

BŁAŻEJ PRUSAK,^a ULYANA ZAREMBA,^b PAWEŁ GALIŃSKI^{c†}

FACTORS AFFECTING THE CONCLUSION OF AN ARRANGEMENT IN RESTRUCTURING PROCEEDINGS: EVIDENCE FROM POLAND

CZYNNIKI WPŁYWAJĄCE NA ZAWARCIE UKŁADU W POSTĘPOWANIU RESTRUKTURYZACYJNYM: DOŚWIADCZENIA Z POLSKI

The EU Restructuring Directive (2019/1023) requires Member States to provide a preventive restructuring framework for financially distressed entities that remain viable or are likely to readily restore economic viability. The first step to a successful restructuring is the approval of an arrangement between the debtor and creditors. The main research objective of the article is to identify factors affecting the conclusion of an arrangement in restructuring proceedings. In the process of filtering companies initiating a restructuring procedure, these factors are seen as increasing the probability of concluding an arrangement between debtor and creditors. Moreover, an additional research objective is to construct a turnaround prediction model aimed at assessing the probability of a conclusion of an arrangement in restructuring proceedings. The study covered the companies in Poland for which restructuring proceedings opened between 2016 and 2021 ended with the approval of an arrangement, and a similar number of companies that failed to restructure successfully. Binary logistic regression was applied to achieve the aims of this study. The results show that two financial variables affected companies in terms of their chances to conclude the arrangement: the *current ratio* and *return on assets* were among the statistically significant indicators and they are characterized by higher values for debtors reaching the arrangement with their creditors. A direct positive relationship was also identified between the *company's lifespan* and the outcome of the proceedings. The probability of the conclusion of the arrangement was also affected by the *type of industry*. Models assessing the probability of completing restructuring proceedings with an arrangement can be useful for insolvency practitioners and financial analysts during viability assessments.

Keywords: financial distress; preventive restructuring; turnaround prediction model; bankruptcy prediction; law & economics; Poland

^a Gdańsk University of Technology, Poland / Politechnika Gdańska, Polska
blaprusa@pg.edu.pl, <https://orcid.org/0000-0002-6526-0407>

^b University of Information Technology and Management, Rzeszów, Poland /
Wyższa Szkoła Informatyki i Zarządzania w Rzeszowie, Polska
uzaremba@wsiz.edu.pl, <https://orcid.org/0000-0003-3892-1983>

^c University of Gdańsk, Poland / Uniwersytet Gdański, Polska
pawel.galinski@ug.edu.pl, <https://orcid.org/0000-0002-9407-4515>

Unijna dyrektywa restrukturyzacyjna (2019/1023) nakłada na państwa członkowskie obowiązek zapewnienia ram restrukturyzacji zapobiegawczej dla podmiotów znajdujących się w trudnej sytuacji finansowej, dla których istnieje szansa na przywrócenie im rentowności. Pierwszym krokiem do realizacji skutecznej restrukturyzacji jest zatwierdzenie układu między dłużnikiem a wierzycielami. Głównym celem badawczym artykułu jest identyfikacja czynników wpływających na zawarcie układu w postępowaniu restrukturyzacyjnym. W procesie filtracji przedsiębiorstw inicjujących postępowanie restrukturyzacyjne czynniki te postrzegane są jako zwiększające prawdopodobieństwo zawarcia układu. Dodatkowym celem badawczym jest budowa modelu predykcji skutecznej restrukturyzacji (*turnaround prediction model*) ukierunkowanego na ocenę prawdopodobieństwa zawarcia układu w postępowaniu restrukturyzacyjnym. Badaniem objęto wszystkie przedsiębiorstwa w Polsce, dla których postępowania restrukturyzacyjne otwarte w latach 2016–2021 zakończyły się zatwierdzeniem układu, oraz podobną liczbę przedsiębiorstw, którym nie udało się przeprowadzić skutecznej restrukturyzacji. Do realizacji celów badania zastosowano metodę regresji logistycznej. Uzyskane wyniki wskazują, że zmienne finansowe w niewielkim stopniu różnicowały przedsiębiorstwa pod względem szans zawarcia układu. Zidentyfikowane zostały dwa istotne statystycznie wskaźniki finansowe, tj. *wskaźnik bieżącej płynności* oraz *rentowności aktywów* (ROA). Wyższej wartości tych mierników odpowiada większe prawdopodobieństwo zawarcia układu. Zaobserwowano również dodatni związek pomiędzy *długością życia przedsiębiorstwa* a wynikiem postępowania. Na prawdopodobieństwo zawarcia układu wpływał również rodzaj branży. Zaproponowane w artykule modele służące do oceny szansy zawarcia układu między dłużnikiem a wierzycielami mogą stanowić narzędzie wspomagające pracę doradców restrukturyzacyjnych podczas realizacji tak zwanego testu zdolności do kontynuacji działalności.

Słowa kluczowe: upadłość i restrukturyzacja; restrukturyzacja zapobiegawcza; model predykcji skutecznej restrukturyzacji; prognozowanie upadłości; ekonomiczna analiza prawa; Polska

I. INTRODUCTION

In recent years, a trend can be observed in the field of insolvency and restructuring laws towards the introduction of more debtor-friendly regulations to enable the implementation of so-called ‘new or second chance’ policies.¹ There is a strong emphasis on restructuring processes to help reduce the negative effects of corporate failure.² Such effects occur at all times but are particularly strong during periods of economic slowdown. This is evidenced, among other things, by the rising values of global and regional insolvency indices.³

In the European Union, many initiatives and actions have been taken to promote the idea of a second-chance policy, as well as a framework for preventive restructuring.⁴ One of the most recent and very important pieces of legislation is Directive (EU) 2019/1023 of the European Parliament and of the Council of 20 June 2019 on Preventive Restructuring Frameworks.⁵ In

¹ McCormack et al. (2016); Morawska et al. (2020); Prusak et al. (2022); Tajti (2018).

² Xie (2016).

³ Lemerle et al. (2022).

⁴ Prusak, Galiński (2021).

⁵ Directive (EU) 2019/1023 of the European Parliament and of the Council of 20 June 2019 on preventive restructuring frameworks, on discharge of debt and disqualifications, and on mea-



vency of 20 June 2019, which, initially, was to be implemented in the EU countries by 17 July 2021 (with the possibility to extend the deadline by one year).⁶ In turn, considering the economic point of view, the above-mentioned test is to act as a filter in the process of dividing companies initiating restructuring proceedings into those with prospects of success in restructuring and those which are not likely to succeed. In the first case, the debtors should be allowed to carry out restructuring proceedings and try to enter into an arrangement with creditors. In the second case, it is justified to start the liquidation process of the entity. In principle, financial premises should be the main focus when performing the viability test; however, some researchers go further and claim that non-financial, ESEG (environmental, social, ethical, and governance) values should also be considered.⁷ While performing the test, the decision-makers may make two forecast errors: (1) block the restructuring proceedings, which may result in the liquidation of an enterprise that has a chance to restore its ability to compete on the market, or (2) qualify for the restructuring proceedings an entity with no prospects of performing the arrangement.

The purpose of the tools supporting the decision-making process during viability assessment is to obtain the lowest possible forecast error. According to Garrido et al.,⁸ the viability test should be a rather simple tool that does not generate too high costs. Moreover, those authors argue that for the evaluation of micro and small entities, due to the need to reduce the costs of the proceedings, the viability test should be abandoned and very simple measures should be used instead, that is, future profitability. Identification of factors affecting enterprises to conclude arrangements in restructuring proceedings as well as development of turnaround prediction models, which are designed based on the techniques used for bankruptcy prediction models⁹, can serve as supporting tools to assess viability. In the turnaround prediction model, the measure of success/failure of the restructuring proceedings, as evidenced by the implementation/non-implementation of the debtor's arrangement with its creditors in the restructuring proceedings, can be used as a dichotomous explanatory variable. In countries where restructuring proceedings are implemented according to new procedures and the current data on the implementation or non-implementation of the arrangement are not yet sufficient to build the model, the approval of the arrangement between the debtor and creditors by the court may be considered as a measure of the success of the restructuring proceedings. However, it is important to be aware that the approval of a debtor-creditor arrangement is the first and necessary step to perform effective restructuring, but it is not sufficient to restore the viability of the busi-

⁶ Tsioli (2021).

⁷ Linna (2020).

⁸ Garrido et al. (2021): 11.

⁹ Issues concerning the forecasting of corporate bankruptcy both in Poland and abroad have been addressed in the literature. See, e.g., works by Altman (1968); Aziz, Dar (2006); Bellovary et al. (2007); Alaka et al. (2018); Kovacova et al. (2019); Mączyńska (1994), (2004); Gajdka, Stos (1996); Hadasik (1998); Hołda (2001); Gruszczyński (2003); Hamrol et al. (2004); Antonowicz (2007); Prusak (2005), (2018).



ness. Financial measures and other quantitative and qualitative measures can be used as explanatory variables.

The research on the factors of successful restructuring, which allow distinguishing distressed companies that have successfully undergone the restructuring process from those that have been liquidated, goes back to the 1980s and was initially conducted in the United States. Highly significant studies were conducted by White and Casey.¹⁰ It was found that out of the 6 variables: size, change in size, retained earnings/assets at the last available moment prior to filing for bankruptcy, equity commitment by management, net profit/assets at the last available moment prior to filing for bankruptcy, free assets percentage only the last two were characterized by a significant ability to differentiate the two groups of entities. The above-mentioned authors were the first ones to use the probit method to build a model the effectiveness of which for the training sample was 69%, and for the test sample – 59%.

Poston et al.¹¹ are among the first researchers to test financial ratios, on a larger scale, as potential predictors to distinguish between distressed companies that have successfully undergone the restructuring process from those that have failed. According to their research, selected probit and Altman models, as well as most financial indicators, did not show significant discriminatory ability between the aforementioned groups of companies. Among the indicators, the exceptions were: inventory/sales revenue and total liabilities/total capital, which statistically significant differentiated the aforementioned groups of companies. Growth in both these areas contributed to a lower chance of successful restructuring.

Studies on the effectiveness of the restructuring proceedings have also been carried out in other countries, including Asian ones. Among the key and statistically significant variables influencing restructuring, the following ones were noted: the risk and size of the enterprise, and the result of an audit. The authors of the study, using the logistic regression, built a model the effectiveness of which for the training sample was 81.4%.¹² Binti and Ameer¹³ conducted analyses on the effectiveness of restructuring public companies listed on the Malaysian stock exchange with the use of multi-dimensional linear discriminant analysis models used for bankruptcy forecasting. According to them, the severity of financial distress, liquidity and size were important factors responsible for the effectiveness of restructuring. Studies of public companies listed on the Malaysian stock exchange were also performed by Ahmad et al.¹⁴ The researchers show that the following factors were statistically significant: interest coverage ratio, stock returns, blockholder ownership, and political connections. In China, Li et al.¹⁵ conducted research on the effective-

¹⁰ Casey et al. (1986).

¹¹ Poston et al. (1994).

¹² Kim et al. (2008).

¹³ Binti, Ameer (2010).

¹⁴ Ahmad et al. (2022).

¹⁵ Li et al. (2019).



ness of asset restructuring in corporate restructuring using various statistical methods (MDA – multiple discriminant analysis, logistic regression, probit, case-based reasoning, SVM – support vector machine and bagged ensembles). It was found that SVM technique was the most efficient one in turnaround prediction models.

Regarding Europe, similar studies have been performed in Germany. Based on the results, enterprises that are financed to a greater extent with external capital, that have a high share of debt coming from banks, and that show a higher going concern value, have greater prospects of successful restructuring.¹⁶ The analyses conducted in Spain show that the success of restructuring depends on the sector, ROA – return on assets, cash ratio, and it increases if the entity functions within a group of companies.¹⁷ However, with regard to successfully and unsuccessfully conducted restructuring proceedings, not all studies confirmed a significant diversification of financial ratios. This was the case of, for example, Estonia and Finland, with the latter country having non-financial data, such as the resignation of the management and prior payment procedure, which played an important role in the filtering process.¹⁸ It is worth mentioning that in the UK, research was conducted to identify the factors contributing to a failure in the process of concluding an arrangement between a debtor and creditors under the CVA – Company Voluntary Arrangement. Among them, the following were indicated: lack of support from relevant institutions, the reluctance of unsecured creditors; lack of interest from key suppliers, over-optimistic financial forecasts and underestimation of the impact of the agreement on working capital, failure to pay post-CVA creditors, failure of the management to implement the required changes and the fact that the proposals in the agreement did not address all the issues that the company was facing.¹⁹

In Poland, the Restructuring Law²⁰ entered into force at the beginning of January 2016, introducing new types of restructuring proceedings that aim to protect against bankruptcy by restoring the debtor's ability to perform its obligations and providing protection from enforcement. From economic transformation until 2016, the only solution for an insolvent debtor was to make an arrangement with its creditors as part of bankruptcy proceedings. On the one hand, the new legislation has resulted in an increase in the share of restructuring proceedings in relation to liquidation bankruptcy proceedings. On the other hand, however, it has turned out that many of the restructuring proceedings initiated do not even end with the conclusion of an agreement between the debtor and creditors.²¹ Such a situation results in a significant

¹⁶ Jostarndt, Sautner (2010).

¹⁷ Camacho-Miñano et al. (2015).

¹⁸ Laitinen (2008), (2011); Lukason, Urbanik (2013).

¹⁹ Walton et al. (2020).

²⁰ Restructuring law of 15 May 2015, consolidated text: Journal of Laws of the Republic of Poland [JL] 2015, item 978.

²¹ Herman (2021): 20.



lengthening of the execution of proceedings and a decrease in their efficiency.²² This makes it imperative to separate the wheat from the chaff at the outset of restructuring proceedings.

Numerous studies and reflections have been devoted to restructuring in Poland. This process has been analysed from the point of view of different research areas and disciplines, for instance economics and law, and has concerned economies, sectors and enterprises.²³ Different research methods (case studies, quantitative methods, expert opinions, questionnaire studies) were applied to corporate restructuring research and addressed a wide range of issues. For example, using questionnaire surveys, Kałowski²⁴ analysed the causes and directions of restructuring activities. Among the most important causes, there were included: changes in legislation, restrictions in consumption levels, increased competition, lack of experienced staff, changing exchange rates and new developments in technology. In turn, Glinkowska²⁵ conducted similar research concerning the causes of restructuring companies. Porada-Rochoń,²⁶ on the other hand, analysed the determinants of financial distress in a group of small and medium-sized enterprises and the tools aimed at decreasing this distress. The study based on questionnaire interviews showed certain factors which contributed to financial disruption: price volatility, political conditions and the economic situation in the country. Thus, the respondents indicated the most effective tools: reduction of investment expenditures and renegotiation of contract terms. The case study method, on the other hand, was used to analyse the restructuring process of the chosen enterprise by Boratyńska.²⁷ Borowiecki and Wysłocka,²⁸ in contrast, comprehensively demonstrated the applicability of economic analysis and the expert evaluation in corporate restructuring processes. They presented the assessment of undertaking recovery measures and proposed synthetic indicators in this field: current and quick liquidity, rotation of receivables and liabilities, labour productivity, technical equipment of work, profitability, debt structure and coverage, and net debt to sales revenue. In addition, the research of Zaremba²⁹ on the financial health of companies in restructuring has shown that liquidity and the ability to generate profits are key factors in the process of successful restructuring. Furthermore, companies in restructuring were, in many cases, characterized by high levels of indebtedness, low values of liquidity ratios, lack of profit-generating ability, and changes in the asset structure, particularly one year before the opening of restructuring proceedings. In another study, it was indicated that the share of

²² Zaremba (2021).

²³ Publications on this subject have been written or edited, among others, by Borowiecki (1996), (1999a), (1999b), (2010), (2014); Gabrusewicz (1999); Grudzewski, Hejduk (2000); Mączyńska (2001); Suszyński (2003); Dorozik (2006); Rochoń (2009); Nowak, Zarzecki (2012); Czerkas, Teisseyre (2016).

²⁴ Kałowski (2012).

²⁵ Glinkowska (2015).

²⁶ Porada-Rochoń (2018).

²⁷ Boratyńska (2011).

²⁸ Borowiecki, Wysłocka (2012).

²⁹ Zaremba (2021).



short-term liabilities in total liabilities and the share of short-term receivables in the total assets determined the conclusion of an arrangement in restructuring proceedings in the companies listed on the stock exchange in Poland.³⁰ In addition, Herman³¹ also conducted in-depth research using financial measures on companies in good condition and those undergoing bankruptcy and restructuring proceedings. He used 13 popular financial ratios from capital structure, profitability, liquidity and efficiency. The main conclusions of this study are as follows: 1) Companies initiating bankruptcy and restructuring proceedings are characterized by a similar financial condition, which differs significantly from that of healthy companies. 2) For entities for which an arrangement has been approved and companies that have declared bankruptcy, no statistically significant difference was found in the distribution of their values between the financial indicators. 3) The financial situation of companies undergoing restructuring did not impact the choice of the type of restructuring procedure.

To sum up, the research results on the factors affecting the conclusion of an arrangement in restructuring proceedings are inconclusive both in Poland and abroad. Many of them show that financial measures differentiate to a small extent between entities that successfully conclude an arrangement and those that do not. Several studies also show that financial measures do not differentiate between the above-mentioned groups of companies. Hence, conducting this type of research is valid and essential from both a theoretical and business practice perspective.

III. DATA AND METHODOLOGY

The study covered the companies operating in Poland for which the restructuring proceedings opened between 2016 and 2021 ended with the approval of an arrangement and this arrangement was in progress or fully implemented. Achieving the research objectives proposed in the introduction required the collection of data not only for successful cases but also for companies where the restructuring attempt failed. Therefore, the research sample also included the companies for which restructuring proceedings opened in 2016–2019 were unsuccessful: the proceedings were discontinued, the company was declared bankrupt, or the bankruptcy application was rejected due to the ‘poverty’ of the bankruptcy estate (i.e. lack of property). The data were obtained from the Repository of Financial Documents maintained by the National Court Register. The completion of the data collection process resulted in the final inclusion of 648 companies in the research sample: 327 entities with an arrangement approved and 321 with restructuring failed (Tab. 1). This is in line with the comment of Veganzones and Severin,³² who indicated that data sets for predicting corporate failure should contain equal numbers of failed and non-failed firms to achieve the optimal classification performance per class.

³⁰ Prusak, Galiński (2021).

³¹ Herman (2021).

³² Veganzones, Severin (2021).



Table 1

Characteristics of companies by industrial classification and company lifespan

	Arrangement approved	% in total	Restructuring failed	% in total
Industrial classification				
Manufacturing	88	27	103	32
Construction	45	14	61	19
Wholesale and retail trade	78	24	65	20
Services and other	116	35	92	29
Company lifespan				
less than 5 years	58	18	69	21
from 5 to 10 years	109	33	112	35
more than 10 years	160	49	140	44
Total	327	100	321	100

Source: the authors' own elaboration based on Polish National Court Register and Economic Monitor (MSiG).

Binary logistic regression was applied as the research method. The canonical link function for the binomial distribution is the logit, which is defined as the natural log of the odds. In turn, the odds are the probability of an event occurring divided by the probability of the event not occurring. Thus, the formula for the logit is (1)³³:

$$\text{logit}(\hat{\pi}) = \ln\left(\frac{\hat{\pi}}{1-\hat{\pi}}\right), \quad (1)$$

where $\hat{\pi}$ is the predicted probability of an event occurring.

The explanatory variable is represented by a zero-one variable (2):

$$Y = \begin{cases} 1 - \text{arrangement approved (success)} \\ 0 - \text{arrangement not approved (failure - unsuccessful restructuring)}. \end{cases} \quad (2)$$

The linear form of the binary logistic regression model can be expressed as (3)³⁴:

$$\text{logit}(\hat{\pi}) = \ln\left(\frac{\hat{\pi}}{1-\hat{\pi}}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p, \quad (3)$$

where β_0 is the intercept; β_1, \dots, β_p are the regression coefficients for the p predictor variables X_1 to X_p .

³³ Coxe et al. (2013): 33–34.

³⁴ Coxe et al. (2013): 27–34.



Thus, the logistic regression model may be written as (4)³⁵:

$$\hat{\pi}(Y = 1 | X_1, X_2, \dots, X_p) = \frac{e^{\beta_0 + \sum_{i=1}^p \beta_i X_i}}{1 + e^{\beta_0 + \sum_{i=1}^p \beta_i X_i}} \quad (4)$$

In the binary logistic regression model in the interpretation of e^{β_i} , the term odds ratio is applied. It is the effect of a 1-unit change in X_i on the odds of being a case and this interpretation is especially useful for categorical predictors, for example type of industry. Thus, for a 1-unit increase in X_i , the odds of being a case is multiplied by e^{β_i} , holding all other variables constant.³⁶

Table 2

Explanatory variables used in the research

Variable	Formula/Description
Financial leverage ratios	
Debt-to-asset ratio (including provisions for liabilities)	Liabilities and provisions for liabilities/assets
Debt-to-asset ratio (excluding provisions for liabilities)	Liabilities (excluding provisions for liabilities)/ assets
Short-term debt-to-asset ratio	Short-term liabilities/assets
Liability structure ratio	Short-term liabilities/liabilities and provisions for liabilities
Debt and interest coverage ratios	
Interest coverage ratio (inverse)	Financial costs / EBITDA
Debt service coverage ratio	EBITDA / (financial costs + short-term liabilities)
Liquidity ratios	
Current ratio	Current assets/short-term liabilities
Quick ratio	(Current assets – inventories)/short-term liabilities
Cash ratio	Cash/short-term liabilities
Turnover ratios	
Asset turnover	Revenues/assets
Accounts receivable turnover	Short-term receivables/revenues
Inventory turnover	Inventories/revenues
Liabilities turnover	Short-term liabilities/total operating costs

³⁵ Kleinbaum, Klein (2010): 7–8.

³⁶ Coxe et al. (2013).



Profitability ratios	
Sales margin	Profit (loss) on sales/revenues
EBIT margin	EBIT/revenues
Return on Assets (ROA)	Net profit (loss)/assets
Additional non-financial measures	
Lifespan (in years)	The day of opening the restructuring proceedings minus date of entry in the National Court Register (KRS)
Industrial classification	Manufacturing, Construction, Wholesale and retail trade, Services, and other

Source: the authors' own elaboration.

The procedure for constructing the final form of the logistic regression models was as follows:

1. Quantitative as well as qualitative variables were considered to identify factors contributing to concluding an arrangement. Among variables, there are indicators of the financial situation of companies, as well as the type of industry and company lifespan (Tab. 2). Financial data were collected for one year prior to the initiation of the restructuring proceedings ($t-1$). The list of selected indicators was based on the findings of Zaremba,³⁷ Herman,³⁸ Kovacova et al.,³⁹ Camacho-Miñano et al.⁴⁰ and Zhou et al.⁴¹ In addition, these measures were selected bearing in mind the availability of data among analysed companies. In the process of variable selection, collinearity was controlled based on the Variance Inflation Factor (VIF) value.

2. Models were estimated for 648 entities ($Y = 1$ for 327 companies; $Y = 0$ for 321 companies), which included the following variables for the period prior to the event ($t-1$): current ratio, return on assets, lifespan of the company (years) and type of industry: manufacturing and construction (hence companies from other industries served as a reference group in the process of interpreting model parameters). Hence, the above-mentioned financial variables concern the year before the declaration of restructuring proceedings. The authors searched only for models with statistically significant variables for this period. The occurrence of influential observations was identified using DFBETAS (cut off $u > 0.3$)⁴² for which the highest values of Pregibon's influence statistic were recorded.⁴³ It is worth mentioning that outliers whose location has a large effect on the regression solution are called influential cases,⁴⁴

³⁷ Zaremba (2021).

³⁸ Herman (2021).

³⁹ Kovacova et al. (2019).

⁴⁰ Camacho-Miñano et al. (2015).

⁴¹ Zhou et al. (2022).

⁴² Harrell (2015): 137.

⁴³ Long, Freese (2014): 215–216.

⁴⁴ Srinivasan, Lohith (2017): 82.



and might be removed⁴⁵ from the process of the final estimation due to the fact that the logistic regression is sensitive to them.⁴⁶ In this way, five influential cases were identified and excluded. It is worth noting that influential cases in the *arrangement approved* group had low ROA ratios: -14.65 (manufacturing) and -12.82 (manufacturing), while influential cases in the *restructuring failed* group had a very high current ratio: 22.56 (construction), 14.19 (manufacturing) and 13.17 (other than manufacturing and construction). As a result, the following were estimated: (1) Model 1 – including all the variables previously indicated; (2) Model 2 – including financial variables together with a variable indicating the lifespan of the company; (3) Model 3 – including only financial variables. Predictors for the success of restructuring proceedings were interpreted for Model 1, with the relatively best goodness of fit measures. It is worth adding that no other financial variable added to Model 1 showed any statistical significance, keeping all the remaining variables statistically significant.

3. Measures of goodness-of-fit of individual models were estimated, including pseudo R^2 measures such as: R^2 McFadden, R^2 Cragg-Uhler (Nagelkerke) and Count- R^2 , adjusted Count- R^2 , as well as information criteria: Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC). The values of AUC (area under the curve) were also determined, and for the model characterized by its highest value, the ROC curve was presented. The lowest and highest values of the Variance Inflation Factor are also presented to show the absence of a collinearity problem between the variables in the different models. The classification table is presented in order to indicate both the sensitivity and specificity⁴⁷ of Model 1, as characterized by the best goodness-of-fit measures. As a result, Type I error (false positive) rate, and Type II error (false negative) rate are shown. Additionally, the recall was included as the number of true positives divided by the number of true positives plus the number of false negatives, to show the ability of the model to find all the positive cases.⁴⁸

4. The correctness of the functional form of the estimated models was verified by means of Pregibon link test⁴⁹ as well as the RESET test.⁵⁰ In the Pregibon link test, the predictor of interest is 'hatsq', which is the square of the hat matrix diagonal. If 'hatsq' is not significant, the model is well specified.⁵¹ In turn, in the RESET test, the model is re-estimated with the square of the predicted values in order to check whether or not the model is well specified. If the functional form is correct, the newly tested variable should not be significant.⁵² Moreover, two other statistical tests were presented: logit model

⁴⁵ Rousseeuw, Leroy (1987): 8.

⁴⁶ Włodarczak (2019): 47–48.

⁴⁷ Kleinbaum, Klein (2010): 349.

⁴⁸ Ohri (2019): 172.

⁴⁹ Pregibon (1980): 15–24.

⁵⁰ Deb et al. (2017): 59.

⁵¹ Hilbe (2009): 84–85.

⁵² Jones (2007): 14.



LM test for homoskedasticity – LM HOM (H0: residuals are homoscedastic; H1: residuals are heteroskedastic) and logit model LM test of logistic against burr type II – LM-BURR [H0: logistic distribution; H1: burr (skewed distribution)]. For each model, the likelihood-ratio test (LR test) was also estimated, in which the null hypothesis is that the coefficients of all regressors are jointly equal to zero.⁵³

5. The potential problem of overdispersion was verified. Overdispersion can be caused by the omission of important predictors, a correlation between binary responses, or a misspecified link function.⁵⁴ Based on these assumptions, the overdispersion parameter (Pearson Chi-Square/df) was estimated. Therefore, if its value is considerably greater than 1.0, the model is overdispersed.⁵⁵

6. Furthermore, the bootstrap method with 200 replications ($B = 200$) was used to validate and calibrate Model 1. Harrell indicates the findings of Breiman,⁵⁶ who found that bootstrap validation on the original sample was as efficient as having a separate test sample twice as large. This method enables the level of the ‘optimism’ to be evaluated: it is subtracted from the final model fit’s apparent accuracy to obtain the overfitting-corrected estimate. As a result, the following indexes were estimated⁵⁷: R^2 (Cragg-Uhler (Nagelkerke) pseudo- R^2), D_{xy} (Somers’ rank correlation) which equals $2(C - 0.5)$, where C is the ‘ROC Area’, Intercept, Brier Score and a Slope (calibration slope), which indicates overfitting if it is smaller than one. Hence, the calibration curves were presented. It is worth mentioning that the ‘corrected’ slope can be thought of as a shrinkage.⁵⁸ Therefore, it can be applied to adjust a model for future use, for example to correct beta parameters.⁵⁹

IV. RESULTS AND DISCUSSIONS

Following the research procedure, three logistic regression models were developed. The final models included 325 companies in which the arrangements were approved, and 318 companies in which the arrangements were not concluded. The first group of companies: 325, was characterized by the higher average level of the current ratio and the lifespan. Moreover, in the companies in which the arrangement was not approved: 318, there were worse positions in the field of the average level of the return on assets (Tab. 3).

⁵³ Gujarati (2011): 24, 172.

⁵⁴ Ekstrom (2011): 87–88.

⁵⁵ Hilbe (2009): 302; Ekstrom (2016): 128; Demétrio et al. (2014): 230.

⁵⁶ Breiman (1992): 738–754.

⁵⁷ Harrell (2015): 124.

⁵⁸ Harrell (2015): 269.

⁵⁹ Steyerberg (2019): 270, 299.



Table 3

Descriptive statistics for the quantitative variables in the models 1–3

Variable	Obs.	Mean	Standard deviation	Min	Max
Companies, in which the arrangement was approved ($Y = 1$)					
Return on Assets	325	-0.2496	1.2645	-6.2840	17.1831
Current ratio	325	2.2367	10.1881	0.0182	102.0150
Lifespan	325	10.5218	5.2325	0.4849	20.2795
Companies, in which the arrangement was not approved ($Y = 0$)					
Return on Assets	318	-0.6205	2.3934	-24.0326	1.0625
Current ratio	318	0.8148	0.6485	0.0021	5.2420
Lifespan	318	9.5805	4.8562	0.6849	18.6877

Source: the authors' own elaboration.

As far as the estimated models are concerned, the results of the LR test indicate that all the estimated regression models with a different set of predictors are significantly different from the model with only the constant. At the same time, the study shows that Model 1 exhibits the highest AUC value (0.6154), as well as the highest values of the goodness of fit measures: Pseudo-R², Count-R², Adjusted Count-R².

According to Model 1, a 1-unit increase in ROA improved the odds of concluding an arrangement under restructuring proceedings by 10.62% ($(e^{0.1009} - 1) \times 100\%$). Furthermore, a 1-unit increase in the current ratio also raised the odds of concluding such an arrangement by 24.14% ($(e^{0.2162} - 1) \times 100\%$). The results of Model 1 also indicate that there was a positive relationship between 'company lifespan' and the odds of entering into the arrangement. Thus, an additional year of operation of the company increased its odds of concluding an arrangement by 4.04% ($(e^{0.0396} - 1) \times 100\%$). Moreover, belonging to the construction and manufacturing industries reduced the odds of concluding the agreement by 45.72% ($(e^{-0.6110} - 1) \times 100\%$) and 45.72% ($(e^{-0.4069} - 1) \times 100\%$), respectively, in comparison to other industries.

The results of the Pregibon link test indicate that the specification of the estimated models is correct. For each case in this test, 'hatsq' is not significant (p -value = 0.8730). This is also confirmed by the RESET test, the results of which also suggest that the functional form of the models is correct. Moreover, no multicollinearity was observed between the explanatory variables. For Model 1, the Variance Inflation Factor (VIF) does not exceed 1.10 and the problem of overdispersion is not present ('Pearson Chi-Square/df' close to 1) in any model. At the same time, the LM-HOM test shows no heteroskedasticity, while the LM-BURR test indicates that the distribution is logistic in the models (Tab. 4).

Table 4

Results of the estimation of logistic regression models for concluding an arrangement in restructuring proceedings

Details	Model 1	Model 2	Model 3
Return on Assets	0.1009* (0.0575)	0.1053* (0.0563)	0.1124** (0.0567)
Current ratio	0.2162** (0.1055)	0.2096** (0.1054)	0.2200** (0.1055)
Lifespan	0.0396** (0.0162)	0.0331** (0.0159)	–
Construction	–0.6110*** (0.2327)	–	–
Manufacturing	–0.4069* (0.1859)	–	–
Intercept	–0.3285 (0.2087)	–0.4736** (0.2015)	–0.1466 (0.1253)
Goodness of fit measures			
R ² McFadden	0.037	0.027	0.022
R ² Cragg-Uhler	0.067	0.049	0.040
Count-R ²	0.589	0.551	0.529
Adjusted Count-R ²	0.170	0.091	0.047
AIC	870.217	875.451	877.800
BIC	897.014	893.315	891.198
AUC	0.6154	0.5752	0.5456
VIF min-max	1.01–1.10	1.00–1.01	1.00–1.00
Pearson Chi-Square/df	0.9972	0.9924	0.9905
Statistical tests			
LR	[< 0.0001]	[< 0.0001]	[0.0001]
Pregibon link test (<i>hatsq</i>)	[0.740]	[0.940]	[0.947]
RESET	[0.709]	[0.926]	[0.934]
LM-HOM	[0.919]	[0.664]	[0.795]
LM-BURR	[0.634]	[0.795]	[0.937]

Note: 1) ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively; 2) standard errors are given under the coefficients in parentheses; 3) results of statistical tests are expressed as *p*-value.

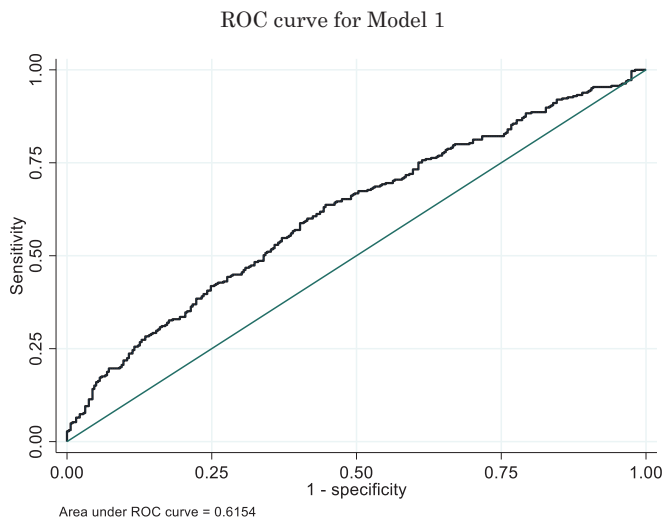
Source: the authors' own elaboration.

For Model 1, the percentage of accurate predictions was 0.589 (Count-R², Tab. 4). At the same time, its sensitivity was 60.92% and the specificity was 56.92% (Tab. 5). Thus, 198 companies that reached an agreement were correctly classified, and 181 entities that did not reach an agreement were also



correctly classified. Regarding the two types of errors (type I – false positive and type II – false negative), the model was wrong in 137 cases in predicting the value $\hat{Y} = 1$, while true was $Y = 0$ (43.08%). Additionally, in 127 cases Model 1 incorrectly classified observations predicting that $\hat{Y} = 0$, while true was $Y = 1$ (39.08%). Therefore, the accuracy of the analysed model was 58.94%, and the recall rate, as a positive predictive value, was 59.10%. As a consequence, the AUC for Model 1 was 0.6164 (Tab. 4, Graph 1).

Graph 1



Source: the authors' own elaboration.

Table 5

Classification table for Model 1

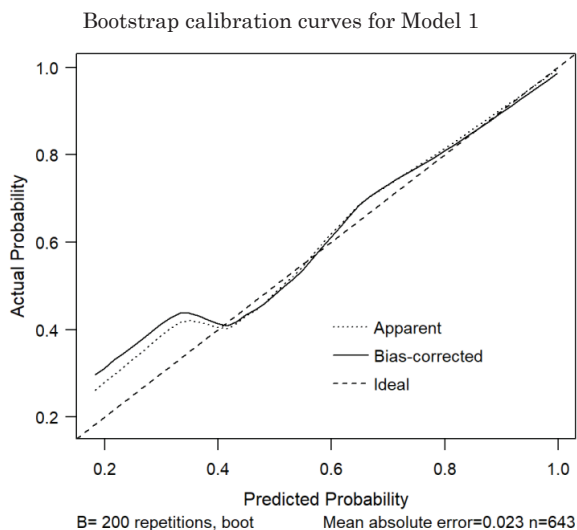
Classified	True		Total
	$D (Y = 1)$	$\sim D (Y = 0)$	
+ ($\hat{Y} = 1$)	198	137	335
- ($\hat{Y} = 0$)	127	181	308
Total	325	318	643
Classified + if predicted $\Pr(D) \geq 0.5$ True D defined as $Y = 1$			
Sensitivity		$\Pr(+ D)$	60.92%
Specificity		$\Pr(- \sim D)$	56.92%
Positive predictive value		$\Pr(D +)$	59.10%
Negative predictive value		$\Pr(\sim D -)$	58.77%
False + rate for true $\sim D$		$\Pr(+ \sim D)$	43.08%
False - rate for true D		$\Pr(- D)$	39.08%

False + rate for classified +	$\Pr(\sim D +)$	40.90%
False - rate for classified -	$\Pr(D -)$	41.23%
Correctly classified	58.94%	

Source: the authors' own elaboration.

Using 200 bootstrap replications, the validation of Model 1 showed it to be slightly overfitted (Tab. 6). The Brier Score was corrected a little and the Pseudo-R² dropped moderately. Moreover, the slope shrinkage factor (corrected Slope) is not troublesome, and the coefficients of Model 1 can be multiplied by 0.9003 for future applications. The calibration curves (Graph 2) of the predicted probability versus the probability calibrated with the bootstrap method indicate the good calibration of the probabilities derived from the model. It is also confirmed by the validated value of the intercept (it does not differ much from 0). The mean absolute error between the predicted and calibrated probabilities was 0.023.

Graph 2



Source: the authors' own elaboration.

Table 6

Results of the estimation of the validation of the predictive quality of Model 1 using the bootstrap method (200 repetitions)

Index	Original	Training sample	Testing sample	Optimism	Corrected
D _{xy}	0.2309	0.2369	0.2141	0.0228	0.2080
R ² Cragg-Uhler	0.0669	0.0725	0.0600	0.0125	0.0544



Table 6 (continued)

Brier Score	0.2385	0.2370	0.2406	-0.0036	0.2421
Intercept	0.0000	0.0000	-0.0047	0.0047	-0.0047
Slope	1.0000	1.0000	0.9003	0.0997	0.9003

Source: the authors' own elaboration.

V. CONCLUSIONS

The success of restructuring proceedings can be considered in legal and economic terms. In legal terms, a restructuring procedure can be considered successful when the debtor makes an arrangement with its creditors, and it is approved by the court. In economic terms, the success of the restructuring follows the execution of the arrangement. In some situations, even partial implementation of the arrangement is more beneficial to creditors than the satisfaction of claims in the course of liquidation proceedings. On the other hand, restructuring proceedings (especially those that are protracted due to multiple creditors, deficiencies or errors in documentation) can be detrimental to creditors. They should be discontinued as soon as the inability to restore economic viability is detected.

This paper attempted to identify the factors that affect a debtor's ability to enter into an arrangement with its creditors. As the processing of an application for the initiation of restructuring proceedings must be quick due to the need to protect the debtor's assets from bailiff enforcement, the use of the viability test is most relevant at the stage of the development of the restructuring plan. As Stef⁶⁰ stated, the content of a restructuring plan can determine the survival of a company. Therefore, the variables identified in our study can be used to create an easy-to-use model (for example, based on the logistic regression) for the restructuring advisors to accelerate discontinuance decisions. However, the viability test is not necessarily a one-off tool. The financial situation of an entity under restructuring is usually extremely dynamic and often the restructuring adviser, who acts as a supervisor or administrator, is faced with the task of giving an opinion on whether the proceedings should be continued or discontinued.

The study found that financial variables made little difference between the two groups of entities, although the *current ratio* and *return on assets* were among the statistically significant indicators. Debtors characterized by higher values of those indicators have a greater chance of successfully reaching an arrangement with their creditors. This is in line with 1) the study of Sinnadurai et al.,⁶¹ where the current ratio was the only financial variable with a significant coefficient in each of the 4 estimated corporate recovery prediction models for distressed Malaysian companies; 2) the research conducted by

⁶⁰ Stef (2023).

⁶¹ Sinnadurai et al. (2022).

Camacho-Miñano et al.⁶² and White and Casey,⁶³ where the return on assets was one of the key indicators used for assessing of probability of successful restructuring.

A positive relationship between the *company lifespan* and the success of the proceedings was also identified. Entities which have existed in the market longer are more likely to enter into an arrangement with creditors. This conclusion is consistent with the research on the recurrence of financial distress conducted by Zhou et al.⁶⁴ In addition, the *industry* in which the analysed companies operate plays an important role. Very similar conclusions were revealed by Camacho-Miñano et al.⁶⁵ Financial measures can vary between industries and caution should be exercised when building the so-called universal turnaround prediction models.

The authors are aware of the limitations of the conducted research, which result from the relatively short period in which the Restructuring Law has been in force in Poland. The identification of the explanatory variables as the approval of the arrangement by the court, rather than its implementation by the debtor, can also be justified in legal terms. The activities of the court supervisor include not only the drawing up of the restructuring plan and the preparation of the list of receivables but also, among other things, the evaluation of the arrangement proposals and the issuing of an opinion on the possibility of implementing the arrangement. According to Article 165 of the Restructuring Law in Poland, the court refuses to approve the arrangement if it is clear that it will not be implemented. Thus, an assessment of the debtor's ability to perform the arrangement is already included in the court's decision to approve the arrangement. Another limitation of the research is the assumption of the stationarity of the data. This was mainly due to the fact that there were numerous data gaps in financial statements of enterprises for the more extended periods preceding the decision to accept/reject the arrangement between the debtor and the creditors.

In the future, the authors intend to continue their research on developing tools to increase the effectiveness of restructuring proceedings through proper viability assessment. As more and more data are acquired: 1) attempts will be made to build a model where the measure of success will be implementing of the arrangement and not only its conclusion; 2) a multinomial logistic regression model, which will also include the so-called healthy companies, will be created; 3) the development of dynamic and sectoral models will be considered; 4) the impact of the war in Ukraine in the context of the identified variables will be analysed; and 5) the quantitative analysis will be supplemented by qualitative research concerning debtors, restructuring advisors and judges.

⁶² Camacho-Miñano et al. (2015).

⁶³ Casey (1986).

⁶⁴ Zhou et al. (2022).

⁶⁵ Camacho-Miñano et al. (2015).



References

- Ahmad, A.H., Abdullah, N.A.H., Mohd, K.N.T. (2022). Predicting restructuring outcomes of financially distressed firms in Malaysia. *International Journal of Economics and Management* 16(1): 107–118.
- Alaka, H.A., Oyedele, L.O., Owolabi, H.A., Kumar, V., Ajayi, S.O., Akinade, O.O., Bilal, M. (2018). Systematic review of bankruptcy prediction models: towards a framework for tool selection. *Expert Systems with Applications* 94: 164–184. <https://doi.org/10.1016/j.eswa.2017.10.040>
- Altman, E.I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance* 23(4): 589–609. <https://doi.org/10.1111/j.1540-6261.1968.tb00843.x>
- Antonowicz, P. (2007). *Metody oceny i prognoza kondycji ekonomiczno-finansowej przedsiębiorstw [Methods for Assessing and Forecasting the Economic and Financial Condition of Companies]*. Gdańsk: Ośrodek Doradztwa i Doskonalenia Kadr.
- Aziz, M.A., Dar, H.A. (2006). Predicting corporate bankruptcy: where we stand? *Corporate Governance* 6(1): 18–33. <https://doi.org/10.1108/14720700610649436>
- Bellovary, J.L., Giacomino, D.E., Akers, M.D. (2007). A review of bankruptcy prediction studies: 1930-present. *Journal of Financial Education* 33: 1–42.
- Binti, S., Ameer, R. (2010). Turnaround prediction of distressed companies: evidence from Malaysia. *Journal of Financial Reporting and Accounting* 8(2): 143–159. <https://doi.org/10.1108/19852511011088398>
- Boratyńska, K. (2011). Restrukturyzacja jako narzędzie realizacji planu naprawczego Polskiego Koncernu Mięsnego Duda SA [Restructuring as a Tool of Recovery Plan of Polski Koncern Mięsny Duda SA Realization]. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu* 172: 15–24.
- Borowiecki, R. (ed.) (1996). *Restrukturyzacja w procesie przekształceń i rozwoju przedsiębiorstw [Restructuring in Transformation and Development of Enterprises]*. Kraków: AE, TNOiK.
- Borowiecki, R. (1999a). Restrukturyzacja przedsiębiorstw – wnioski i zalecenia wynikające z doświadczeń polskich przedsiębiorstw [Restructuring of enterprises – conclusions and recommendations from the experience of Polish enterprise]. *Zeszyty Naukowe Akademii Ekonomicznej w Krakowie* 532: 5–10.
- Borowiecki, R. (ed.) (1999b). *Wyzwania rozwojowe a restrukturyzacja przedsiębiorstw [Development Challenges and Enterprise Restructuring]*. Warsaw, Kraków: AE, CECIOS, TNOiK.
- Borowiecki, R. (2010). Permanentna restrukturyzacja jako czynnik rozwoju i sukcesu przedsiębiorstw w dobie globalizacji rynku [Permanent restructuring as a factor in the success and development of businesses functioning on the global market]. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie* 836: 27–44.
- Borowiecki, R. (ed.) (2014). *Zarządzanie restrukturyzacją przedsiębiorstw i gospodarki. Uwarunkowania – procesy – efekty [Managing the Restructuring of Enterprises and the Economy: Determinants – Processes – Effect]*. Kraków: Fundacja Uniwersytetu Ekonomicznego.
- Borowiecki, R., Wysłocka, E. (2012). Analiza ekonomiczna i ocena ekspercka w procesie restrukturyzacji przedsiębiorstw [Economic Analysis and Expert Opinion in the Restructuring Process of Enterprises]. Warsaw: Difin.
- Breiman, L. (1992). The little bootstrap and other methods for dimensionality selection in regression: x-fixed prediction error. *Journal of the American Statistical Association* 87(419): 738–754. <https://doi.org/10.1080/01621459.1992.10475276>
- Camacho-Miñano, M.-del-M., Segovia-Vargas, M.J., Pascual-Ezama, D. (2015). Which characteristics predict the survival of insolvent firms? An SME reorganization prediction model. *Journal of Small Business Management* 53(2): 340–354. <https://doi.org/10.1111/jsbm.12076>
- Casey, C.J., Mcgee, V.E., Stickney, C.P. (1986). Discriminating between reorganized and liquidated firms in bankruptcy. *The Accounting Review* 61(2): 249–262.
- Coxe, S., West, S.G., Aiken, L.S. (2013). General linear models. In T.D. Little (ed.), *The Oxford Handbook of Quantitative Methods* (pp. 26–51). Oxford: Oxford University Press.
- Czerkas, K., Teisseyre, B. (2016). Restrukturyzacja zadłużenia przedsiębiorstw – od ugód bilateralnych do postępowań restrukturyzacyjnych i upadłościowych [Corporate Debt Restructuring

- From Bilateral Settlements to Restructuring and Bankruptcy Proceedings]. Gdańsk: Ośrodek Doradztwa i Doskonalenia Kadr.
- Deb, P., Norton, E.C., Manning, W.G. (2017). *Health Econometrics Using Stata*. Stata Press.
- Demétrio, C.G.B., Hinde, J., Moral, R.A. (2014). Models for overdispersed data in entomology. In C.P. Ferreira, W.A.C. Godoy (eds.), *Ecological Modelling Applied to Entomology* (pp. 219–259). Springer International Publishing. https://doi.org/10.1007/978-3-319-06877-0_9
- Dorozik, L. (ed.) (2006). *Restrukturyzacja ekonomiczna przedsiębiorstw [Economic Restructuring of Enterprises]*. Warsaw: Polskie Wydawnictwo Ekonomiczne.
- Ekstrom, C.T. (2011). *The R Primer*. Boca Raton: CRC Taylor & Francis Group. <https://doi.org/10.1201/b11150>
- Ekstrom, C.T. (2016). *The R Primer*, second edition. Boca Raton: CRC Taylor & Francis Group.
- Gabruszewicz, W. (1999). Restrukturyzacja i metody oceny jej efektów [Restructuring and methods to evaluate its effects]. *Przegląd Organizacji* 3: 26–29.
- Gajdka, J., Stos, D. (1996). Wykorzystanie analizy dyskryminacyjnej w ocenie kondycji finansowej przedsiębiorstw [Use of discriminant analysis in assessing the financial condition of enterprises]. W: R. Borowiecki (eds.), *Restrukturyzacja w procesie przekształceń i rozwoju przedsiębiorstw [Restructuring in Transformation and Development of Enterprises]* (pp. 59–63). Kraków: Wydawnictwo Akademii Ekonomicznej w Krakowie.
- Garrido, J., DeLong, C., Rasekh, A., Rosh, A. (2021). Restructuring and Insolvency in Europe: Policy Options in the Implementation of the EU Directive. *IMF Working Papers*, 2021(152). <https://doi.org/10.5089/9781513573595.001>
- Glinkowska, B. (2015). Restrukturyzacja firm wchodzących na rynki zagraniczne [Restructuring of companies entering foreign markets]. W: P. Kuźbik, M.J. Szymankiewicz (ed.), *Zarządzanie organizacją z perspektywy metodologicznej. Wybrane zagadnienia [Organization Management from a Methodological Perspective: Selected Issues]* (pp. 177–185). Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
- Grudzewski, W.M., Hejduk, I.K. (2000). Restrukturyzacja firmy jako kierunek wzrostu jej wartości [Restructuring of a firm as a direction of value based management]. *Annales Universitatis Mariae Curie-Skłodowska. Sectio H. Oeconomia* 34: 25–57.
- Gruszczyński, M. (2003). Modele mikroekonometrii w analizie i prognozowaniu zagrożenia finansowego przedsiębiorstw [Microeconometrics models in the analysis and forecasting of corporate financial risk]. *Zeszyty Polskiej Akademii Nauk* 23.
- Gujarati, D. (2011). *Econometrics by Example*. Palgrave Macmillan.
- Hadasik, D. (1998). Upadłość przedsiębiorstw w Polsce i metody jej prognozowania [Corporate Bankruptcy in Poland and Methods for Its Forecasting]. *Zeszyt* 153. Poznań: Wydawnictwo Akademii Ekonomicznej w Poznaniu.
- Hamrol, M., Czajka, B., Piechocki, M. (2004). Upadłość przedsiębiorstwa – model analizy dyskryminacyjnej [Enterprise bankruptcy – a discriminant analysis model]. *Przegląd Organizacji* 6: 35–39. <https://doi.org/10.33141/po.2004.06.09>
- Harrell, F.E. (2015). *Regression Modeling Strategies*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-19425-7>
- Herman, S. (2021). Is it worth to restructuring? Analysis of companies in poor financial condition in Poland. *Wiadomości Statystyczne / The Polish Statistician* 66(6): 7–26. <https://doi.org/10.5604/01.3001.0014.9701>
- Hilbe, J.M. (2009). *Logistic Regression Models*. Chapman and Hall/CRC. <https://doi.org/10.1201/9781420075779>
- Holda, A. (2001). Prognozowanie bankructwa jednostki w warunkach gospodarki polskiej z wykorzystaniem funkcji dyskryminacyjnej Z_H [Corporate bankruptcy prediction in the Polish economy using the discriminant function Z_H]. *Rachunkowość* 5: 306–310.
- Jones, A. (2007). *Applied Econometrics for Health Economists: A Practical Guide*. 2nd edn. Redcliffe Publishing.
- Jostarndt, P., Sautner, Z. (2010). Out-of-court restructuring versus formal bankruptcy in a non-interventionist bankruptcy setting. *Review of Finance* 14(4): 623–668. <https://doi.org/10.1093/rof/rfp022>
- Kałowski, A. (2012). Kierunki procesów restrukturyzacji przedsiębiorstw w kryzysie [Directions of corporate restructuring processes in crisis]. *Kwartalnik Nauk o Przedsiębiorstwie* 3: 42–47.



- Kim, M., Kim, M., McNeil, R. (2008). Predicting survival prospect of corporate restructuring in Korea. *Applied Economics Letters* 15(15): 1187–1190. <https://doi.org/10.1080/13504850601018080>
- Kleinbaum, D.G., Klein, M. (2010). *Logistic Regression: A Self-Learning. (Statistic for Biology and Health)*. 3rd edn. Springer.
- Kovacova, M., Kliestik, T., Valaskova, K., Durana, P., Juhaszova, Z. (2019). Systematic review of variables applied in bankruptcy prediction models of Visegrad group countries. *Oeconomia Copernicana* 10(4): 743–772. <https://doi.org/10.24136/oc.2019.034>
- Laitinen, E.K. (2008). Data system for assessing probability of failure in SME reorganization. *Industrial Management & Data Systems* 108(7): 849–866. <https://doi.org/10.1108/02635570810897964>
- Laitinen, E.K. (2011). Assessing viability of Finnish reorganization and bankruptcy firms. *European Journal of Law and Economics* 31(2): 167–198. <https://doi.org/10.1007/s10657-009-9136-4>
- Lemerle, M., Kuhnathan, A., Duthoit, A., Péresse, G., Saada, L., Jakobson E.H. (2022). *Global Insolvency Report. Growing Risks and Uneven State Support*. https://www.allianz-trade.com/content/dam/onemarketing/aztrade/allianz-trade_com/en_gl/erd/publications/pdf/2022_05_18_Insolvency-Report.pdf
- Li, H., Chen, Q., Hong, L., Zhou, Q. (2019). Asset restructuring performance prediction for failure firms. *Journal of Corporate Accounting & Finance* 30(4): 25–42. <https://doi.org/10.1002/jcaf.22409>
- Linna, T. (2020). Business Sustainability and Insolvency Proceedings – The EU Perspective. *Journal of Sustainability Research* 2(2):e200019. <https://doi.org/10.20900/jsr20200019>
- Long, J.S., Freese, J. (2014). *Regression Models for Categorical Dependent Variables Using Stata*. 3rd edn. Stata Press.
- Lukason, O., Urbanik, A. (2013). Why reorganization of firms fails: evidence from Estonia. *Estonian Discussions on Economic Policy* 21(1): 73–84.
- Mączyńska, E. (1994). Ocena kondycji przedsiębiorstwa. Uproszczone metody [Assessing enterprise condition: simplified methods]. *Zycie Gospodarcze* 38: 42–45.
- Mączyńska, E. (2001). Restrukturyzacja przedsiębiorstw w procesie transformacji gospodarki polskiej [Restructuring of Enterprises in the Transformation Process of the Polish Economy]. Vol. 1–2. DiG.
- Mączyńska, E. (2004). Systemy wczesnego ostrzegania [Early warning systems]. *Nowe Życie Gospodarcze* 12(373): 4–9.
- McCormack, G., Keay, A., Brown, S., Dahlgreen, J. (2016). *Study on a New Approach to Business Failure and Insolvency Comparative Legal Analysis of the Member States' Relevant Provisions and Practices*. University of Leeds.
- Morawska, S., Prusak, B., Banasik, P., Pustulka, K., Groele, B. (2020). Bankruptcy law severity for debtors: comparative analysis among selected countries. *European Research Studies Journal* 23(2, Special issue): 659–686.
- Nowak, J., Zarzecki, D. (2012). Perspektywa finansowa restrukturyzacji z elementami prognozowania upadłości przedsiębiorstw [A Financial Perspective on Restructuring with Elements of Corporate Bankruptcy Forecasting]. Warsaw: Difin.
- Ohri, A. (2019). *SAS for R Users*. Wiley. <https://doi.org/10.1002/9781119256441>.
- Porada-Rochoń, M. (2018). Zaburzenia finansowe a restrukturyzacja finansowa przedsiębiorstw – determinanty i skutki [Financial distress and financial restructuring of companies – determinants and consequences]. *Contemporary Economy* 9(1): 23–33. <https://doi.org/10.26881/wg.2018.1.03>
- Poston, K.M., Harmon, K., Gramlich, J.D. (1994). A test of financial ratios as predictors of turnaround versus failure among financially distressed firms. *Journal of Applied Business Research (JABR)* 10(1): 41–56. <https://doi.org/10.19030/jabr.v10i1.5962>
- Pregibon, D. (1980). Goodness of link tests for generalized linear models. *Applied Statistics* 29(1): 15–24. <https://doi.org/10.2307/2346405>
- Prusak, B. (2005). *Nowoczesne metody prognozowania zagrożenia finansowego przedsiębiorstw [Modern Methods of Forecasting Financial risk of Enterprises]*. Warsaw: Difin.



- Prusak, B. (2018). Review of research into enterprise bankruptcy prediction in selected Central and Eastern European countries. *International Journal of Financial Studies* 6(3). <https://doi.org/10.3390/ijfs6030060>
- Prusak, B., Galiński, P. (2021). Approval of an arrangement in the restructuring proceedings and the financial condition of companies listed on the Stock Exchanges in Warsaw. Is there any relationship? *Journal of Risk and Financial Management* 14(11). <https://doi.org/10.3390/jrfm14110523>
- Prusak, B., Morawska, S., Łukowski, M., Banasik, P. (2022). The impact of bankruptcy regimes on entrepreneurship and innovation. Is there any relationship? *International Entrepreneurship and Management Journal* 18(1): 479–498. <https://doi.org/10.1007/s11365-021-00773-3>
- Rochoń, M. (2009). Restrukturyzacja przedsiębiorstw w procesie adaptacji do współczesnego otoczenia. Perspektywa międzynarodowa [Corporate Restructuring in the Process of Adaptation to the Contemporary Environment: An International Perspective]. Warsaw: Difin.
- Rousseeuw, P.J., Leroy, A.M. (1987). *Robust Regression and Outlier Detection*. John Wiley & Sons.
- Sinnadurai, P., Ismail, N., Haji-Abdullah, N.M. (2022). Prediction of corporate recovery in Malaysia. *Review of Quantitative Finance and Accounting* 59(4): 1303–1334. <https://doi.org/10.1007/s11156-022-01076-6>
- Srinivasan, R., Lohith, C.P. (2017). *Strategic Marketing and Innovation for Indian MSMEs*. Springer Singapore.
- Stef, N. (2023). Bankruptcy voting process and corporate reorganization. *Bulletin of Economic Research* 75(2): 58–524. <https://doi.org/10.1111/boer.12368>
- Steyerberg, E.W. (2019). *Clinical Prediction Models (Second Edition)*. Springer International Publishing.
- Suszyński, C. (2003). Restrukturyzacja, konsolidacja, globalizacja przedsiębiorstw [Restructuring, Consolidation, Globalisation of Companies]. Warsaw: Polskie Wydawnictwo Ekonomiczne.
- Tajti, T. (2018). Bankruptcy stigma and the second chance policy: the impact of bankruptcy stigma on business restructurings in China, Europe and the United States. *China-EU Law Journal* 6(1/2): 1–31.
- Tsioli, L. (2021). Viability assessment in corporate debt restructuring: optimizing the filtration effect of the European Directive on restructuring and insolvency. *Norton Journal of Bankruptcy Law and Practice* 30(5): 397–447.
- Veganzones, D., Severin, E. (2021). Corporate failure prediction models in the twenty-first century: a review. *European Business Review* 33(2): 204–226. <https://doi.org/10.1108/EBR-12-2018-0209>
- Walton, P., Umfreville, C., Jacobs, L. (2020). A snapshot of company voluntary arrangements: Success, failure and proposals for reform. *International Insolvency Review* 29(2): 267–284. <https://doi.org/10.1002/iir.1381>
- Włodarczak, P. (2019). *Machine Learning and its Applications*. CRC Press.
- Xie, B. (2016). *Comparative Insolvency Law: The Pre-Pack Approach in Corporate Rescue*. Edward Elgar Publishing.
- Zaremba, U. (2021). Restrukturyzacja sądowa a upadłość przedsiębiorstw w Polsce [Court restructuring and insolvency of companies in Poland]. Rzeszów: Oficyna Wydawnicza Aspra, WSIiZ w Rzeszowie.
- Zhou, F., Fu, L., Li, Z., Xu, J. (2022). The recurrence of financial distress: a survival analysis. *International Journal of Forecasting* 38(3): 1100–1115. <https://doi.org/10.1016/j.ijforecast.2021.12.005>



