

## **APPLICATION OF MULTIVARIATE DISCRIMINANT ANALYSIS FOR PREDICTION OF BANKRUPTCY OF SELECTED CONSTRUCTION AND DEVELOPMENT COMPANIES**

**Monika Zielińska-Sitkiewicz**

Department of Econometrics and Statistics  
Warsaw University of Life Sciences – SGGW  
e-mail: monika\_zielinska\_sitkiewicz@sggw.pl

**Abstract:** Functioning of the company in the conditions of the free market competition depends on its flexible reactions to changes and the response speed to perturbations in the unstable economy. Entities, which are not able to keep up with the current changes, enter the path of crisis in the company, which last stage may be the bankruptcy. The paper presents an attempt to use and evaluate five Polish models of the multivariate discriminant analysis in forecasting the threat of bankruptcy. The analysis was conducted for the years 2008 – 2013. For the study there were selected 10 construction and real estate development companies, listed on the main market of the Warsaw Stock Exchange, which profit and loss account is made in the calculation model and for which in the years 2012-2014 there were initiated the bankruptcy proceedings.

**Keywords:** Polish real estate market, construction company, financial ratios, discriminant analysis

### **INTRODUCTION**

The variability of the economic environment and the increase of the competition on the market makes the assessment of the economic condition the key element of the management process in the company. In addition, the reliable information about the companies “building” the Polish residential market is of fundamental importance for the security of relations between the participants of the real estate market and the mutual trust of all its participants.

However, maintaining a stable financial situation of construction and real estate development companies may sometimes be more difficult due to the nature of their activities, which feature a long process of the construction investment.

Recent data indicate that in 2013 213 construction companies went bankrupt. This means the decrease of 2,3% compared to the previous year. However, this is still almost four times more bankruptcies than in 2008. (cf. Table 1)

The collapse of the construction market from 2012 moved to 2013. Many companies, which did not manage to obtain the sufficient number of orders and get financing for their implementation ceased their activities. A lot of companies of the sector are still facing the liquidity problems. The additional problem is still the small amount of new investments, what inhibits the growth of companies, enhances the competitive struggle and pressure on margins. Experts predict that 2014 may bring some recovery in the industry, but so far, in the ongoing year, construction companies are still responsible for every fourth bankruptcy in the Polish economy.

Table 1. Figures concerning the bankruptcy in construction

Year	Construction companies	Share in the total number of bankruptcies	Companies serving the real estate market
2013	213	24,1 %	16
2012	218	24,9 %	37
2011	143	19,8 %	28
2010	98	15,0 %	12
2009	82	11,9 %	14
2008	59	14,3 %	6

Source: Coface report on bankruptcies of companies in Poland in 2013

Bankruptcy of companies may be considered both in the economic and legal aspect.

From the economic point of view, bankruptcy of the company means that it is not able to independently continue the activity without outside help. The company may be in a critical condition but still this is not revealed in financial data.

In legal terms, bankruptcy is determined in court. It is a procedure introduced in order to satisfy claims, in case of insolvency of the debtor and addressed to his whole property. Bankruptcy proceedings are conducted under systemic or liquidation bankruptcy. Systemic bankruptcy is to restructure the company and to conclude an arrangement with creditors. The consequence of the liquidation bankruptcy is the sale of the assets of the bankrupt company and the satisfaction of creditors from thus obtained assets.

## PURPOSE AND DESCRIPTION OF THE STUDY

The purpose of the article is the attempt to use and evaluate some Polish models based on the discriminant analysis in the field of forecasting the threat of bankruptcy of 10 selected construction and real estate development companies,

listed on the main market of the Warsaw Stock Exchange, which profit and loss account is made by the calculation model. The analysis was conducted for the years of 2008 – 2013.

For the study there were selected companies: ABM SOLID S.A., ALTERCO S.A., BUDOPOL-WROCŁAW S.A., DSS S.A., ENERGMONTAŻ-POŁUDNIE S.A., GANT S.A., PBG S.A., HYDROBUDOWA POLSKA S.A., INTAKUS S.A., POLIMEX MOSTOSTAL S.A. and PBG S.A. towards which in the years 2012-2014 there were initiated the bankruptcy proceedings. (cf. Table 2)

Table 2. Information concerning the bankruptcy proceedings in the studied companies

Company	Bankruptcy proceeding
ABM SOLID	from 6.09.2012 – systematic bankruptcy from, 13.09.2012 – liquidation bankruptcy from 3.04.2013 – systematic bankruptcy again
ALTERCO	from 27.11.2012 – systematic bankruptcy from 22.02.2013 – cancellation of bankruptcy proceedings May 2014 – submission of the creditor's petition for liquidation bankruptcy
BUDOPOL-WROCŁAW	from 6.09.2012 – systematic bankruptcy from 30.07.2014 – liquidation bankruptcy
DSS	from 17.04.2012 – liquidation bankruptcy from 29.06.2012 – systematic bankruptcy
ENERGMONTAŻ- POŁUDNIE	from 26.01.2013 – systematic bankruptcy from 28.08.2013 – liquidation bankruptcy
GANT	from 2.01.2014 – systematic bankruptcy from 7.07.2014 – liquidation bankruptcy
HYDROBUDOWA POLSKA	from 22.06.2012 – systematic bankruptcy from 1.10.2013 – liquidation bankruptcy
INTAKUS	from 8.05.2012 – systematic bankruptcy
POLIMEXMS	from 10.2012 creditors submit petitions for liquidation bankruptcy
PBG	from 13.06.2012 – systematic bankruptcy

Source: Stock Exchange reports

The study used five discriminant models with the greatest ability to predict bankruptcy. The presented methods have been developed for the Polish market and selected based on the ranking of Z-score models created by P. Antonowicz.

The first place in the ranking was taken by the model of  $Z_7$  INE PAN, which best predicts the bankruptcy with the average prognosis efficiency of 94,82% and the error of 5,18%. The second place was occupied by the model of  $Z_6$  INE PAN with a slightly lower average of the prognosis efficiency of 94,20% and the error of 5,80%. Both models were created in the Institute of Economics PAN under the direction of E. Mączyńska.

Financial indicators used for the construction of both functions have the form of:

- $X_1$  = operational result/value of assets,
- $X_2$  = value of equity/value of assets,
- $X_3$  = (net result + depreciation)/total liabilities,
- $X_4$  = current assets/short-term liabilities,
- $X_5$  = sales revenue/value of assets.

The discriminant function of the  $Z_{7 \text{ INE PAN}}$  model used the group of first four variables and it is presented by the equation:

$$Z_{7 \text{ INE PAN}} = -1,498 + 9,498 \cdot X_1 + 3,566 \cdot X_2 + 2,903 \cdot X_3 + 0,452 \cdot X_4 \quad (1)$$

The form of the  $Z_{6 \text{ INE PAN}}$  model used all five indicators:

$$Z_{6 \text{ INE PAN}} = -2,478 + 9,478 \cdot X_1 + 3,613 \cdot X_2 + 3,246 \cdot X_3 + 0,455 \cdot X_4 + 0,802 \cdot X_5 \quad (2)$$

Entities with values for both discriminant functions above zero ( $Z_{[7 \text{ and } 6 \text{ INE PAN}]} > 0$ ) are determined as those not at risk of bankruptcy. While companies for which the results take the values not greater than zero ( $Z_{[7 \text{ and } 6 \text{ INE PAN}]} \leq 0$ ), are the companies at risk of bankruptcy in the perspective of 1 year. [Mączyńska 2006]

The Poznan model developed by three authors: M. Hamrol, B. Czajka and M. Piechocki took the third place in the ranking of P. Antonowicz, with an average prognosis efficiency of 93,78% and the error of 6,22%. The model used four financial indicators:

- $X_1$  = net financial result/total assets,
- $X_2$  = (current assets – inventories)/short-term liabilities,
- $X_3$  = fixed capital/ total assets,
- $X_4$  = sales financial result/sales incomes.

When interpreting the discriminant function:

$$Z_{\text{HCP}} = -2,368 + 3,562 \cdot X_1 + 1,588 \cdot X_2 + 4,288 \cdot X_3 + 6,719 \cdot X_4 \quad (3)$$

we should be based on the following principles:  $Z_{\text{HCP}} \leq 0$  is a company at risk of bankruptcy in the perspective of 1 year, and when  $Z_{\text{HCP}} > 0$  the company is not at risk of bankruptcy.

The fourth and fifth places in the ranking of P. Antonowicz were occupied by two models of B. Prusak:  $Z_{\text{BP1}}$  and  $Z_{\text{BP2}}$ . The first model predicts the bankruptcy for a year ahead, with an average prognosis efficiency of 92,52% and its error of 7,48%. The second function allows you to extrapolate bankruptcy two years in advance, with an average prognosis efficiency of 91,82% with the error of 8,19%.

$Z_{\text{BP1}}$  model uses four financial indicators:

- $X_1$  = results from the operational activity/average value of the balance sum,
- $X_2$  = operating expenses (without other operating expenses)/short-term liabilities (without special funds and financial liabilities),
- $X_3$  = current assets/short-term liabilities,
- $X_4$  = result from the operating activity/net incomes from sales,

and is expressed by the formula:

$$Z_{\text{BP1}} = -1,5685 + 6,5245 \cdot X_1 + 0,1480 \cdot X_2 + 0,4061 \cdot X_3 + 2,1754 \cdot X_4 \quad (4)$$

Making the correct interpretation of results of the function  $Z_{\text{BP1}}$  is possible based on the certain boundary values:

- $Z_{\text{BP1}} > 0,65$  company unthreatened by bankruptcy,
- $Z_{\text{BP1}} < (-0,13)$  company threatened by bankruptcy in the perspective of 1 year,
- $Z_{\text{BP1}} \in < -0,13; 0,65 >$  area of uncertainty, so-called “gray area”,
- Cut-off point = (-0,13)

The  $Z_{BP2}$  function used three financial indicators:

$X_1$  = (net results + depreciation)/total liabilities,

$X_2$  = operating expenses/short-term liabilities,

$X_3$  = sales profit/balance sum.

Linear discriminatory model estimated on their basis adopted the following form:

$$Z_{BP2} = -1,8713 + 1,4383 \cdot X_1 + 0,1878 \cdot X_2 + 5,0229 \cdot X_3 \quad (5)$$

Function interpretations are performed based on the following criteria:

$Z_{BP2} > 0,2$  company not threatened by bankruptcy

$Z_{BP2} < (-0,7)$  company threatened by bankruptcy in the perspective of 2 years

$Z_{BP2} \in < -0,7; 0,2 >$  area of uncertainty, that is the "gray area"

Cut-off point = (-0,295). [Antonowicz 2007 p. 61-62]

Based on data from the financial statements of the studied companies there were determined values of discriminant functions for the years of 2008-2013. Then, in accordance with the rules of interpreting the values of individual models, there was performed the assessment of the threat of bankruptcy.

## RESEARCH RESULTS

In tables numbered from 3 to 12 there are presented results of the discriminant analysis for all studied companies. There were adopted the following labelling according to the appropriate criteria determined for particular studied models:

	- a company not threatened by bankruptcy
	- a company in a situation of uncertainty (grey area)
	- a company at risk of bankruptcy

The results of the discriminant analysis for the ABM SOLID S.A. company were presented in table 3. After a period of moderate gains in the years of 2008-2010, in 2011 the company started to generate losses of PLN 47 million, and in 2012 of PLN 185 million. Since 2012 against the company there has been conducted the bankruptcy proceeding.

Table 3. Results of early warning models for the ABM SOLID company

MODEL	2013	2012	2011	2010	2009	2008
$Z_7$ INE PAN	-5,2624	-12,3315	-2,1561	0,4269	1,0091	1,4180
$Z_6$ INE PAN	-5,6893	-12,7279	-1,9318	0,5043	1,2724	1,6780
$Z_{HCP}$	-5,8043	-8,3755	-1,0285	1,4160	1,6308	2,9453
$Z_{BP1}$	-1,3648	-6,2366	-1,4542	-0,1400	-0,0211	0,4608
$Z_{BP2}$	-1,6151	-2,6230	-1,6218	-0,7921	-0,4845	-0,3315

Source : own calculations

$Z_{BP1}$  and  $Z_{BP2}$  models already since 2010 have shown the risk of bankruptcy of the company, and since 2008 the uncertainty regarding the bankruptcy prognosis. Other functions alarmed the bankruptcy since 2011. In the years of

2008-2010 both PAN models and the Poznan model indicated the lack of risk of bankruptcy in the perspective of one year.

Table 4 presented the results of the discriminant analysis for the ALTERCO S.A. company. This company since 2011 has had serious problems with the financial liquidity, as evidenced by the petitions for bankruptcy submitted by creditors in the years of 2011 and 2012. The paradoxical situation in case of this company is the fact of redemption for bankruptcy in February 2013 due to the lack of resources in the company to conduct the bankruptcy proceedings.

Only the  $Z_{BP2}$  function already since 2008 has signalled troubles of this company. Rother models detected the threat of bankruptcy in 2012, with a single warning alarm in 2009 of the  $Z_{BP1}$  function.

Table 4. Results of early warning models for the ALTERCO company

MODEL	2013	2012	2011	2010	2009	2008
$Z_7$ INE PAN	-12,5324	-28,1509	3,2807	4,0611	2,6761	0,7448
$Z_6$ INE PAN	-13,6010	-29,3803	2,5675	3,4879	1,8123	0,0879
$Z_{HCP}$	-10,2503	-15,1740	9,8822	7,6251	10,8209	3,3866
$Z_{BP1}$	-9,5842	-18,0824	1,7851	0,7899	-29,6340	<sup>1</sup>
$Z_{BP2}$	-1,9412	-3,8294	-1,2558	-0,5927	-1,5413	-1,1630

Source : own calculations

The company BUDOPOL-WROCLAW (dominant shareholder is the development company GANT) in 2012 reported a dramatic increase in financial expenses, caused by losses on financial assets, what was probably connected with the reckless financial policy of the company. In September 2012 the court issued a decision declaring the bankruptcy of the company with the possibility of an arrangement. Table 5 illustrates the results of the discriminant analysis for the BUDOPOL-WROCLAW company. The most vulnerable were the  $Z_{BP1}$  and  $Z_{BP2}$  models, which already in, respectively, 2009 and 2008 have signalled the deterioration of the company's situation, which in the years of 2008-2011 reached good financial results. All functions have alerted the thread of bankruptcy in 2012.

Table 5. Results of early warning models for the BUDOPOL-WROCLAW company

MODEL	2013	2012	2011	2010	2009	2008
$Z_7$ INE PAN	-5,2054	-4,1476	2,2514	2,0400	2,6573	2,9321
$Z_6$ INE PAN	-6,0225	-4,5021	2,3929	2,2345	2,5056	3,3915
$Z_{HCP}$	0,5692	-0,8568	3,7873	2,9147	5,8204	5,1536
$Z_{BP1}$	-5,6527	-2,4355	0,4827	-0,0399	0,1708	0,9987
$Z_{BP2}$	-1,6777	-2,2258	-0,6646	-0,5447	-0,7385	-0,0593

Source : own calculations

<sup>1</sup> The financial statements of the company have been prepared according to IFRS since 2009, what means that the earliest data relate to 2008. The  $Z_{BP1}$  model refers to the average balance sum of the current and previous year. The result is the lack of capacity to perform function calculations for 2008, due to referring to data from 2007.

The company of Lower Silesian Rock Raw Materials (Dolnośląskie Surowce Skalne) (DSS) in the years of 2008 - 2013 was experiencing losses of a few to even several hundred (in 2011) millions of zlotys. The consequence of poor financial results was the company's bankruptcy announced by the court in 2012. (cf. Table 2)

Almost all analysed discriminant functions paid attention to the risk of the DSS company's bankruptcy already since 2008. Only the Poznan model  $Z_{HCP}$  in the years of 2009-2010 estimated the company positively. (cf. Table 6)

Table 6. Results of early warning models for the DSS company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7\text{ INE PAN}}$	-14,4024	-6,2103	-10,7606	-0,2150	-0,5554	-0,3671
$Z_{6\text{ INE PAN}}$	-15,1875	-7,0201	-11,0610	-1,0164	-1,2899	-1,2407
$Z_{HCP}$	-14,3441	-6,4193	-7,3586	0,5936	4,1502	4,7984
$Z_{BP1}$	-5,4356	-1,3858	-6,5406	-1,3620	-1,5417	- <sup>2</sup>
$Z_{BP2}$	-1,9502	-1,5122	-3,0377	-1,6517	-0,9343	-1,4563

Source: own calculations

The ENERGMONTAŻ-POŁUDNIE company since 2009 has generated several million negative financial results, so that in 2012 to register the highest loss of PLN 345 million. Crisis in the whole construction industry resulted in the company's trouble, towards which in January 2013 there was initiated the bankruptcy proceeding. (cf. Table 2)

Indices  $Z_{6\text{ INE PAN}}$  and  $Z_{BP1}$  indicated the threat of bankruptcy of the ENERGMONTAŻ-POŁUDNIE company since 2009. The  $Z_{BP2}$  model has signalled bankruptcy since 2008, the  $Z_{7\text{ INE PAN}}$  function since 2011, and the  $Z_{HCP}$  index has maintained optimism the longest alarming the threat only since 2012. (cf. Table 7)

Table 7. Results of early warning models for the ENERGMONTAŻ-POŁUDNIE company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7\text{ INE PAN}}$	-22,5409	-46,4777	-0,7148	0,1856	0,3268	1,4937
$Z_{6\text{ INE PAN}}$	-23,3026	-45,9320	-1,0072	-0,1115	-0,1733	1,1900
$Z_{HCP}$	-24,9915	-27,9479	0,4686	1,7352	2,8325	2,6186
$Z_{BP1}$	-6,1621	-13,2109	-1,1211	-0,7814	-0,6905	0,2889
$Z_{BP2}$	-2,6538	-6,7029	-1,4299	-1,2798	-1,2265	-0,8358

Source: own calculations

<sup>2</sup> Compare footnote 1

GANT is a large real estate development company, building, among others, by own forces using the acquired construction companies, e.g., BUDOPOL-WROCŁAW.

In the years of 2010-2012 the company recorded an impressive increase in sales revenues (by 158 % in 2012 in relation to 2010). However, at the same time, cost of sales increased by 194 % and the company updated the value of inventories, financial assets and investment properties, what resulted in the enormous loss in the amount of PLN 450 million in 2012. The year 2013 was closed by the developer with the loss of PLN 71 million, and at the beginning of 2014 declared bankruptcy.

Table 8 shows the results of the discriminant analysis for the GANT company. First three models  $Z_{7 \text{ INE PAN}}$ ,  $Z_{6 \text{ INE PAN}}$  and  $Z_{\text{HCP}}$  indicated the bankruptcy threat since 2012. The  $Z_{\text{BP1}}$  function already in the years of 2010-2011 paid attention to the deterioration of the developer's situation, and the  $Z_{\text{BP2}}$  index signalled bankruptcy in the perspective of two years already since 2008. (cf. Table 8)

Table 8. Results of early warning models for the GANT company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7 \text{ INE PAN}}$	-0,4459	-4,5500	1,2210	1,3963	2,3408	2,4447
$Z_{6 \text{ INE PAN}}$	-1,2981	-5,3876	0,4252	0,5405	1,6639	1,7163
$Z_{\text{HCP}}$	-0,8761	-1,8726	1,3616	1,8282	3,4493	4,6081
$Z_{\text{BP1}}$	-0,5380	-3,3542	0,3355	0,2888	1,1762	1,1533
$Z_{\text{BP2}}$	-1,9007	-2,5806	-1,6312	-1,6894	-1,0950	-1,1316

Source: own calculations

The HB POLSKA company in the years of 2008-2011 achieved the net incomes from sales of PLN 1,5 billion and the profit in the range from PLN 45 to 113 million. In 2012 the company reduced the incomes only to PLN 61 million and recorded a gigantic loss of PLN 1 190 million. This resulted in the transition of the company in 2012 into bankruptcy.

Table 9. Results of early warning models for the HB POLSKA company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7 \text{ INE PAN}}$	- <sup>3</sup>	-28,0780	0,3434	0,5189	1,0554	0,4066
$Z_{6 \text{ INE PAN}}$	-	-29,2816	0,2551	0,4549	1,0446	0,2827
$Z_{\text{HCP}}$	-	-98,8002	1,0695	1,2662	1,7199	1,3777
$Z_{\text{BP1}}$	-	-46,8762	-0,4019	-0,3712	0,0124	0,1331
$Z_{\text{BP2}}$	-	-10,0113	-1,3132	-1,1858	-0,8598	-0,9888

Source: own calculations

<sup>3</sup> 28.03.2013 r. WSE withdraw from trading shares of the company HYDROBUDOWA POLAND SA and the company has been exempted from the requirement to publish financial statements.



The  $Z_{7\text{ INE PAN}}$ ,  $Z_{6\text{ INE PAN}}$  and  $Z_{\text{HCP}}$  functions signalled the bankruptcy threat only in the bankruptcy year of the company. The  $Z_{\text{BP1}}$  function since 2010 paid attention to the bankruptcy threat in the perspective of one year, and the  $Z_{\text{BP2}}$  model indicated this threat in the perspective of two years already in 2008. (cf. Table 9)

The INTAKUS company has clearly reduced its incomes in the years of 2010 – 2013 from the level of PLN 64 million to PLN 12 million. From 2011 to 2013 the company has constantly generated losses of several million zlotys, resulting in the declaration of bankruptcy in 2012.

The  $Z_{\text{HCP}}$  model as the only one in the years of 2008-2013 did not indicate the company's problems. The functions of  $Z_{7\text{ INE PAN}}$ ,  $Z_{6\text{ INE PAN}}$  and  $Z_{\text{BP1}}$  signalled the bankruptcy threat in the perspective of one year since 2011, and the  $Z_{\text{BP2}}$  index predicted this risk in the perspective of two years already since 2008. (cf. Table 10)

Table 10. Results of early warning models for the INTAKUS company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7\text{ INE PAN}}$	-1,6259	-2,3484	-2,5836	1,0894	0,8696	1,2004
$Z_{6\text{ INE PAN}}$	-2,5435	-3,1925	-3,3417	0,4543	0,1143	0,6217
$Z_{\text{HCP}}$	2,2978	0,0614	0,1972	4,8850	4,3951	3,7916
$Z_{\text{BP1}}$	-2,7001	-2,4348	-2,4890	0,5469	0,3066	<sup>-4</sup>
$Z_{\text{BP2}}$	-1,6038	-1,9065	-1,9645	-0,9239	-1,1991	-0,8836

Source: own calculations

The POLIMEX MOSTOSTAL company in the years of 2008-2011 achieved net incomes from sales of PLN 4-5 billion and the profit of PLN 102 to 175 million. In 2012 the company still achieved incomes at the level of PLN 4 billion but recorded a gigantic loss of PLN 1244 million. In 2013 the company has reduced its incomes to PLN 2 billion, but it has also reduced the loss to PLN 261 million. Despite this, its creditors since October 2012 has been systematically submitting motions to declare the liquidation bankruptcy of the company.

The  $Z_{7\text{ INE PAN}}$ ,  $Z_{6\text{ INE PAN}}$  and  $Z_{\text{HCP}}$  models paid attention to the bankruptcy threat of the company since 2012. The  $Z_{\text{BP1}}$  function since 2011 has signalled the bankruptcy risk, and the  $Z_{\text{BP2}}$  model alarmed troubles in the perspective of two years already since 2008. (cf. Table 11)

Table 11. Results of early warning models for the POLIMEX MOSTOSTAL company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7\text{ INE PAN}}$	-1,4695	-4,5819	0,6848	1,1717	1,3308	1,1811
$Z_{6\text{ INE PAN}}$	-1,8972	-4,8078	0,6042	1,0913	1,3320	1,2546
$Z_{\text{HCP}}$	-0,6488	-1,6005	1,4416	2,5217	2,7604	2,3041
$Z_{\text{BP1}}$	-1,5263	-3,2845	-0,4728	-0,1062	0,0323	0,0964
$Z_{\text{BP2}}$	-1,7393	-2,7367	-1,0520	-0,7533	-0,5701	-0,6373

Source: own calculations

<sup>4</sup> Compare footnote 1

The specificity of the PBG company is that the significant part of its assets are the already listed companies of HB POLSKA and ENERGOPOMIĄCZ-POŁUDNIE. This company in the years of 2008 – 2013 achieved incomes from PLN 1,5 to about 4 billion, and in the years of 2008 -2011 the profits at the level of PLN 200 million. However, the crisis in the construction industry, own troubles and of the subsidiaries made the company in 2012 record a huge loss in the amount of PLN 3 690 million. Hence, in the same year, the decision of court to declare the company in the systematic bankruptcy.

Table 12. Results of early warning models for the PBG company

MODEL	2013	2012	2011	2010	2009	2008
$Z_{7\text{ INE PAN}}$	-0,5814	-14,6167	0,7147	1,3614	1,6770	1,6890
$Z_{6\text{ INE PAN}}$	-1,1533	-15,4425	0,2251	0,8926	1,2715	1,3631
$Z_{\text{HCP}}$	-1,4141	-8,6531	2,0054	3,4712	3,5799	3,4784
$Z_{\text{BP1}}$	0,2246	-9,6399	-0,4446	0,0083	0,2175	0,5717
$Z_{\text{BP2}}$	-1,6694	-4,1537	-1,3368	-1,1541	-0,9849	-0,8116

Source: own calculations

The values placed in table 12 indicate that indices  $Z_{7\text{ INE PAN}}$ ,  $Z_{6\text{ INE PAN}}$  and  $Z_{\text{HCP}}$  detected the bankruptcy risk of the PBG company since 2012, that is from the year of declaring the company's bankruptcy. The  $Z_{\text{BP1}}$  function paid attention to the bankruptcy threat since 2011, and the  $Z_{\text{BP2}}$  model alarmed the threat in the perspective of two years already since 2008.

## SUMMARY

Analysis of the financial threat of the studied companies indicates that the use of particular discrimination models does not guarantee the clear assessment of their economic condition.

The characteristic feature for construction companies is the recognition of the incomes and costs of construction services based on the International Accounting Standard 11 – Construction Contracts. Overall, this provision states that the result of the contract for the construction service is estimated based on incomes and costs connected with the construction contract estimated as incomes and costs respective for the advancement state of the implementation of the contract at the reporting day. The completion state of the contract is determined based on the proportion of the costs incurred for works performed to date in relation to the estimated total contract costs. The incurred costs only consider those contract costs, which reflect the state of the performed works.

However, when the entity recognises that the implementation of the given contract will be connected with incurring losses (even in the distant future), then it is obliged to the single increase of costs of the current period.

This is connected with a number of effects, among others:

- the contracts include the costs of the failure to accomplish or the untimely fulfilment of the contract, therefore the current period will be charged with future contractual penalties;
- a single deterioration of the financial result may result in the reaction of the funders of the company, in particular banks and lessors. Long-term loans may become short-term, with higher interest rate. However, while the companies often come to an agreement with banks, the lessors are ruthless. The result of this are the drastic increases of the financial costs (interests) and other operating costs (creating provisions for liabilities towards lessors and impairment losses for the value of fixed assets);
- company's environment, and especially entities, which ordered services, may terminate contracts.

In the light of the above, it should be noted that the indicators included in the models only indirectly refer to the other operating and financial costs. From the construction of many indicators it also results that the effect of influence of these costs is mitigated by the fact that these items are included indirectly in the numerator and denominator of the indicator.

Three of the analysed models:  $Z_{7 \text{ INE PAN}}$ ,  $Z_{6 \text{ INE PAN}}$  and  $Z_{\text{HCP}}$  indicated the companies as threatened with bankruptcy too late, because in the year in which this bankruptcy was announced. These functions refer in the indicators used to the broadly understood assets. However, in companies there is often a situation that only at the time of announcing the bankruptcy, a large part of assets (e.g. receivables and inventories) is subject to verification as to their real value. Suddenly, from day to day, there are made powerful write-downs updating assets, while on the other hand the financial result of the company deteriorates. The financial statement of the company made in good faith may not reflect the essential threats resulting from, e.g., the collapse of the payments in the chain of service recipients.

Other two models of B. Prusak:  $Z_{\text{BP1}}$  and  $Z_{\text{BP2}}$  were more sensitive to threats of bankruptcy and in some cases of the studied companies in great advance alarmed the potential troubles of companies. These functions in most part refer to the values of the profit and loss account. Their sensitivity, and hence the success in the assessment of the studied companies, may result from the use of the indicator, referring directly to the incurred costs by the company, which informs about the cycle of implementation of commitments in relation to operating costs. Moreover, the  $Z_{\text{BP1}}$  model takes into account the changes of the balance sum over time.

Each of the analysed discriminant functions is based on another set of indicators and it better or worse analyses the state of the finances of the construction and real estate development companies. In assessing the discriminatory model one should focus on the dynamics of financial results of the given company from previous years. Such an analysis may indicate the long-term

factors determining the company's activity, which in the future may cause financial problems.

## REFERENCES

- Antonowicz P., *Metody oceny i prognozowania kondycji ekonomiczno-finansowej przedsiębiorstwa*, ODDK, Gdańsk 2007.
- Jajuga K., Walesiak M. (1998) *Klasyfikacja i analiza danych. Teoria i zastosowania*, AE, Wrocław
- Kisielińska J., Waszkowski A. (2010) *Polskie modele do prognozowania bankructwa przedsiębiorstw i ich weryfikacja*, EiOGŻ nr 82, Wydawnictwo SGGW, Warszawa
- Lichota W. (2009) *Metody wczesnego ostrzegania o zmianach sytuacji finansowej przedsiębiorstw*, *Wiadomości Statystyczne* nr 10, Warszawa
- Hamrol M., Chodakowski J. (2008) *Prognozowanie zagrożenia finansowego przedsiębiorstwa. Wartość predykcyjna polskich modeli analizy dyskryminacyjnej*, *Badania Operacyjne i Decyzje* nr 3, Wrocław
- Mączyńska E., Zawadzki M. (2006) *Dyskryminacyjne modele predykcji bankructwa przedsiębiorstw*, *Ekonomista* nr 2, Warszawa
- Prusak B. (2005) *Nowoczesne metody prognozowania zagrożenia finansowego przedsiębiorstwa*, Difin, Warszawa
- Prusak B. (2004) *Jak rozpoznać potencjalnego bankruta?*, Wydawnictwo Politechniki Gdańskiej, *Prace Naukowe Katedry Ekonomii i Zarządzania Przedsiębiorstwem*, Tom 3, Gdańsk
- Raport Coface nt. upadłości firm w Polsce w 2013 r., 2 stycznia 2014, <http://www.coface.pl/Aktualnosci-i-Media/Biuro-prasowe>