding predicting bankruptcy of meat companies in Poland.

In 2015, Zielińska-Chmielewska investigated five meat enterprises in Poland over the period from 2005 to 2011. She used four discriminant analysis models and concluded the companies were in good financial standing. Note two firms with poor financial standing in 2008 and 2009. A risk of bankruptcy was identified for them. Importantly, Zielińska-Chmielewska considered the financial liquidity of the companies in her research.

Research methods

The research objective is to assess the financial standing and the risk of bankruptcy of selected WIG Food meat enterprises from 2014 to 2022. The meat sector was selected for the study because it is the core of the Polish food industry (also regarding international food trade). The particular period (2014–2022) was chosen because of critical global developments that directly affected the Polish meat industry and companies (ASF, avian flu, Brexit, the COVID-19 pandemic). The study poses a research problem in the form of a question: are the selected discriminant analysis models valuable tools for assessing the financial standing of selected WIG Food meat companies in Poland? The objective is pursued with four discriminant analysis models. Data for the analyses come from the annual accounts of the investigated organisations.

As data on all meat facilities in Poland is hardly available, we decided to select the sample purposefully. The analysed companies were WIG Food index meat enterprises from 2014 to 2022. Their legal form was a Polish Commercial Companies Code joint-stock company (*spółka akcyjna*). The sample consisted of three companies, Gobarto SA, Pamapol SA, and Tarczyński SA. Table 2 characterizes the investigated organisations.

Table 2. Characteristics of the sample for 2014–2022

Business name	Legal form	Employees in 2014	Employees in 2022	Total sales revenue (PLN thousand) in 2014	Total sales revenue (PLN thousand) in 2022
Gobarto SA	joint-stock company	830	1,358	1,688,424	2,641,062
Pamapol SA	joint-stock company	559	463	379,964	1,115,366
Tarczyński SA	joint-stock company	1,225	1,134	494,401	1,613,780

Source: Authors' own study based on accounts for 2014–2022.

As shown in Table 2, even though staffing increased only in Gobarto SA from 2014 to 2022, all the investigated organisations enjoyed greater total sales revenues, some even doubled (in Pamapol SA and Tarczyński SA). In Gobarto SA, total sales revenue grew by PLN 952,638 thousand from 2014 to 2022. Note that one of the companies was included on the "List of 500" by the *Rzeczpospolita* daily in 2022. The list follows the model of Fortune and contains the 500 largest Polish enterprises by revenue. In 2022, Gobarto SA was ranked 304 (down from 230 in 2021) (Rankingi.rp.pl, 2023).

Limited data availability restricted the analysed period to 2014–2022. The present research investigates the current ratio (CR) over the period of interest. The research assesses the liquidity of the companies based on the most common indicators with obvious methodological backgrounds. The companies' ability to pay current liabilities was investigated with the current ratio. It reflects the capability to pay obligations based on current assets according to the following equation (Szymańska & Lukoszová, 2021):

$$Current\ ratio = \frac{current\ assets}{short\ term\ liabilities}$$

The finance literature fails to propose a clear-cut "right" value of the current ratio. One can find various intervals of the measure. The most common include 1.5–2.0 (Nowak, 2017) and 1.2–2.0 (Sierpińska & Jachna, 2004). This means that liquidity is ensured when current assets are 1.2 to 2 times larger than current liabilities (Kuciński, 2023). We adopted the current ratio interval proposed by Sierpińska and Jachna of 1.2–2.0.

We employed four discriminant analysis models in the present research: Hadasik's model, model Z6 by the INE PAN (Institute of Economics of the Polish Academy of Sciences), model Z7 by the INE PAN, and the so-called Poznań model. One of the key criteria for model selection was their high performance and popularity with other researchers. According to Dąbrowski and Boratyńska (2011), the performance of Hadasik's model is 95.08%, Z7 model – 94.82%, Z6 model – 94.20%, and Poznań model – 93.78%.

Hadasik's model from 1998 is described with the equation (Wierzba, 2000):

$$Z_{HAD} = 2.362 + 0.365X_1 - 0.765X_2 - 2.404X_3 + 1.590X_4 + 0.002X_5 - 0.012X_6$$

where:
X_1 is current assets / current liabilities,
X_2 (is current assets – stock) / current liabilities,
X_3 is total liabilities / total assets,
X_4 (is current assets – short-term liabilities) / total liabilities,
X_5 is receivables / sales revenue,
X_6 inventory/ sales revenue.

The Z6 model by the INE PAN is expressed with the following equation (Mączyńska, 1994):

$$Z_{6INE\ PAN} = 9.478X_1 + 3.613X_2 + 3.246X_3 + 0.455X_4 + 0.802X_5 - 2.478$$

where:
X_1 is the operating result / asset value,
X_2 is the equity capital value / asset value,
X_3 (is the net income + depreciation) / total liabilities,
X_4 is non-fixed assets / short-term liabilities,
X_5 is sales revenue / asset value.

The Z7 model by the INE PAN is expressed with the following equation (Mączyńska, 1994):

$$Z_{7INE\ PAN} = 9.498X_1 + 3.566X_2 + 2.903X_3 + 0.452X_4 - 1.4987$$

where:
X_1 is the operating result / asset value,
X_2 is the equity capital value / asset value,

X_3 (is the net income + depreciation) / total liabilities,
X_4 is non-fixed assets / short-term liabilities.

The fourth model is the Poznań model with the following formula (Hamrol et al., 2004):

$$Z_{POZ} = 3.562X_1 + 1.588X_2 + 4.288X_3 + 6.719X_4 - 2.368$$

where:
X_1 is the net income / total assets,
X_2 is (current assets – stock) / short-term liabilities,
X_3 is the constant capital / total assets,
X_4 is sales income / sales revenue.

The threshold value for all the models is set to zero. It means that $Z < 0$ reflects difficult financial standing and $Z > 0$ means good financial standing in each model.

Results

Table 3 contains the final current ratio values and the discriminant analysis models used to verify the companies from 2014 to 2022. The colour coding for the table is the following white: company safe from bankruptcy, grey: company at risk of bankruptcy. Grey in "Current ratio" means short-term liabilities exceeded current assets.

Table 3. Current ratio and results of the selected discriminant analysis models for the companies in 2014–2022

Gobarto SA									
Value	2014	2015	2016	2017	2018	2019	2020	2021	2022
Current ratio	1.05	1.06	1.10	0.69	0.85	0.74	0.67	0.81	0.88
Hadasik's model	0.94	0.90	0.92	0.49	0.62	0.48	0.76	0.67	0.62
Model Z6	2.78	2.18	2.28	1.25	1.16	1.47	1.50	1.08	0.70
Model Z7	1.71	1.47	1.67	0.84	0.44	0.78	0.70	0.30	1.50
Poznań model	2.28	2.03	2.15	0.79	0.93	0.96	1.40	1.20	1.52
Pamapol SA									
Value	2014	2015	2016	2017	2018	2019	2020	2021	2022
Current ratio	0.00	1.05	0.93	1.26	1.15	0.88	0.98	0.88	1.04
Hadasik's model	0.64	0.77	0.67	0.90	0.76	0.49	0.58	0.47	0.65
Model Z6	0.30	0.67	0.70	0.85	0.73	2.66	1.26	0.87	0.52
Model Z7	0.34	0.57	0.56	0.55	0.46	3.47	0.71	0.48	2.58
Poznań model	2.16	2.15	1.60	2.38	2.22	-0.09	0.44	0.17	0.95
Tarczyński SA									
Value	2014	2015	2016	2017	2018	2019	2020	2021	2022
Current ratio	0.80	0.99	0.89	0.92	1.04	1.03	1.09	0.99	0.83
Hadasik's model	0.49	0.48	0.46	0.49	0.47	0.53	0.71	0.97	0.60
Model Z6	1.00	1.50	0.87	1.35	1.19	1.16	2.86	2.06	1.95
Model Z7	0.90	1.37	0.71	1.14	1.12	1.08	2.68	2.04	2.18
Poznań model	1.63	2.32	1.55	2.05	2.34	2.34	3.35	2.67	4.78

Source: Authors' own study based on accounts for 2014–2022.

The analysis of the current ratio of Gobarto SA demonstrated that the company failed to reach the required interval of 1.2–2.0 in any year and the selected discriminant analysis models did not identify the poor financial standing of the company. Note that the values from individual models were declining over the investigated period, approaching the threshold value, which may be a warning sign. The same is true for Pamapol SA. In 2014, Pamapol SA reached a current ratio of 0.00, which may reflect its poor financial standing regarding its ability to pay short-term debts with current assets. Consecutive years saw an improvement of up to 1.26 in 2017, which conforms to the required interval. The current ratio of Tarczyński SA remained relatively constant from 2014 to 2017 but failed to reach the required level at any point over the analysed period. Its current ratio oscillated from 0.80 in 2014 to 0.83 in 2022.

The analysis with Hadasik's model unambiguously identified the financial standing of all the meat companies as good from 2014 to 2022. They all exceeded the threshold (0), with Tarczyński SA reaching the highest value of 0.97 in 2021.

Results of models Z6 and Z7 unequivocally demonstrate the good financial standing of all the meat companies over the period of interest with Z above zero.

Note especially the Poznań model. It warned of a potential bankruptcy only in the case of Pamapol SA's performance in 2019. The Z value at the time was –0.09. The situation improved for Pamapol SA in consecutive years to exceed the threshold from 2020 to 2022. In 2019, Pamapol SA was considered at risk of bankruptcy by the model because the return on assets (indicator X1) was negative. Pamapol SA was still listed on the Warsaw Stock Exchange under the WIG Food index in 2014–2022.

The discriminant analysis models developed in Poland successfully predicted no risk of bankruptcy for all the companies because all of them continue operations and thrive.

Discussion

Research by Firlej et al. (2014) with Wierzba's model, model Z7 by the INE PAN, Poznań model, and the NBP Industry model did not signal a risk of bankruptcy of Pampol SA or Tarczyński SA and assessed their financial standing as good. Zielińska-Chmielewska (2015) analysed meat companies between 2005 and 2011 with five discriminant analysis models. Two of the models (Z7 by the INE PAN and Poznań) demonstrated the good financial standing of Pamapol SA over the entire period. Model Z7 indicated problems in 2008 when it reached -0.20. Wierzba's model and Hadasik's model were particularly sensitive to the declining standing of Pamapol SA (-1.26 in 2008 and -0.63 in 2009 for the former and -2.12 in 2008 and -2.01 in 2009 for the latter). In her research on WIG Food companies from 2007 to 2009, Zdunek (2010) demonstrated that Pamapol SA was at risk of bankruptcy using a logit model and a linear discriminant function (-0.6820 (2007), -1.5974 (2008), and -0.9549 (2009)). Pamapol SA was investigated by other researchers as well.

Zielińska-Sitkiewicz (2016) analysed selected companies in 2008–2014 with model Z7 by the INE PAN, among other methods. Pamapol SA scores were -0.556 (2008) and -0.370 (2013) due to such factors as negative return on sales and assets and a net loss of PLN 40.40 million and PLN 1.88 million in these years. The Poznań model demonstrated the good financial standing of Pamapol SA. Firlej (2022) analysed WIG Food companies with four discriminant analysis models. The analysis covered the period from 2014 to 2018. All the investigated companies reached discriminant model values above the threshold value in the period of interest, which may be indicative of their good financial standing.

Conclusions

Results of the present research are consistent with results by other authors and demonstrate that the multiple discriminant analysis employed here is a valuable tool (concerning the selected models). It also supports decision-making regarding *ex ante* prediction of the risk of insolvency and bankruptcy of the investigated companies.

If results of discriminant analysis fail to yield an unambiguous picture of the financial standing, it is reasonable to include a traditional *ex post* financial analysis (for instance, regarding ratio analysis), which was not necessary in this case.

The present discriminant model analysis of selected Polish meat companies explicitly indicated their good financial standing and no risk of bankruptcy. The investigated enterprises are in good health and sound financial standing. They are building competitive advantages and improving their market positions. Only the Poznań model in 2019 was particularly sensitive to the degrading financial standing of Pamapol SA. Note that the discriminant analysis models selected here are not flawless. One issue can be the choice and selection of indicators characteristic for the model and the determination of their weights to reflect the specific conditions and environment for the company or industry. Another consideration is that any given model was estimated during a specific period of a business cycle and can erroneously indicate a risk of bankruptcy during a recession or financial crisis.

The Polish meat industry faced numerous challenges in 2014–2022, such as African swine fever in 2014, Brexit in 2020, and the COVID-19 pandemic in 2019–2021. One more factor detrimental to the financial standing of the investigated organisations was the EUR to PLN exchange rate. Most meat exporters conduct business in euros. The results of the selected multiple discriminant analysis models show that one needs to remain cautious regarding the outcomes. It is a daunting task to find a universal model that could be applied to any company (regardless of the legal form or industry). The results may be indicative of the limited usefulness of some multiple discriminant analysis models for predicting failures of meat companies. One must not, however, generalise this conclusion because the research involved three meat companies and four models from among over a dozen available in the literature.

The study answered the research question and demonstrated that the selected discriminant analysis models are valuable tools for assessing the financial standing of selected WIG Food meat companies in Poland. The discriminant analysis models employed here are undoubtedly valuable and effective tools for assessing the risk of corporate bankruptcy and verifying the financial standing of companies. Their diversified sensitivity determines the need for auxiliary methods (such as ratio analysis of earning capacity, indebtedness, or profitability). The present study is a continuation of research on the application of multiple discriminant analysis and its characteristics regarding the discrimination of the financial standing of Polish meat processing companies. The results justify the need for verification of the existing discriminant analysis models and new discriminant analysis models adapted to the characteristics of the Polish food processing industry.

The present study calls for broader future research. The analysis focuses on Polish meat companies in 2014–2022 and four selected methods of multiple discriminant analysis. Future research can focus on the assessment of bankruptcy risk in these companies using different methods over a longer interval. We hope this article will further the theory and practice in its relevant research domain and will also affect public policy.

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