CORPORATE BANKRUPTCY PREDICTION IN POLAND AGAINST THE BACKGROUND OF FOREIGN EXPERIENCE

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Abstract

In highly developed countries, research in the field of bankruptcy risk prediction has been conducted for many years. For example, in the United States, which can be considered a pioneering country, the first publications appeared in the early twentieth century. In Poland, due to political and economic reasons, the interest in this issue dates back to the early 1990s. For this reason, this publication attempts to answer the following questions: 1) What is the level of advancement of the research into predicting bankruptcies of enterprises in Poland? 2) How does it compare to worldwide trends? Therefore, the main aim of this study is to present and evaluate the scientific achievements of Polish authors in the field of corporate bankruptcy prediction and compare them to global trends. Literature analysis was adopted as the research method and shows that initially in Poland only very simple tools were used to assess the risk of bankruptcy of enterprises. With time, however, advanced methods began to be introduced and new models included non-financial variables. Also, research on the selection of the samples was conducted. Currently, the level of research and applied tools do not differ from those used in highly developed countries.

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INTRODUCTION

The first publications in the field of predicting bankruptcy of enterprises appeared in the subject literature at the beginning of the 20th century and concerned the United States. Initially, ratio analysis was used to assess the risk of insolvency (Rosendale, 1908, p. 187 as cited in Beaver, 1968, p. 114; Ramser & Foster 1931 as cited in Back, Laitinen, Sere & van Wezel, 1997; Fitzpatrick, 1932). It was subsequently enriched with the one-dimensional discriminant analysis thanks to the efforts of Beaver (1966).

A breakthrough in this research area occurred in 1968 after the publication of Altman (1968), who reduced the impact of many financial variables showing the condition of enterprises with a single indicator (Z-score), using the linear multidimensional discriminant analysis technique. That moment marked the start of competition between researchers seeking techniques that would prove superior as regards forecasting the risk of bankruptcy of enterprises. The development of statistical and analytical tools enabled the use of more sophisticated techniques for analysing larger data sets, and the race to find more and more effective methods continues today.

In the 1970s and 1980s, logit and probit analysis predominated (Chesser, 1974; Martin, 1977; Ohlson, 1980; Zavgren, 1983; Zmijewski, 1984), while in the 1990s artificial neural networks were the approach of choice (Odom & Sharada, 1990; Coats & Fant, 1991-1992; Wilson & Sharda, 1994). In the 21st century, in addition to the aforementioned neural networks, also other so-called "soft computational techniques" began to be used: genetic algorithms (Shin & Lee, 2002), the support vector machine (Härdle, Moro & Schäfer, 2004), fuzzy logic (Spanos, Dounias, Matsatsinis & Zopounidis, 2001), as well as swarm algorithms, with particular focus on the ant colony algorithm (Zhang & Wu, 2011; Martin, Lakshmi & Venkatesan, 2014). Apart from the above-mentioned, other methods have been used, such as: linear programming, the recursive partitioning method, cluster analysis, classification trees, the method based on the rough set theory, cash inventory management methods, the catastrophe theory, multicriteria decision aid methodology, the method of case-based reasoning, the DEA (Data Envelopment Analysis) method, the multidimensional scaling technique, structural models

based on the option theory, the most popular of which is KMV (Prusak, 2005, pp. 27–35), concepts based on the entropy theory (Bal, Cheung & Wu, 2013), the pattern recognition method (Kolari, Caputo & Wagner, 1996), the methods of self-organizing maps (Kiviluoto, 1998), the hazard model (Shumway, 2001), bankruptcy trajectories (Argenti, 1976, p. 121) or auditors' opinions on the continuation of business activity of the surveyed enterprises (Carson et al., 2013).

Another important issue covered in the professional literature of the subject is the selection of explanatory variables for the models. Originally, only financial indicators and figures were used, while later other ones were introduced, related to macroeconomics, sectors of industry or the area of corporate governance (Prusak, 2005, pp. 20–27).

Furthermore, two extreme approaches to building models can be observed. The first of these assumes the creation of universal models, i.e. intended to assess the risk of bankruptcy of as many economic units as possible (regional, global or national models). Within the second approach, it is proposed to develop models tailored to the specifics of the analysed enterprises, i.e. taking into account e.g. their size, sector of industry or the fact of being listed on the stock exchange.

In Poland, due to the change of the economic system, interest in this subject appeared only in the early 1990s. Therefore, the following research questions can be asked:

1) What is the level of advancement of the research into the prediction of the bankruptcy of enterprises in Poland?

and

2) How does it compare to worldwide trends?

Therefore, the main aim of this study is to present and evaluate the scientific achievements of Polish authors in the field of predicting bankruptcies of enterprises and compare them to global trends. Literature analysis was adopted as the research method.

The article, apart from the introduction, is divided into three parts. The first section describes bankruptcy in Poland as an introduction to the problem of predicting the risk of enterprise bankruptcy. The second section contains the review of research and the latest trends in the field of predicting bankruptcies of enterprises in Poland. In the final part the conclusions from the conducted analysis are presented.

The bankruptcies of enterprises in Poland – an outline of the problem

The institution of enterprise bankruptcy began to operate in Poland relatively late in comparison to many European countries, the United States, Canada or Australia (Sgard, 2006; Tabb, 1995). This resulted i.a. from the historical past, when Poland was partitioned for many years.

It was not until 1934 that the *Ordinance of the President of the Republic of 24 October 1934, Bankruptcy Law* (Dziennik Ustaw 1934, no. 93, item 834) and the *Ordinance of the President of the Republic of 24 October 1934, Law on the Arrangement Proceedings* (Dziennik Ustaw 1934, no. 93, item 836) were adopted. Due to systemic changes after World War II, bankruptcy and arrangement law was practically dead in Poland, except for sporadic cases of the bankruptcies of co-operatives. As a result of the economic transformation in the late 1980s, the first bankruptcies of enterprises under the aforementioned law began to be recorded starting from the year 1990. In 1990, 149 applications for bankruptcy were filed, of which 59 were considered, and only in the case of 47.5% of them the court declared bankruptcy. In the years 1991–1992, the figures were as follows:

1) 1250 applications for the declaration of bankruptcy, of which 656 were considered, and only in the case of 45.3% of them the court declared bankruptcy,

2) 3661 applications for the declaration of bankruptcy, of which 2155 were considered, and only in the case of 37.7% of them the court declared bankruptcy.

The statistical data on the arrangement proceedings initiated in 1990–1992 show even less interest in this procedure in comparison to bankruptcy proceedings, i.e.:

1) in 1990, two applications were submitted, all of which were considered, but the proceeding was actually initiated only in one company,

2) in 1991, 76 applications were submitted, of which 24 were considered, and the proceedings were initiated in the case of 33.3% of them,

3) in 1992, 688 applications were submitted, of which 527 were considered, and the proceedings were introduced in 18.6% of them (Nowara & Szarzec, 2004).

In the following years, the numbers of applications for declaration of bankruptcy and initiation of arrangement proceedings were closer to those of the year 1992 than those observed in the years 1990–1991, i.e. significantly more of them were recorded than in the initial years of the transformation period.

The next significant changes in the legislation regarding the bankruptcy of enterprises was introduced in 2003, when the aforementioned legal acts were replaced by the new Bankruptcy and Reorganization Law (Act of 28 February 2003, Dziennik Ustaw, No. 60, item 535). The new act has provided for three basic procedures for companies that are insolvent or threatened with insolvency, i.e. recovery, arrangement and liquidation proceedings. Recovery proceedings were initiated very rarely due to numerous restrictions. In accordance with the assumptions of the Act, the dominance of creditor protection over the concept of protection of the debtor's enterprise was adopted. This approach has changed with the introduction of the restructuring law as of 1 January 2016 (Act of 15 May 2015, Dziennik Ustaw, item 978), the aim of which is to avoid, if possible, the bankruptcy of the entrepreneur, and enable the continuation of the debtor's business.

To sum up, it can be stated that in the period after World War II, the institution of bankruptcy in Poland began to function from the year 1990, when bankruptcies started to take place on a larger scale (i.e. there were more than a few per year). Even so, the number of bankruptcies declared in the years 1990 and 1991 was relatively small, and only since 1992 began to increase. As a consequence, the interest in the area of predicting the risk of bankruptcy of enterprises appeared relatively late in comparison to what could be observed in the United States or highly developed Western European countries. It should also be noted that access to information on bankruptcies and financial statements of insolvent companies was significantly hampered and much more time-consuming during this period.

Polish experience in forecasting enterprise bankruptcies

Pioneering work on predicting bankruptcies of enterprises in Poland appeared around the mid-1990s and interest in these issues intensified particularly in the first decade of the twenty-first century. Initially, attempts were made to use foreign models and concepts to assess the risk of bankruptcy of domestic enterprises, with particular reference to the models of Altman or Jacobs, or the Kralicek test (Mączyńska, 1994; Gasza, 1997; Łukaszewski

& Dąbroś, 1998; Bławat, 1999; Zdyb, 2001). Zdyb (2001) proposed i.a. adjusting the cut-off point in Altman's model to Polish conditions, so that it generates more efficiency.

In a similar period the Polish researchers also started using the ratio analysis (Wędzki, 2000; Stępień & Strąk, 2003; Michaluk, 2003; Kniewski, 2004; Prusak, 2005), as well as building the first national models used for predicting corporate bankruptcies (Pogodzińska & Sojak, 1995; Gajdka & Stos 1996; Hadasik, 1998; Wierzba, 2000). Due to the limited access to or scarcity of data, these models were created using small samples and based on multivariate linear discriminant analysis. Among the aforementioned authors of the models, Hadasik (1998) was the first in Poland to present the problem of enterprise bankruptcies and predicting them in a comprehensive manner in the book entitled *Upadłość przedsiębiorstw w Polsce i metody jej prognozowania* ('*The bankruptcies of enterprises in Poland and the methods of predicting them*').

Numerous other models were subsequently created using the same statistical technique, with usually higher sizes of learning samples (Hołda, 2001; Sojak & Stawicki, 2001; Mączyńska, 2004; Appenzeller & Szarzec, 2004; Korol, 2004; Hamrol, Czajka & Piechocki, 2004; Prusak, 2005; Siudek, 2005; Mączyńska & Zawadzki, 2006; Pociecha, 2007; Maślanka 2008; Kisielińska, 2009; Zdunek, 2009; Wysocki & Kozera, 2012; Jagiełło, 2013; Juszczyk & Balina, 2014; Król & Stefański, 2014; Wojnar, 2015).

Similarly as in the United States and other highly developed countries, more and more advanced methods began to be used over time. Logit models, both binomial and polynomial, have become very popular[1] (Gruszczyński, 2003; Michaluk, 2003; Wędzki, 2004; Stępień & Strąk, 2004; Ciesielski, Domeracki & Gruszczyński, 2005; Prusak & Więckowska, 2007; Zdunek, 2009; Nehrebecka & Dzik, 2012; Jagiełło, 2013; Pisula, Mentel & Brożyna, 2013; Waszkowski, 2013; Ptak-Chmielewska, 2014; Pociecha, Pawełek, Baryła & Augustyn, 2014; Wojnar, 2015; Karbownik, 2017; Iwanowicz, 2017).

In addition to the above-mentioned approaches, Polish researchers also used: classification trees, the probit analysis, linear probability models, the survival analysis using the Cox model and the so-called methods of soft computational techniques, including artificial neural networks and genetic algorithms (Michaluk, 2003;

Korol, 2004; Kisielińska, 2009; Hołda, 2009; Zdunek, 2009; Lasek, Pęczkowski & Wierzba, 2009, Pisula, Mentel & Brożyna, 2013; Pociecha et al., 2014; Pisula et al., 2015; Ptak-Chmielewska, 2016; Wójcicka, 2017). Korol (2010b) also applied the support vectors machine algorithm and fuzzy logic. The latter concept was also used by Pisula et al. (2015). Gąska (2016) used very advanced supervised learning methods to build prediction models for companies listed on the Warsaw Stock Exchange. They included a naive Bayesian classifier, a method indirectly based on the logit model, the k-nearest neighbours method, potential functions, kernel classifiers, the support vector machine algorithm, artificial neural networks, decision trees and random forests, Bayesian networks and methods for combining classifiers into an aggregate model. In addition to the aforementioned author, also Pawełek and Grochowina (2017) used a multiple-model approach in the field of enterprise bankruptcy prediction. Their research shows that in general this concept allows for achieving higher efficiency of predictions than the traditional approach (based on a single model). Lach (2017) investigated the efficiency of using classifier combination and selection methods in the prediction of corporate bankruptcy in Poland. It turned out that the accuracy of these techniques is relatively high in the situation of a small number of explanatory variables. A completely new approach to bankruptcy forecasting has been proposed by Siemieniuk (2018). He used deterministic chaos methods to predict the bankruptcy of listed companies in Poland.

Borkowski and Rogowski (2007) applied another solution in the form of benchmarking and rating within a group of companies from the construction sector. In this respect, it should be noted that the logit model of Stępień and Strąk was used to build the rating. On the other hand, Ciechan-Kujawa (2017) proposed a scoring model for the assessment of business discontinuity risk, including not only financial measures but also numerous qualitative variables. Siedlecki (2007; 2014), however, linked the analysis of warning signals to the life cycle of enterprises. To this end, he used the concepts of strategic bands and the taxonomic gradient method.

Many studies were also devoted to the comparative analysis of the effectiveness of both Polish and foreign models in assessing the insolvency risk of domestic enterprises (Prusak, 2004; Antonowicz, 2007; Wysocki & Kozera, 2012; Balina, 2012; Tomczak, Przybysławski & Górski, 2012; Noga, Adamowicz & Jakubowski, 2014;

1　In contrast to binomial models, polynomial concepts assume more than two states for the purposes of the assessment of the financial condition of an enterprise.

Table 1: Sectoral bankruptcy prediction models in Poland

Sectors	Authors
Companies from the logistics sector.	Brożyna, Mentel, Pisula (2016)
Karbownik (2017)	
Manufacturing, trade and service enterprises.	Iwanowicz (2017)
Meat sector.	Wysocki, Kozera (2012)
Companies dealing with: wholesale trade in food, beverages and tobacco products, construction of buildings or road transport of goods	Balina, Bąk (2016)
Transport, construction, service, commercial and industrial companies.	Jagiełło (2013); Karbownik (2017); Król, Stefański (2014)
Forwarding companies.	Juszczyk, Balina (2009); Karbownik (2017)
Farms.	Kisielińska (2009)
Cooperative banks.	Siudek (2005)
Mines.	Sukiennik (2013)

Source: Own elaboration based on sources included in the table

Iwanowicz, 2017), as well as to applying them to analyse the risk of bankruptcy of a selected group of business entities from various sectors (Grzegorzewska & Runowski, 2008; Śmiglak-Krajewska & Just, 2013; Mentel, 2013; Zielińska-Chmielewska, 2015; Pawlak & Smoleń, 2015, Maciąg & Bobola, 2015).

It is worth noting that in addition to universal models many sectoral models were created (Table 1).

Apart from sectoral models, systems of bankruptcy risk assessment taking into account the criterion of enterprise size were developed (Jagiełło, 2013; Ptak-Chmielewska, 2014, 2018; Kaczmarek, 2018). With an aim to obtain signals warning of bankruptcy as early as possible, i.a. Prusak (2005), Maslanka (2008) and Nehrebecka and Dzik (2012) proposed the development of models that would include several functions for different time advance periods of prediction.

A very important problem in this research area is the selection of variables for models. Polish researchers used not only financial indicators but also macroeconomic measures as explanatory variables (Korol, 2010a; Ptak-Chmielewska, 2014). Kisielińska (2009) introduced specific measures such as the age of the farmer or the cultivated area into the models of assessing the bankruptcy risk of farms. Gąska (2016, pp. 138, 182) used market value ratios in addition to typical financial indicators. Although he did not confirm unambiguously the hypothesis that these measures contribute to greater effectiveness of models, he still believes that there is potential in them. Wędzki (2008, p. 98) and Maślanka (2008, pp. 193–254) verified

the hypothesis assuming that enhancing the Polish models with cash flow indicators increases their efficiency. However, it has not been unambiguously confirmed, i.e. the introduction of such measures increased the effectiveness of some models, while in the case of other models it brought no such result. Moreover, Pociecha and Pawełek (2011) based on the conducted research showed that the risk of bankruptcy depends on the economic cycle and therefore suggested that enterprise bankruptcy forecasting models should take into account measures showing changes in economic conditions.

In addition to the above issues, Grochowina (2014) dealt with the topic of using data imputation methods in the case of building a logit model of enterprise bankruptcy risk assessment and their impact on its effectiveness. Pociecha et al. (2014, p. 133) examined the impact of the method of sampling the population of bankrupt and non-bankrupt enterprises on the predictive capabilities of models. It turned out that significantly better results could be obtained by means of models in which the selection of the sample was carried out using the independent random sampling method compared to those in which companies were selected in pairs.

As presented before in the aforementioned studies on improving the effectiveness of predictions in the field of assessing the risk of enterprise bankruptcy, some authors also checked whether the relevant models are used in practice. Based on interviews conducted with 10 auditors by Iwanowicz (2017), it turned out that only three of them knew the principles of discriminatory models

and only one person used such tools. Seven auditors used the ratio analysis to assess the reasonability of continuing business. In addition, Ciechan-Kujawa (2017) conducted research on the application of discriminatory methods in enterprises operating in Poland. It turned out that out of the 501 responses received only in 75 cases the respondents were evaluating the business of their enterprises using such tools. Among the companies that did not use these methods, the view that they are useless in the decision-making process prevailed. The author also checked whether they are used by auditors and included in their opinions on the audited financial statements. Such an approach turned out to be extremely rare. Similar conclusions can be drawn from the surveys carried out by Kopczyński (2016), indicating that bankruptcy risk prediction models are used in very few enterprises.

Conclusions

The analysis of literature shows that the problem of predicting bankruptcies of enterprises in Poland became a subject of interest relatively late in comparison to what was the case in the United States and other developed countries, as it happened only at the beginning of the 1990s. It resulted i.a. from the fact that the institution of bankruptcy in practice remained a dead letter in the post-war period until 1990. Only the first bankruptcies of enterprises raised interest among Polish researchers.

At the beginning, as was the case in other Central and Eastern European countries, attempts were made to implement foreign solutions in national conditions and to use ratio analysis. The most popular model was the one developed by Altman. In the mid-1990s, the first proposals for national models appeared in Poland, for the construction of which linear multidimensional discriminant analysis was used. In the 21st century, interest in these issues has intensified and Polish researchers have begun to use more and more advanced analytical tools to create models. It can be said that currently, in terms of research in this area, we do not differ from the best world standards. In addition to using more and more advanced techniques, domestic scientists use both financial and non-financial measures to assess the risk of bankruptcy. Moreover, research is being conducted on the impact of sample selection methods on the efficiency of models being built.

However, there is some doubt regarding the usefulness of the tools described in this article. Namely, it turns out that not many Polish entrepreneurs and auditors use the described methods in practice. On the one hand, it results from a lack of knowledge about them, while on the other many of them think that these tools are not useful in the decision-making process. Therefore, further considerations in this research area should focus on the analysis of the usefulness of such tools in practice and their role in financial analysis.

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