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APPLICATION OF MULTIVARIATE DISCRIMINANT ANALYSIS FOR ASSESSMENT OF CONDITION OF CONSTRUCTION COMPANIES

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Abstract: The construction is important in a market economy. From the development of the construction industry depends on large extent how the economy will function. Hence, the need for continuous monitoring of both – the market and the use of methods- that will objectively evaluate the quality of the construction companies. The paper contains consideration about usage discriminant analysis in financial audit of construction companies. 30 companies from construction sector, which are listed on the Warsaw Stock Exchange, were selected for study. The analysis encompassed financial data from balance sheets and from profit and loss account in the period from January 1, 2005 to December 31, 2012.

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

INTRODUCTION

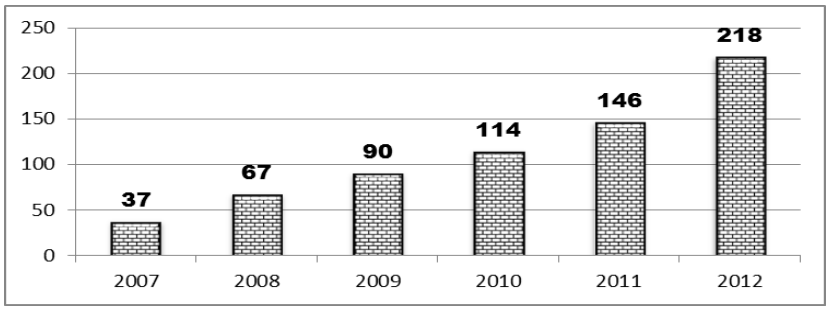
Important role of the construction industry in the economy results from the social function fulfilled by the industry that is expressed in the construction of housing and commercial premises, municipal infrastructure, including roads and investments aimed at environmental protection. Unfortunately, such function is not able to ensure the stability of the construction market, so it characterizes with big fluctuations. In the present times of globalisation the course of economic construction cycle in Poland points out directly to direct relationship with fluctuations in the Polish and global economy.

Current statistical data point out clearly to a slowdown in the construction market. Construction engineering recorded a fall of 9% in 2012 as compared to

2011, and the production in the road transportation infrastructure recorded a decrease amounting to 15.4%. Housing and commercial construction industries were the only areas that ended with a growth in 2012 of 10.8% and 10.6% respectively. Deteriorating results of the construction industry are the outcome of decreasing value of works in all the three types of construction companies. The lowest activity was recorded by the group of companies that build buildings, since the growth of the value of their works amounted to 0.1% only. Slightly higher growth was recorded by companies performing engineering works (by 2.1%) and specialist works (by 2.6%). For the first time after many years the construction and assembly production executed in Poland in 2012 was lower than in the previous year. The decrease amounted to 1.1%.

The economic situation in the construction industry is assessed more and more pessimistically, and growing problems with payment of liabilities led to bankruptcy of many construction companies.

Figure 1. Bankruptcies of construction companies in 2007-2012



Source: ASM – Centrum Badań i Analiz Rynku Sp. z o. o.

The most recent data point out to bankruptcy of 273 construction companies in 2012. It translates into a growth by 87.0% as compared to the previous year. What is more, it means seven times more bankruptcies than in 2007 (compare Figure 1). It should be emphasized that regardless of the type of operations of a company, payment backlogs were the main reason of bankruptcies.

Taking into account the fact that we observe further deterioration of the macroeconomic situation, it seems necessary to start analysing the condition of the construction industry for companies quoted at the Warsaw Stock Exchange, at least from the perspective of investors. So it is worth examining what picture of the construction industry may be seen in result of analysis of financial data from companies in that industry.

The aim of the article is to present some Polish models based on the discriminant analysis and to attempt to use them for general evaluation of the condition of 30 selected construction companies. Enterprises selected for the examination are quoted on the main market of the Warsaw Stock Exchange and their profit and loss account is made by type. The analysis referred to the following

models: Hołda's (1996), Mączyńska's (1994), Sojak and Stawicki's (1998), Gajdek and Stos's (2003) and Mączyńska and Zawadzki's (2006). Presented methods were prepared for the Polish market and they are highly estimated in the literature in respect to their forecasting value.

USE OF DISCRIMINANT ANALYSIS FOR ASSESSMENT OF THE CONDITION OF CONSTRUCTION COMPANIES

Discriminant models are used for early identification of the symptoms of deteriorating financial condition of an enterprise. A set of financial ratios used for a given model should decide about the condition and development opportunities of a given company. The discriminant analysis allows identification of ratios that well or badly reflect financial capabilities of a company.

The main forecasting tool is the discriminant function that has the following general form [Prusak 2005]:

$$Z = a_0 + a_1 X_1 + a_2 X_2 + ... + a_n X_n \tag{1}$$

where:

Z – value of the discriminant function,
X_i, for i = 1, 2, …, n – explanatory variables (financial indices),
a_i, for i = 1, 2, ..., n – coefficients of the discriminant function,
a_0 – constant.

The result is interpreted on the basis of comparison of calculated Z value of the discriminant function with a boundary value set by an author of a given model. Entities are classified as members of separable groups on the basis of Z value.

One of the first models estimated for the Polish conditions was the model prepared by A. Hołda. The period of research covered years 1993–1996, and the research covered 40 enterprises threatened with bankruptcy and 40 enterprises that had already gone bankrupt. The entities belonged to group 45-74 of the European Classification of Activities (e.g. construction industry, hotels and restaurants, financial intermediation and others). They were selected by industry and underwent ratio analysis. In the final form of the model the number of ratios was reduced to 5:

X_1 = current assets / short-term liabilities
X_2 = (borrowed capital / total liabilities) * 100
X_3 = (net profit / average value of total assets) * 100
X_4 = (average value of current liabilities / costs of production of sold products, goods and materials) * 360
X_5 = total revenues / average value of total assets

Economic entities in case of which the value of discriminant function in form of:

$$Z = 0{,}605 + 0{,}681 \cdot X_1 - 0{,}0196 \cdot X_2 + 0{,}00969 \cdot X_3 + \\ + 0{,}000672 \cdot X_4 + 0{,}157 \cdot X_5 \tag{2}$$

is higher than 0.1. are defined as very unlikely to go bankrupt, while if the value is lower than -0.3, they are very likely to go bankrupt. The range of uncertainty that is the range of Z function values that are very likely to be classified wrongly was set at the level from -0.3 to 0.1 [Hołda 2001].
The results of the classification for analysed construction enterprises are presented in Table 1.

Table 1. Results of Hołda's model (1996) for construction companies

Name of the company	2012-12-31	2011-12-31	2010-12-31	2009-12-31	2008-12-31	2007-12-31
TOTAL	**-0,296**	**0,299**	**0,517**	**0,615**	**0,575**	**0,611**
BUDIMEX	0,009	0,031	0,074	0,151	0,311	0,268
POLIMEXMS	-0,264	0,338	0,533	0,528	0,473	0,717
PBG W UPADŁOŚCI	-1,083	0,440	0,788	0,846	0,699	0,543
MOSTALWAR	0,031	0,221	0,599	0,653	0,505	0,620
TRAKCJA	0,287	0,247	1,175	1,760	0,888	0,452
HBPOLSKA W UPADŁOŚCI	-3,445	0,309	0,365	0,332	0,132	
ERBUD	0,623	0,645	0,867	0,816	0,786	1,156
ELBUDOWA	0,963	1,011	1,102	1,474	1,322	0,577
MOSTALZAB	0,746	0,530	0,469	0,536	0,367	1,094
POLAQUA	-0,096	0,474	0,143	0,685	0,746	
DSS W UPADŁOŚCI	-1,654	-1,765	0,058	-0,093		
ABMSOLID W UPADŁOŚCI	-2,175	-0,304	0,251	0,441	0,735	1,002
INSTALKRK	1,640	1,301	1,613	1,595	1,243	0,954
AWBUD	0,150	0,404	0,503			
PROJPRZEM	2,056	1,854	1,702	2,352	2,012	2,710
BIPROMET	1,019	0,550	0,866	0,795		
INTAKUS W UPADŁOŚCI	-0,719	-0,093	0,886	0,961		
UNIBEP SA	0,491	0,648	0,861	0,759	0,881	
ZUE SA	0,617	0,786	0,627			
ULMA CONSTRUCCION POLSKA SA	1,108	0,816	0,490	0,385	0,566	1,032
ENERGOMONTAŻ-POŁUDNIE SA	-6,136	0,025	0,616	0,680	0,594	1,032
P.A. NOVA SA	0,564	1,073	1,441	1,463	1,483	4,040
INTERBUD-LUBLIN SA	0,457	0,913	0,791			
PROCHEM SA	1,265	1,005	1,241	1,080	0,692	0,747
MOSTOSTAL-EXPORT SA	1,237	0,428	1,516	1,213	1,315	0,932
ELEKTROTIM SA	1,434	1,758	2,322			
CNT	1,026	1,150	1,577	1,340	1,325	2,604
ENERGOAPARATURA SA	0,999	1,058	1,396	0,826	0,554	0,571
BUDOPOL-WROCŁAW SA	-0,251	1,272	0,993	2,182	2,056	
RESBUD SA	1,497	0,225	0,987	0,999	1,179	
UNCERTAINTY **-0,3 <= Z <= 0,1**		BANKRUPT RISK **Z< -0,3**			GOOD **Z > 0,1**	

Source: own calculations

The following ratios were decisive in Hołda's function for evaluation of construction companies: (X_1) (basic liquidity ratio) and (X_2) (debt ratio), while asset profitability ratio (X_3) was equal zero. It should be pointed out that in case of bankrupt companies, problems occurred next year were detected in 2011 already, except companies Polimex and PBG. However, it should be taken into account that as the dominating shareholder, in its consolidated financial statement PBG includes disastrous results of HBPOLSKA and ENERGOMONTAŻ-POŁUDNIE.

The examination on the discriminant model adjusted to the Polish conditions was conducted by E. Mączyńska, as well. She adapted O. Jacobs's function used for the assessment of credit rating of entities. The form of the function was worked out relatively long time ago, but its forecasting values are high. Comments adopted

in the model took account of the meaning of individual ratios for the general financial conditions of a company [Mączyńska 1994].

Financial ratios used for the purpose of model construction have the following form:

X_1 = (gross result + depreciation) /total liabilities
X_2 = total assets / total liabilities
X_3 = gross result / total assets
X_4 = gross result /revenues from sales
X_5 = inventory/ revenues from sales
X_6 = revenues from sales / total assets

Results of the classification for analysed developers are presented in Table 2.

Table 2. Results of Mączyńska's model (1994) for construction companies

Name of the company	2012-12-31	2011-12-31	2010-12-31	2009-12-31	2008-12-31	2007-12-31
TOTAL	**-4,850**	**0,393**	**0,791**	**1,236**	**1,329**	**1,294**
BUDIMEX	1,105	1,308	1,484	1,238	0,984	0,294
POLIMEXMS	-5,408	0,595	0,932	1,208	1,017	1,138
PBG W UPADŁOŚCI	-22,266	0,828	1,194	1,518	1,690	1,521
MOSTALWAR	-0,753	-0,824	1,165	2,054	1,736	1,268
TRAKCJA	0,206	0,884	1,348	3,031	1,801	1,417
HBPOLSKA W UPADŁOŚCI	-119,685	0,503	0,425	1,413	1,102	
ERBUD	0,713	-0,086	0,783	1,738	0,603	1,535
ELBUDOWA	1,474	1,569	1,981	2,999	3,100	2,296
MOSTALZAB	0,111	1,274	0,923	1,713	1,846	3,165
POLAQUA	-3,841	1,121	-5,053	-0,985	0,963	
DSS W UPADŁOŚCI	-5,722	-12,764	-0,969	-1,460		
ABMSOLID W UPADŁOŚCI	-14,143	-1,964	0,566	0,970	1,358	1,390
INSTALKRK	1,792	1,823	1,973	2,610	2,610	2,451
AWBUD	-1,592	0,270	-0,230			
PROJPRZEM	1,998	0,571	-1,744	0,700	2,066	2,845
BIPROMET	1,388	1,125	0,617	0,537		
INTAKUS W UPADŁOŚCI	-4,959	-4,926	0,521	0,015		
UNIBEP SA	0,650	1,145	1,487	1,682	2,341	
ZUE SA	0,439	1,367	1,159			
ULMA CONSTRUCCION POLSKA SA	2,514	3,551	1,334	0,173	2,058	4,184
ENERGOMONTAŻ-POŁUDNIE SA	-44,048	-1,038	0,038	-0,308	1,373	1,730
P.A. NOVA SA	1,384	1,967	1,960	2,951	2,433	3,550
INTERBUD-LUBLIN SA	-0,213	1,181	1,678			
PROCHEM SA	-0,062	0,996	0,956	0,877	1,624	1,870
MOSTOSTAL-EXPORT SA	-5,409	-12,040	-2,259	-1,807	4,879	0,532
ELEKTROTIM SA	1,420	2,030	1,370			
CNT	1,395	1,085	1,281	-2,221	-2,221	1,359
ENERGOAPARATURA SA	1,594	1,305	2,598	2,173	1,485	0,131
BUDOPOL-WROCŁAW SA	-7,855	1,762	1,491	1,358	1,030	
RESBUD SA	-12,303	-4,469	0,131	-1,510	3,388	
VERY GOOD S>2	GOOD 1<S<=2		WEAK 0<S<=1		WRONG S<0	

Source: own calculations

Interpretation of a discriminant function:

$$Z = 1{,}5 \cdot X_1 + 0{,}08 \cdot X_2 + 10 \cdot X_3 + 5 \cdot X_4 - 0{,}3 \cdot X_5 + 0{,}1 \cdot X_6 \quad (3)$$

should be based on the following principles: Z <= 0 is an enterprise threatened with bankruptcy within 1 year, if 0 < Z < 1 an enterprise is weak but not threatened with bankruptcy, is 1 <= Z <= 2 an enterprise is good and if Z >= 2 an enterprise is very good.

The ratios that were most decisive in an assessment of a given company in Mączyńska's model were turnover profitability (X_4) and sales margin (X_3). The

assessment of enterprises shows their large differentiation. All companies classified in the worst category of economic condition had very bad financial results in relation to their assets. On the basis of comparisons of the results of this model for a few former years it should be stated that it is possible to point out quite precisely to companies that will have serious problems sooner or later.

Contrary to the other models, Sojak and Stawicki's model consists of three classification functions for: good enterprises, average enterprises and enterprises threatened with bankruptcy. An analysis conducted by the researchers covered 58 enterprises and they computed 20 financial ratios on the basis of information from 1998. Then by means of data clustering the authors selected 11 ratios out of those 20 that are best for group discrimination. Then 7 best ratios were selected out of those 11 ratios [Prusak 2004]:

X_1 = (net financial result/average value of current assets) · 100;
X_2 = (current assets - inventory - accruals) /short-term liabilities;
X_3 = average working capital / average value of assets;
X_4 = (net financial result / average value of equity) · 100;
X_5 = (net financial result / average value of fixed assets) · 100;
X_6 = (net financial result + interests on borrowed capital– income tax) / average value of assets;
X_7 = current assets / short-term liabilities;

And the three following classification functions were constructed on the basis of them:

$$Enterprise_{wrong} = -0{,}1144 \cdot X_1 + 0{,}5178 \cdot X_2 - 20{,}4475 \cdot X_3 + \\ - 0{,}0661 \cdot X_4 + 0{,}0663 \cdot X_5 - 50{,}461 \cdot X_6 + 1{,}8358 \cdot X_7 - 11{,}6499 \quad (4)$$

$$Enterprise_{average} = -0{,}0586 \cdot X_1 - 3{,}3608 \cdot X_2 + 10{,}7088 \cdot X_3 + \\ + 0{,}01455 \cdot X_4 - 0{,}066 \cdot X_5 + 4{,}5837 \cdot X_6 + 0{,}24329 \cdot X_7 - 2{,}3393 \quad (5)$$

$$Enterprise_{good} = -0{,}0153 \cdot X_1 + 2{,}0482 \cdot X_2 + 9{,}637 \cdot X_3 + \\ + 0{,}1714 \cdot X_4 - 0{,}0091 \cdot X_5 - 15{,}78 \cdot X_6 - 0{,}0018 \cdot X_7 - 5{,}992 \quad (6)$$

Allocation to a respective group of enterprises depends on the highest positive ratio. Results of the classification for analysed construction companies are presented in Table 3. The group of ratios selected for the above functions focuses on profitability, and in result it refers directly or indirectly to inventories that are small in construction companies. Thus it may be observed that these models assessed more highly companies that invested their financial surpluses in the current activities. But they did not show any threats in case of two companies

undergoing bankruptcy proceedings in 2012, that is ABMSOLID and HBPOLSKA.

Table 3. Results of Sojak and Stawicki's models (1998) for construction companies

Name of the company	2012-12-31	2011-12-31	2010-12-31	2009-12-31	2008-12-31	2007-12-31
TOTAL	WRONG	Max<0	Max<0	Max<0	Max<0	GOOD
BUDIMEX	GOOD	GOOD	GOOD	GOOD	Max<0	Max<0
POLIMEXMS	WRONG	Max<0	Max<0	Max<0	Max<0	Max<0
PBG W UPADŁOŚCI	WRONG	Max<0	GOOD	GOOD	GOOD	GOOD
MOSTALWAR	Max<0	Max<0	Max<0	GOOD	GOOD	GOOD
TRAKCJA	Max<0	Max<0	GOOD	GOOD	GOOD	GOOD
HBPOLSKA W UPADŁOŚCI	GOOD	Max<0	Max<0	GOOD	GOOD	
ERBUD	GOOD	Max<0	GOOD	GOOD	GOOD	GOOD
ELBUDOWA	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
MOSTALZAB	Max<0	Max<0	Max<0	Max<0	Max<0	GOOD
POLAQUA	WRONG	Max<0	WRONG	Max<0	Max<0	
DSS W UPADŁOŚCI	WRONG	GOOD	Max<0	Max<0		
ABMSOLID W UPADŁOŚCI	GOOD	Max<0	Max<0	Max<0	GOOD	Max<0
INSTALKRK	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
AWBUD	Max<0	Max<0	Max<0			
PROJPRZEM	GOOD	Max<0	Max<0	GOOD	GOOD	GOOD
BIPROMET	Max<0	Max<0	Max<0	Max<0		
INTAKUS W UPADŁOŚCI	WRONG	WRONG	Max<0	Max<0		
UNIBEP SA	Max<0	GOOD	GOOD	Max<0	GOOD	
ZUE SA	Max<0	Max<0	Max<0			
ULMA CONSTRUCCION POLSKA SA	Max<0	Max<0	Max<0	Max<0	Max<0	Max<0
ENERGOMONTAŻ-POŁUDNIE SA	GOOD	Max<0	Max<0	Max<0	Max<0	GOOD
P.A. NOVA SA	Max<0	Max<0	GOOD	Max<0	GOOD	GOOD
INTERBUD-LUBLIN SA	Max<0	Max<0	GOOD			
PROCHEM SA	Max<0	Max<0	Max<0	Max<0	Max<0	GOOD
MOSTOSTAL-EXPORT SA	Max<0	WRONG	Max<0	Max<0	GOOD	Max<0
ELEKTROTIM SA	GOOD	GOOD	GOOD			
CNT	GOOD	GOOD	GOOD	Max<0	Max<0	GOOD
ENERGOAPARATURA SA	GOOD	GOOD	GOOD	GOOD	Max<0	Max<0
BUDOPOL-WROCŁAW SA	WRONG	GOOD	GOOD	GOOD	GOOD	
RESBUD SA	WRONG	WRONG	Max<0	Max<0	GOOD	

Source: own calculations

Another model, that is Gajdek and Stos's model dated 2003, was constructed for the purpose of assessment of companies quoted on the Warsaw Stock Exchange. The system was worked out on the basis of a balanced sample consisting of 34 items: 17 bankrupt companies to which 17 "healthy" entities with similar business profile were assigned [Kisielińska, Waszkowski 2010].
Estimated linear discriminant model had the following form:

$$Z = -0,3342 - 0,000500 \cdot X_1 + 2,055200 \cdot X_2 + 1,726000 \cdot X_3 + \\ + 0,115500 \cdot X_4 \tag{7}$$

Four financial ratios were used in this model:
X_1 = average value of short-term liabilities / costs of sold production * 360 days;
X_2 = net profit / average asset value during a year;
X_3 = gross profit / net revenues from sales;
X_4 = total assets/ total liabilities;

Results of the classification for analysed developers are presented in Table 4.

The boundary value for the model is zero. If $Z < 0$, an enterprise is classified in a group of companies threatened with bankruptcy, if $Z > 0$ – in a group with good financial standing. The uncertainty range for the model is ⟨–0.49; 0.49⟩.
The decisive ratio in the assessment of the condition of construction companies was ratio (X_4), that is inverse debt rate but only in case of years when a company recorded small profit or loss. When companies recorded relatively high profits or losses, ratios (X_2) – asset profitability and (X_3) – return on sales were dominant. The model pointed out to the threat in respect to all bankrupt companies and by means of 2011 results it confirmed the crisis in the construction industry in 2012.

Table 4. Results of Gajdek and Stos's model (2003) for construction companies

Name of the company	2012-12-31	2011-12-31	2010-12-31	2009-12-31	2008-12-31	2007-12-31
TOTAL	**- 1,244**	**-0,142**	**-0,049**	**0,043**	**0,069**	**0,076**
BUDIMEX	-0,049	0,029	0,082	0,040	-0,028	-0,164
POLIMEXMS	-1,369	-0,075	-0,023	0,030	-0,003	0,031
PBG W UPADŁOŚCI	-5,237	0,002	0,081	0,166	0,186	0,171
MOSTALWAR	-0,394	-0,408	-0,008	0,143	0,094	0,034
TRAKCJA	-0,175	-0,016	0,157	0,402	0,196	0,068
HBPOLSKA W UPADŁOŚCI	-35,794	-0,131	-0,140	0,081	0,030	
ERBUD	-0,091	-0,251	-0,072	0,097	-0,097	0,173
ELBUDOWA	0,095	0,113	0,220	0,379	0,400	0,191
MOSTALZAB	-0,159	0,017	-0,037	0,099	0,168	0,398
POLAQUA	-1,114	0,004	-1,171	-0,364	0,012	
DSS W UPADŁOŚCI	-1,869	-3,084	-0,484	-0,607		
ABMSOLID W UPADŁOŚCI	-3,284	-0,648	-0,113	-0,048	0,065	0,134
INSTALKRK	0,208	0,206	0,251	0,329	0,320	0,340
AWBUD	-0,559	-0,152	-0,258			
PROJPRZEM	0,363	0,094	-0,325	0,178	0,327	0,632
BIPROMET	0,142	0,053	0,032	-0,007		
INTAKUS W UPADŁOŚCI	-1,620	-1,518	-0,074	-0,175		
UNIBEP SA	-0,076	-0,016	0,070	0,101	0,259	
ZUE SA	-0,110	0,065	0,070			
ULMA CONSTRUCCION POLSKA SA	0,287	0,511	0,056	-0,202	0,251	0,767
ENERGOMONTAŻ-POŁUDNIE SA	-5,794	-0,409	-0,185	-0,288	0,118	0,164
P.A. NOVA SA	0,196	0,345	0,382	0,576	0,463	0,931
INTERBUD-LUBLIN SA	-0,215	0,087	0,246			
PROCHEM SA	-0,066	0,073	0,131	0,043	0,103	0,167
MOSTOSTAL-EXPORT SA	-1,475	-2,605	-0,376	-0,496	0,866	0,074
ELEKTROTIM SA	0,116	0,257	0,213			
CNT	0,030	0,027	0,097	-0,545	-0,551	0,273
ENERGOAPARATURA SA	0,101	0,063	0,240	0,161	0,043	-0,143
BUDOPOL-WROCŁAW SA	-1,871	0,206	0,175	0,193	0,117	
RESBUD SA	-2,825	-1,106	-0,220	-0,450	0,413	
BANKRUPT RISK Z<=0			GOOD Z > 0			

Source: own calculations

The last presented Polish model is the model worked out by E. Mączyńska and M. Zawadzki in 2006. The authors conducted a research on a balanced sample of 80 companies quoted on the WSE, using financial statements for 1997–2001 and financial ratios computed on the basis of such statements. The research included 45 ratios characterising profitability, liquidity, debt level, operating efficiency and dynamics of company's growth. Four ratios were selected for the purpose of presented model:
X_1 = (gross result + depreciation) /total liabilities
X_2 = total assets / total liabilities
X_3 = gross result /total assets

X_4 = gross result /revenues from sales

Results of the classifications for analysed construction companies were presented in Table 5.

Table 5. Results of Mączyńska and Zawadzki's model (2006) for construction companies

Nazwa spółki	2012-12-31	2011-12-31	2010-12-31	2009-12-31	2008-12-31	2007-12-31
RAZEM BUDOWNICTWO	**-1,573**	**4,180**	**5,065**	**5,680**	**5,648**	**5,652**
BUDIMEX	3,746	4,205	4,435	4,270	4,386	3,676
POLIMEXMS	-1,908	4,672	5,273	5,458	5,094	5,757
PBG W UPADŁOŚCI	-9,976	5,089	5,735	6,268	6,233	5,620
MOSTALWAR	2,114	2,295	5,428	6,620	5,699	5,392
TRAKCJA	4,516	4,523	8,132	12,948	7,001	5,314
HBPOLSKA W UPADŁOŚCI	-15,665	4,082	4,308	4,954	4,088	3,373
ERBUD	4,648	3,640	5,544	6,625	4,845	7,014
ELBUDOWA	7,603	7,821	9,369	12,352	11,229	6,526
MOSTALZAB	5,694	5,785	5,067	6,530	5,991	10,642
POLAQUA	-0,572	5,685	-2,038	3,862	6,271	8,433
DSS W UPADŁOŚCI	-1,538	-7,060	3,423	2,743	3,739	
ABMSOLID W UPADŁOŚCI	-6,833	0,555	3,832	4,720	5,379	7,833
INSTALKRK	11,582	9,597	11,129	11,202	9,719	8,656
AWBUD	1,596	4,238	4,178	5,730		
PROJPRZEM	17,318	12,012	7,662	14,656	14,937	21,941
BIPROMET	9,161	6,747	9,388	8,577	6,524	
INTAKUS W UPADŁOŚCI	0,705	0,338	4,614	4,337	5,126	
UNIBEP SA	4,519	5,096	6,065	6,614	7,421	4,376
ZUE SA	5,165	6,601	5,779	5,353		
ULMA CONSTRUCCION POLSKA SA	7,385	7,860	4,547	3,606	6,002	10,395
ENERGOMONTAŻ-POŁUDNIE SA	-20,046	2,478	4,588	4,189	5,723	7,509
P.A. NOVA SA	7,136	10,884	10,145	19,106	15,249	28,407
INTERBUD-LUBLIN SA	3,946	5,938	5,862	6,141		
PROCHEM SA	9,588	8,702	10,547	9,209	7,036	7,629
MOSTOSTAL-EXPORT SA	5,227	-6,439	11,508	7,100	15,700	7,596
ELEKTROTIM SA	9,490	11,903	13,395	20,744		
CNT	7,378	6,984	8,798	2,851	2,851	14,682
ENERGOAPARATURA SA	7,041	7,029	10,245	6,950	5,361	3,877
BUDOPOL-WROCŁAW SA	-3,620	8,985	9,905	12,143	10,520	9,155
RESBUD SA	-5,748	-1,565	5,515	3,650	11,469	4,562
BANKRUPT RISK Z<0			GOOD Z>=0			

Source: own calculations

The discriminant function has the following form:

$$Z = 9{,}498X_1 + 3{,}566X_2 + 2{,}903X_3 + 0{,}452X_4 - 1{,}498 \quad (8)$$

The boundary value in this model is zero, and if Z < 0, a company is threatened.
The decisive ratio in the assessment of the condition of construction companies was an inverse debt ratio (X_2). In case of companies that experience significant problems with debt repayment also ratio (X_1) –coverage of liabilities with financial surplus – had large impact on the final result of given company assessment. The model pointed out to certain bankrupt companies as threatened companies with certain delay since in 2012 only. Results for 2011 did not point out to any threat. The only exception here is DSS company that was undergoing bankruptcy proceedings in 2011 already.

SUMMARY

After an examination of financial data of 30 construction companies for 2007-2012 it should be stated that 2012 was the most difficult year for this

industry. The majority of companies recorded losses. Preparations for Euro 2012 were the cause of problems and bankruptcies of many enterprises. It should be noted that companies experiencing serious problems recorded also a significant increase of the ratio of purchased external services to revenues from sales, that is from the level of ca. 50% in years 2007-2011 up to 75% in 2012. Thus, problems of companies could also result from a resignation from own construction works in order to earn margins on purchased services.

The analysis of financial threats of examined companies points out to the fact that application of individual discriminant models does not ensure clear assessment of their economic condition. It happens that a model uses ratios that in combination with the others generate a negative or positive impact on assessment of a company. It may completely change perception of the financial condition of the same enterprise. Every analysed discriminant function is based on a different set of ratios and it analyses – in a better or worse way – the state of finances of construction companies. Three models: Hołda's, Sojak – Stawicki's and Mączyńska – Zawadzki's pointed out to companies threatened with bankruptcy too late since only in the year when such bankruptcy was announced. Indeed, it is a specific feature of construction companies that they "settle construction contracts" in compliance with IAS 11, while the majority of companies recognize revenues and costs on the basis of IAS 18. The specific feature of IAS 11 is the fact that non-invoiced revenues resulting from actual progress of construction works in relation to a contract value are recorded as revenues and costs. It results in the fact that revenues and costs are recognized in a given reporting period although they would be recognized in the following periods if the conditions were different. Thus, bad results of numerous companies in 2012 refer – at least partially – to construction contracts that will be finally completed in the upcoming years.

When assessing a given discriminant model one should focus on the history of financial results of a given company in the previous years. Only such analysis may point out to long-term factors determining company's operations that may result in financial problems in the future.

REFERENCES

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.

Gajdka J., Stos D.(1996) Wykorzystanie analizy dyskryminacyjnej w ocenie kondycji finansowej przedsiębiorstw, praca zbiorowa pod red. R. Borowieckiego: Restrukturyzacja w procesie przekształceń i rozwoju przedsiębiorstw, AE, Kraków.

Hamrol M., Chodakowski J. (2008) Prognozowanie zagrożenia finansowego przedsiębiorstwa. Wartość predykcyjna polskich modeli analizy dyskryminacyjnej, Badania Operacyjne i Decyzje nr 3, Wrocław.

Hołda A. (2001) Prognozowanie bankructwa jednostki w warunkach gospodarki polskiej z wykorzystaniem funkcji dyskryminacyjnej Z_H, Rachunkowość nr 5.

Mączyńska E. (1994) Ocena kondycji przedsiębiorstwa (uproszczone metody), Życie gospodarcze nr 38.

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.

Sojak S. Stawicki J. (2001) Wykorzystanie metod taksonomicznych do oceny kondycji ekonomicznej przedsiębiorstw, Zeszyty Teoretyczne Rachunkowości, Tom 3, Warszawa.

Sukiennik M. (2007) Zastosowanie analizy dyskryminacyjnej do oceny stanu finansowego przedsiębiorstw, Referaty II KKMM, Kraków

The consolidated financial statements construction companies for the years 2007-2012.