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BANKRUPTCY RISK OF SELECTED COMMERCIAL BANKS IN POLAND

In the article the business failure phenomenon in the commercial banking sector in Poland is analyzed and models are presented which allow assessing the financial condition and identifying bankruptcy risk of a commercial bank in Poland. The models are based on officially published data. Authors' considerations lead to the conclusion that the misclassification of several banks officially recognized as good, results from the fact that the economic and financial condition of the commercial banks in Poland is worse than is publicly presented.

Keywords: bankruptcy, financial ratios, business failure prediction models, classification accuracy

INTRODUCTION

The main task of the article is an analysis of the business failure phenomenon in the commercial banking sector in Poland and an attempt to build a statistical tool, which would allow to assess the financial condition of a commercial bank in Poland and to identify its bankruptcy risk.

The main thesis proved in the article is that the officially accessible information on the commercial banking sector in Poland is sufficient for each bank customer to predict the business failure of such institutions in Poland. It will also be discussed to what extent the misclassifications of the analyzed banks result from the special "information policy" regarding the banking sector.

1. BANKRUPTCY PROCEEDING IN THE POLISH BANKING SECTOR

Bankruptcy of enterprises, which appeared in Poland from the early 1990's, is specially dangerous for the economy if it concerns banking institutions. Multilateral connections between banks and other economic entities may – in cases of bank failure – cause financial difficulties in many, even properly functioning enterprises and banks (the so-called domino effect). Therefore in

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each economy banks in a poor financial condition are treated differently from other economic entities in a similar economic situation and difficulties in the banking sector are kept secret. Institutions responsible for the functioning of this sector try to protect ineffective, insolvent banks from liquidation and postpone as long as possible the decision to file for their bankruptcy.

In Poland up to now the courts have only declared bankruptcy on five commercial banks. These were: in 1995 Commercial Bank Posnania, Agrobank and Bank for Export Promotion Animex, in 1999 Savim Bank and in 2000 Bank Staropolski. In fact, the list of banks which suffered severe financial problems is much longer. Several banks, due to ineffective functioning and poor financial condition, were unable to operate on their own account and were taken over by new, mostly foreign, investors. In 1993 – 2002 there were 18 such banks (see table 1).

Table 1

Decline in the number of commercial and co-operative banks in 1993 – 2002

Reason of decline	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
COMMERCIAL BANKS											
Bankruptcy	-	-	3	-	-	-	1	1	-	-	5
Liquidation	-	-	-	-	1	1	-	1	-	-	3
Acquisitions	1	6	2	2	1	-	1	2	-	3	18
Mergers	1	-	1	2	2	1	5	1	5	8	26
Decline – total	2	6	6	4	4	2	7	5	5	11	52
COOPERATIVE BANKS											
Bankruptcy	10	23	57	30	6	4	-	-	1	-	131
Liquidation	-	5	9	12	15	6	1	-	-	-	48
Acquisitions	-	-	-	-	-	-	1	2	2	-	5
Mergers	-	13	37	74	78	96	406	99	35	37	875
Decline – total	10	41	103	116	99	106	408	101	38	37	1059

Source: NBP database

From the customers and cooperating institutions point of view it is very important that the bankruptcy of a bank does not appear suddenly, but is a long-lasting process consisting of different phases. Several symptoms of business failure can be observed even from "outside". In most opinions the bankruptcy process of a bank consists of three main phases. The first phase lasts approximately two years and means a deterioration of the general financial condition of the bank. The following phase lasts two years and can be distinguished by the fact that supervising institutions become aware of the threat of bankruptcy, whereas

managers of the bank do not. The third phase is marked by a real crisis in the activity of the bank and the increasing probability of bankruptcy. The experience shows that if at this moment no radical restructuring action is undertaken, such a distressed bank will fail within one year (Solarz 1997, pp. 36–42).

Bankruptcy of banks (like of any other economic entity) is caused by two different groups of factors – endogenous, resulting from a failure in the bank functioning and exogenous, independent from internal bank decisions, resulting from the general situation in the banking sector and in the whole economy (Zdanowicz, Obal 1999, Miklaszewicz 1999).

Mainly incompetent management, resulting in wrong, excessively risky investment decisions, as well as a non-existent system of internal and external supervision caused difficulties in the banking sector in Poland. Moreover in the early 1990's credits were concentrated in weak, unstable economic sectors, insolvency of main bank customers appeared, and macroeconomic conditions were unfavourable. Three banks: Agrobank, Animex and Savim Bank failed because they did not find any strategic investor. In two cases – Bank Staropolski and Bank Rozwoju Rolnictwa Rolbank – bank insolvency was caused by criminal activity.

Detailed information on changes in the commercial banking sector in the last 11 years is given in Table 2. There are listed, in alphabetical order, all commercial banks which were taken into consideration in the first ranking published by the Polish economic journal "Gazeta Bankowa" in 1993. For each analyzed bank information is given whether it failed as a result of its insolvency, is still functioning under an unchanged name or is functioning in a "changed form" or under a changed name (as a result of merger, acquisition or take-over by a new strategic investor). Since 1992 only 14 commercial banks have been functioning in an unchanged form. Table 2 does not include those banks which were established after 1992 in case they were not, in any way, connected with the commercial banks existing in 1992.

Table 2

Evolution of the commercial banking sector after 1992

1992	Evolution up to 2003
AGROBANK SA Warszawa	Failed in 1995.
ANIMEX Bank S.A. Warszawa	Failed in 1995.
Baltic Bank S.A. Gdańsk	Liquidated through acquisition by PBK in 1993.
Bank Amerykański w Polsce W-wa	Is functioning as Bank Amerykański in Poland S.A. „Amerbank".

Bank Częstochowa S.A.	Since 1998 controlled by BRE; in 2003 merged with BRE.
Bank Depozytowo-Kredytowy S.A. in Lublin	Merged with PEKAO S.A. in 1999.
Bank Gdański	Merged with BIG in 1997 r., up to now functioning as BIG Bank Gdański S.A.
Bank Gospodarstwa Krajowego	Still functioning under the unchanged name.
Bank Handlowy W-wa	Merged with CITIBANK in 2001, is functioning as Bank Handlowy in Waszawie S.A.
Bank Komercyjny Posnania S.A.	Failed in 1995.
Bank Komunalny S.A. Gdynia	Changed name to Nordea Bank Polski S.A. in 2001.
Bank Morski S.A. Szczecin	Acquired by PBK in 1997.
Bank Ochrony Środowiska Warszawa	Still functioning under the same name.
Bank Pocztowy S.A. Bydgoszcz	Still functioning under the same name.
Bank Podlaski S.A. Siedlce	In 1998 changed name to AIG Bank Polska S.A.
Bank Przemysłowo-Handlowy Kraków	Merged with PBK in 2001, is functioning as Bank Przemysłowo-Handlowy PBK S.A.
Bank Przemysłowy S.A. Łódź	Still functioning under the same name.
Bank Regionalny S.A. Rybnik	Taken over by Kredyt Bank in 1996.
Bank Rozwoju Cukrownictwa Poznań	Since 1998 controlled by Bank Handlowy; in 2002 taken over by GBW.
Bank Rozwoju Eksportu Warszawa	Still functioning under the same name.
Bank Rozwoju Rolnictwa S.A. Poznań	Taken over by Bank Zachodni in 1996.
Bank Społem S.A. Warszawa	In 2003 changed name to Eurobank S.A.
Bank Staropolski S.A. Poznań	Failed in 2000.
Bank Śląski Katowice	Merged with ING in 2001, is functioning as ING Bank Śląski S.A.
Bank Świętokrzyski, Kielce	In 1998 changed name to LUKAS Bank Świętokrzyski S.A.
Bank Turystyki S.A. W-wa	Twice changed the name: in 1993 and 1998, now is functioning as Bank Współpracy .Europejskiej.
Bank Unii Gospodarczej S.A. Warszawa	Still functioning under the same name.
Bank Własności Pracowniczej S.A. Gdańsk	Taken over by Nordea Bank Polska in 2001.
Bank Wschodni S.A. Białystok	Taken over by Bank Społem in 2002.

Bank Współpracy Regionalnej S.A.	In 2001 changed name to Deutsche Bank 24 S.A.
Bank Zachodni S.A. Wrocław	Merged with WBK in 2001, is now functioning as Bank Zachodni WBK S.A.
Bank Ziemi Radomskiej S.A.	Changed name to Bank Energetyki, and in 1999 taken over by BISE S.A.
Bank Ziemski S.A. Warszawa	Liquidated through acquisition by Kredyt Bank in 1993.
BGŻ Warszawa	Still functioning under the same name.
BIG S.A. Warszawa	Merged with Bank Gdański in 1997, now is functioning as Millenium.
BISE S.A. Warszawa	Merged with Cukrobank in 2002, is functioning as BISE S.A.
Bud-Bank S.A. Warszawa	Still functioning under unchanged name, since 1999 controlled by BGK.
Bydgoski Bank Budownictwa S.A.	Bank branch in Bydgoszcz acquired by WBK in 1996.
Bydgoski Bank Komunalny S.A.	Taken over by Pierwszy Komercyjny Bank in Lublin in 1994.
CITIbank Poland S.A. Warszawa	Merged with Bank Handlowy in 2001.
Creditanstalt S.A. Warszawa	Taken over by PBK in 2000.
Cukrobank S.A. Wrocław	Merged with BISE in 2002.
CUPRUM Bank S.A. Lubin	Since 1994 controlled by Bank Handlowy; in 2002 changed name to Dominent BANK .
DEG Bank Secesyjny S.A. Katowice	Since 1994 controlled by Bank Współpracy Regionalnej, in 1999 taken over by DB24.
Dolnośląski Bank Gospodarczy S.A. Wrocław	Liquidated in 1995.
GECOBANK S.A. Warszawa	Taken over by Kredyt Bank in 1995.
Gliwicki Bank Handlowy S.A.	Taken over by WBK in 2000.
Glob S.A. Warszawa	Taken over by Kredyt Bank in 1996.
Głogowski Bank Gospodarczy S.A.	Taken over by WBK in 1994.
Gospodarczy Bank Południowo-Zachodni S.A.	Still functioning under the same name.
Gospodarczy Bank Wielkopolski S.A.	Still functioning under the same name.
Górnośląski Bank Gospodarczy S.A. Katowice	Since 1995 controlled by PBK.
INTERBANK S.A. Warszawa	Taken over by ABN AMRO Bank in 1994.
Interkrakbank S.A. Kraków	Taken over by BWR in 1994, now Deutsche Bank 24 S.A.

Invest Bank S.A. Poznań	Still functioning under the same name.
Kredyt Bank S.A. Warszawa	Still functioning under the same name.
Łódzkie Towarzystwo Kredytowe S.A.	Twice changed name: 1993 and 1997 (for LG Petro); in 2002 taken over by Nordea.
MEGAbank S.A. Warszawa	Taken over by BayerischeVereinsbank in 1995.
Międzynarodowy Bank w Polsce S.A. W-wa	In 1997 changed name to Credit Lyonnaise Bank Polska S.A.
PcKaO S.A. Warszawa	Merged with PBG, BDK and PBKS in 1999, now functioning as Bank PEKAO S.A.
Pierwszy Polsko-Amerykański Bank	In 2000 changed name to Fortis Bank Polska S.A.
PKO BP	Still functioning under the same name.
Polski Bank Rozwoju Warszawa	Taken over by BRE in 1998.
Polsko-Amerykański Bank Hipoteczny S.A.	In 1999 changed name to GE Bank Mieszkaniowy S.A.
Polsko-Kanadyjski Bank Św. Stanisława S.A.	In 2000 changed name to Danske Bank Polska S.A.
Pomorski Bank Kredytowy S.A. Szczecin	Merged with PEKAO in 1999.
Powszechny Bank Gospodarczy S.A. Łódź	Merged with PEKAO in 1999.
Powszechny Bank Kredytowy Warszawa	Merged with BPH in 2001, now functioning as Bank Przemysłowo-Handlowy PBK S.A.
Raiffeisen Centrobank S.A. W-wa	Functioning as Raiffeisen Bank Polska S.A.
Solidarność Chase DT Bank S.A.	In 1995 changed name to GE Bank Mieszkaniowy S.A.
SOPOT Bank S.A.	Liquidated through acquisition by Bank Gdański in 1995.
Wielkopolski Bank Kredytowy Poznań	Merged with Bank Zachodni in 2001, now functioning as Bank Zachodni WBK S.A.
Wschodni Bank Cukrownictwa S.A. Lublin	Since 2002 functioning with the receivership.

Source: Authors' compilation

Note: Commercial banks listed in 1992 were presented in the ranking of banks published in "Gazeta Bankowa" no. 27/1993.

Bankruptcy also affects co-operative banks in Poland. In the period from 1993 till 2002, 131 banks in this sector went bankrupt, however after 1998 only one co-operative bank was declared bankrupt and numerous banks were taken over. In many co-operative banks which became insolvent and were due to file for bankruptcy, restructuring programs were worked out. For example, in 1993 restructuring proceedings were started in 680 banks, among which over 250 were

due to file for bankruptcy. In 1994, in order to improve functioning and to support structural changes already initiated in the co-operative banking sector, new forms of financial and technical support were introduced: restructuring bonds, loans, paper credit of NBP, exemption from keeping obligatory reserves as well as tax exemption. Simultaneously, a consolidation process in this sector started, which resulted in the number of failing co-operative banks significantly decreasing. Record number of consolidations (406) took place in 1999 and resulted from the decision by the Bank Supervision Committee, which fixed the required minimum of capital assets for the co-operative banks. The last reform of this sector (started in 2002) resulted in three new associating banks being established (instead of 10 associating banks existing previously) and the number of functioning banks decreasing by next 37 bodies, down to 605. The financial condition of the co-operative banking sector is still not good and according to official data deteriorated insignificantly in 2002 (Herer, Pszkit 2003, p. 54–73.).

2. PRINCIPLES OF CONSTRUCTION OF BUSINESS FAILURE PREDICTION MODELS

As was already mentioned, the process of bank failure lasts several years and in the following phases, as the symptoms of bankruptcy are cumulating, the early warning models (systems) allow to predict this phenomenon. Such models are constructed mainly for institutions, which are responsible for the general condition ("health") of the banking sector. Model indications enable to undertake a proper activity, aimed at counteracting the bankruptcy. On the other hand, customers, especially those who have deposited their savings in the bank, are also interested in the information on its financial condition and likelihood of its bankruptcy.

Taking into account the methods used for the construction of early warning systems, two groups of these systems can be distinguished:

a) systems based exclusively on the analysis of ratios, which describe functioning and financial condition of a bank;

b) systems combining financial ratios and formal, statistical methods.

The most famous systems from the first group are CAMEL and BOPEC (Bartkowiak 1997, pp. 99-117), as well as the system constructed and used by the Bank Guarantee Fund (BFG) (Konat, Sowińska 2002). The method of "standardized aggregate indicators" proposed by R. Szewczyk (Szewczyk 1997, pp. 87-98) belongs to the same group. Unfortunately, the author does not present any empirical verification of the suggested method.

M. Zaleska presents early warning systems from the second group (Zaleska 2002). According to her opinion, the use of simple analytical tools and basic, publicly available information (included in the financial reports or calculated on this basis), allows to predict, with a high accuracy, the bankruptcy of a bank. Moreover, she indicates how to construct and use some more complicated early warning systems, which are built by institutions external to the banks. Unfortunately, she does not present any concrete examples of the bankruptcy prediction model for the banking sector.

In the further part of this article we are going to present business failure prediction models for Polish commercial banks. Our models combine the financial ratio analysis with the discriminant analysis. The ratio analysis is a traditional tool for the analysis of the financial condition of any economic entity. The discriminant analysis is a statistical method most often used in order to construct business failure prediction models. In spite of various shortcomings of this method, it has not been proved till now that there is any other method which gives definitely better failure forecasts than the discriminant analysis. Estimation of discriminant function requires data concerning both distressed and healthy banks. Due to difficulties in obtaining such data, up to now discriminant analysis was not used for the construction of bankruptcy prediction models for the banking sector in Poland.

Our models can be used to classify banks described by a fixed set of variables, to one of the following two groups: a group of "good" banks, which can be recommended to clients; and a group of banks in a bad financial condition which are likely to fail. The models are constructed in such a way that after putting variables' values for a given bank into each of them, the score is obtained which is the basis for its classification to one of the mentioned above groups. In the models construction we have assumed zero as the score value, which discriminates banks between the two groups: positive score values will indicate good banks, negative values – banks threatened with bankruptcy.

Let us assume that each analyzed object (bank) is described by K variables $X_1,$ ..., X_k. Discriminant function for an object characterized by K-dimensional column vector x, including values of these variables, is described by the following equation :

$$D(x) = (\bar{x}_0 - \bar{x}_1)^T S^{-1} x - \frac{1}{2}(\bar{x}_0 - \bar{x}_1)^T S^{-1}(\bar{x}_0 + \bar{x}_1) \tag{1}$$

where:

$\bar{x}_i$ - stands for K-dimensional column vector of average values of variables describing objects in group i ($i = 0$ for good banks, $i = 1$ for default banks)

x - stands for K-dimensional vector of values of variables describing the classified object

S - stands for KxK-dimensional variance-covariance matrix, estimated on the basis of the total sample.

If we accept the following notation:

$$a = \begin{pmatrix} a_1 \\ a_2 \\ \dots \\ a_K \end{pmatrix} = S^{-1}(\bar{x}_0 - \bar{x}_1) \qquad (2)$$

and

$$a_0 = -\frac{1}{2}(\bar{x}_0 - \bar{x}_1)^T S^{-1}(\bar{x}_0 + \bar{x}_1). \qquad (3)$$

then the discriminant function (1) can be rewritten as follows:

$$D(x) = a^T x + a_0 = a_1 x_1 + a_2 x_2 + \dots + a_K x_K + a_0. \qquad (4)$$

It clearly results from the above formulas that the discriminant function is a linear combination of variables values for the classified object. Coefficients of this combination are calculated from the estimation of average values and variance-covariance matrix of variables, which describe the objects.

The formal condition of applicability of formula (1) for the calculation of the discriminant function coefficients is invertibility of variance-covariance matrix. In order to fulfil this condition, variables in the discriminant function should not be strongly correlated.

The average values of variables which describe classified objects play a special role in the discriminant analysis. Vectors x_i characterize so called profiles of objects in each group. The more diversified profiles of both groups, the more accurate is the classification of analyzed objects with the use of the constructed model.

An estimation of the discriminant function coefficients proceeds in two steps.

Step I:
estimation of
a)   vectors $\bar{x}_i$ of average values of all variables in the group i

$$\bar{x}_i = \begin{bmatrix} \bar{x}_{i1} \\ \cdot \\ \cdot \\ \bar{x}_{iK} \end{bmatrix}, \qquad \text{where} \quad \bar{x}_{ik} = \frac{\sum_{j=1}^{N_i} x_{ijk}}{N_i} \qquad i = 0, 1$$

(5)

b)   variance-covariance matrix of variables

$$S = \frac{1}{n} \sum_{i=0}^{1} \sum_{j=1}^{N_i} \left(x_{ijk} - \bar{x}_{ik} \right)\left(x_{ijk} - \bar{x}_{ik} \right)^T , \text{ where } n = \sum_{i=0}^{1} N_i - 2. \qquad (6)$$

In the above formulas :

x_{ijk} - stands for value of variable X_k for object j which comes from group i ($i = 0,1; j = 1,\ldots,N_i ; k = 1,\ldots,K$)

N_i - size of this part of sample which was taken from group i ($i = 0,1$)

$\bar{x}_{ik}$ - average value of variable X_k in group i ($i = 0,1$)

Step II:
Using formulas (2) and (3), values of discriminant function coefficients are calculated.

3. DESCRIPTION OF THE CONDUCTED ANALYSIS

The fundamental influence on the estimation results presented in this paper had the selection of the sample, consisting of banks from both analyzed groups. We started the sample selection based on the information included in Table 2 on the evolution in the commercial banking sector after 1992. First, we compiled a list of banks which were threatened with severe financial distress or even bankruptcy in 1992 – 2002, whatever was the issue of that situation (declaration of bankruptcy, take-over by another bank or the successful execution of restructuring program). Each bankrupt bank was matched with a healthy one. Pairs in the sample were

matched according to their total assets. One analyzed bank (Gliwicki Bank Handlowy) appeared twice in the sample: in the group of good banks with the financial report for 1992 and in the group of banks threatened with bankruptcy with the financial report for 1999. This fact is taken into consideration when the received results are discussed. The primary list of banks in each group consisted of 28 entities. Because of missing data needed for model estimation the final sample included only 19 good banks and 19 poor ones (see table 6).

One of the main assumptions in our study was that only publicly available information on the commercial banks should be used for model construction. For that reason we based our analysis on the data published every year in "Gazeta Bankowa" complete with the annual rankings of Polish banks. Data (financial reports) for the paired banks always came from the same calendar year. Financial reports for poor banks were drawn up at the end of the last reporting period, before their financial difficulties started. Unfortunately, the list of variables describing commercial banks published in "Gazeta Bankowa" were subject to changes from one year to another. This was the fundamental restriction which limited the final list of variables used for model construction.

Banks included in the analysis were described by the following nine variables (only these variables could have been calculated on the basis of information published in "Gazeta Bankowa"):

- indices of dynamics of:

branches, fixed assets, total assets, credits, deposits;

- financial ratios:

irregular receivables to credits, securities to total assets, total assets to employee, solvency ratio.

The average values of analyzed ratios for both groups of banks are presented in table 3. The fundamental importance for discrimination accuracy of the model is the differentiation of variables average values between the groups. Therefore in table 3 coefficient R_k^* is presented, which describes the relationship between average values of individual variables in both groups:

$$R_k^* = \frac{\max\{\bar{x}_{0k}, \bar{x}_{1k}\}}{\min\{\bar{x}_{0k}, \bar{x}_{1k}\}}. \tag{7}$$

The closer to 1 is the value of such a coefficient, the less dispersed are average values of variables in both groups. It results from table 3 that the most important for discrimination between distressed and healthy banks is "securities to total assets" ratio and the least important – "irregular receivables to credits" ratio.

Table 3

Average values of variables in examined groups of banks

Ratio	Symbol	Average value		Coefficient
		Distressed banks	Healthy banks	R_k^*
Dynamics indices				
Number of branches	D_ODDZ	1.600	1.222	1.31
Fixed assets	D_MTRW	3.159	2.047	1.54
Total assets	D_SUMB	1.962	1.579	1.24
Credits	D_KR	2.029	1.740	1.17
Deposits	D_DEP	2.281	1.656	1.38
Financial ratios				
Irregular receivables to credits	F_NIER	0.179	0.183	1.02
Securities to total assets	F_PAP	0.090	0.177	1.97
Total assets to employee	F_SUMZ	1.972	2.674	1.36
Solvency	F_WYP	26.939	20.838	1.29

Source: Authors' estimates based on the annual financial information from "Gazeta Bankowa"

The above ratios characterizing both: dynamics of changes and financial condition of banks were the basis for the estimation of several variants of discriminant models (1). Estimation procedure was realized using the software packages *Statistica* and *Statgraphics*. The purpose of those calculations was to find out whether variables taken into consideration enable to construct a model which can be used to assess the banks' situation and to define whether a bank is threatened with bankruptcy. For the statistical verification of all analyzed models the significance level of $a = 0,1$ was accepted. Coefficients of the models were calculated in both a standardized and an unstandardized form. Models with unstandardized coefficients are more convenient for practical use (the score for the classification of any bank is calculated by putting the original values of variables into the model equation). There is one shortcoming of unstandardized models; it is impossible to describe the relative influence of each variable on the value of the discriminant function, because the value of model coefficients depends on the units in which variables are expressed. In order to obtain information on relative influence of each variable, standardized coefficients must be calculated.

Further the best two discriminant models will be presented. The starting point for the estimation of MODEL I was a discriminant function with all nine variables. After rejection of the three least significant variables, the results presented in table 4 were obtained.

Table 4

Estimation results – MODEL I

Model variables	Standardized coefficients	Unstandardized coefficients	P-value	Toleration coefficient
D_MTRW	0.73725	0.167382	.318247	.211706
D_KR	1.34788	0.712528	.089302	.177995
D_DEP	-1.57103	-0.797088	.052510	.168238
F_PAP	0.93246	7.865850	.020225	.667314
F_SUMZ	0.62825	0.331992	.086823	.831585
F_WYP	-0.90279	-0.030246	.207532	.222975
CONSTANT		-1.308040		

Classification accuracy			
Distressed banks		Healthy banks	Total
78.95%		57.89%	68.42%

Source: Authors' estimation

As it results from table 4, the unstandardized equation of MODEL I is as follows:

$$D(x) = 0.167 \times D\_MTRW + 0.713 \times D\_KR - 0.797 \times D\_DEP + 7.866 \times F\_PAP +$$
$$+ 0.332 \times F\_SUMZ - 0.03 \times F\_WYP - 1.308$$

Table 5

Discriminant function (MODEL II) – stepwise "backward" analysis

Model variables	Standardized coefficients	Unstandardized coefficients	P-value	Toleration coefficient
D_KR	1.20183	0.63532	.135427	.191623
D_DEP	-1.40568	-0.71319	.085401	.183884
F_PAP	0.78857	6.65211	.029474	.911050
F_SUMZ	0.66992	0.35401	.080290	.835691
CONSTANT		-1.50368		

Classification accuracy			
Distressed banks		Healthy banks	Total
78.95%		68.42%	73.68%

Sources: Authors' estimation

There are still two insignificant variables in the model (at $\alpha = 0,1$), but the classification accuracy rate for distressed banks amounts to almost 80%. The classification accuracy in the case of healthy banks is definitely worse. Detailed information on the classification results based on MODEL I is presented in table 6.

Table 6

Classification results according to MODEL I and MODEL II indications

Classification results		Data source
Distressed banks	**Healthy banks**	
Baltic Bank Gdańsk	Invest Bank Poznań	1992
Bank Ziemski Warszawa	Gliwicki Bank Handlowy*/**	1992
Bank Komercyjny Posnania	WBK Poznań	1992
DEG Bank Secesyjny Katowice	Bank Gdański	1992
Bydgoski Bank Komunalny	Wschodni Bank Cukrownictwa*/**	1992
AGROBANK Warszawa	Bank Ochrony Środowiska*	1993
ANIMEX Bank Warszawa	Pomorski Bank Kredytowy	1993
Bank Morski Szczecin	Bank Komunalny Gdynia*	1996
Bank Częstochowa	Pierwszy Polsko-Amerykański Bank	1997
Bank Rozwoju Cukrownictwa Poznań	Bank Przemysłowy Łódź*/**	1997
Bank Podlaski Siedlce	Polsko-Kanad. Bank Św. Stanisława	1997
Bank Ziemi Radomskiej (Energetyki)*/**	BISE Warszawa*/**	1997
Bank Staropolski Poznań	Gospodarczy Bank Pd.-Zach.	1998
Bud-Bank Warszawa*/**	Bank Pocztowy Bydgoszcz	1998
Gliwicki Bank Handlowy	Gospodarczy Bank Wlkp.	1999
Bank Własności Pracowniczej	Cukrobank Wrocław*/**	2000
Bank Wschodni Białystok*/**	Bank Unii Gospodarczej	2000
Bank Współpracy Regionalnej*/**	Bank Amerykański in Poland	2000
Bank Społem Warszawa	Raiffeisen Centrobank*/**	2000

Source: Authors' compilation

Misclassified banks are marked with stars (* – according to model I, ** – model II)

The application of the stepwise "backward" discriminant analysis resulted in the estimation of MODEL II containing four variables (see table 5). As a result of table 5, the unstandardized equation of MODEL II has the following form:

MODEL II is the best one among all the models estimated in our study

$$"D(x) = 0.635 \times D\_KR - 0.713 \times D\_DEP + 6.652 \times F\_PAP + 0.354 \times \\ \times F\_SUMZ - 1.504"$$

and therefore we suggest that it may be used as a basic tool for business failure prediction in the commercial banking sector in Poland. Let us recall that negative value of $D(x)$ indicates banks which should be considered as threatened with bankruptcy. Therefore, a negative value of model coefficient leads to the conclusion that the increasing value of the particular variable increases the bank propensity to fail. Increasing values of variables with positive model coefficients decrease bank propensity to fail. As the result of the standardized coefficient values, dynamics changes have a stronger influence on the bank propensity to fail than the analyzed financial ratios.

Information on classification accuracy rate for MODEL I and MODEL II is presented in table 6. As a matter of fact, the general accuracy of classification is not the best, but in the case of distressed banks the accuracy amounts to almost 80%. Moreover – both models classify in exactly the same way all banks considered in the analysis as threatened with bankruptcy. Some differences appeared in indications of the models for healthy banks. Since we use the model first of all as a tool for business failure prediction, therefore the incorrect classification of healthy banks is less "painful" to us.

Four banks considered in the analysis as threatened with bankruptcy were misclassified by both models. We will analyze closer these banks. Bank Ziemi Radomskiej should be considered jointly with BISE (a healthy bank classified by both models as a distressed one). Both mentioned banks consolidated in 1997. In fact, in the case of mergers it is very difficult to find out from "outside" which bank was in a good condition and which one was likely to fail. So, it cannot be excluded that we have made a wrong assumption in our analysis and the models indicated the real financial condition of these banks.

The second misclassified bank was Bank Współpracy Regionalnej. In the analysis we considered this bank as distressed due to its incorporation into the Group Deutsche Bank and following this event name modification. Our assumption was based on the experience that in many cases the acquisition process was caused by difficulties in the functioning of the incorporated bank. The positive discriminant score obtained in our study for Bank Współpracy Regionalnej is probably evidence of the fact that this merger had another reason.

In the case of two banks, Bud-Bank and Bank Wschodni, we are not able to explain why the classification obtained with use of the models is different from ours. We have classified Bud-Bank as likely to fail because since 1999 it has been controlled by Bank Gospodarstwa Krajowego. Unfortunately, there is no available information which would help to explain whether there

was another reason for this control than the poor financial condition of Bud-Bank. Bank Wschodni experienced severe financial difficulties and was taken over by Bank Społem in 2002. There is no reasonable explanation of the fact that both models classified this bank as a healthy one.

In our opinion several misclassifications of banks which were considered in our analysis as not distressed, can suggest that the difficulties experienced by commercial banks in Poland in recent years were more severe than officially declared and published. At least in some cases a detailed analysis leads to a judgement that the indications of the models seem to be correct. Both discriminant models misclassified Gliwicki Bank Handlowy and Wschodni Bank Cukrownictwa. The results obtained for these banks confirm the common thesis that bankruptcy never appears suddenly but is always a long-lasting process. The official information that Gliwicki Bank Handlowy had financial difficulties appeared seven years after the date when the data used in our analysis was collected. For Wschodni Bank Cukrownictwa the first official information on its financial difficulties was "delayed" for ten years. Bank Komunalny Gdyni, misclassified by MODEL II, required (in order to survive) additional external capitalization five years later. Based on officially published information, we cannot find justification for the wrong classification of Bank Ochrony Środowiska and Raiffeisen Bank Polska.

In order to test the applicability of our models to business failure prediction in the case of banks not included in the estimation sample, we used them to classify banks from the 2003 ranking of "Gazeta Bankowa". Table 7 includes values of the discriminant function for those banks, resulting from both models. The most surprising result is that both models classified GE Capital Bank as threatened with bankruptcy. According to the ranking of "Gazeta Bankowa" this bank was considered as the best one among small banks. The wrong indication of our models may result from the fact that GE Capital Bank is a specialized bank, focused on credit activity. In comparison with the other (universal) banks, GE Capital Bank has a very low value of securities to total assets ratio, which is a significant variable in both models. In such case models based on only a few variables may give wrong indications. This remark can also be an explanation for the misclassification of the mortgage bank HypoVereinsbank.

„Gazeta Bankowa" has not classified the remaining banks which according to the discriminant function indications were threatened by bankruptcy. The main reason that the banks were not classified in "Gazeta Bankowa" was missing financial data. For this reason it cannot be excluded that the classification of our models is correct.

The best bank on our list – WestLBank – was not classified by "Gazeta Bankowa" due to missing information. However, the second and third banks on our list – Deutsche Bank and ABN Amro – have a leading position also in the ranking of "Gazeta Bankowa". Also Dominet Bank can be a confirmation of the indication accuracy of our models. The discriminant scores for this bank are negative which suggests financial distress. Dominet Bank was established in 2002 on the basis of Cuprum Bank and there are no positive changes in its financial condition yet. Our models also confirmed the poor financial condition of BISE, which is probably a result of the Cukrobank acquisition in 2002.

Table 7

Commercial banks in Poland 2003 – discriminant scores and the resulting ranking

Bank	MODEL I	Bank	MODEL II
WestLB Bank Polska	9.0808	WestLB Bank Polska	8.5410
Deutsche Bank Polska	8.8304	Deutsche Bank Polska	8.1350
ABN AMRO Bank (Polska)	6.0277	ABN AMRO Bank (Polska)	5.6727
CC-Bank	4.1333	BRE Bank	3.4106
BRE Bank	3.2552	Bank Handlowy w Warszawie	2.8888
Bank Handlowy w Warszawie	2.8741	Bank Amerykański w Polsce	2.8527
Bank Amerykański w Polsce	2.8171	Bank Pekao SA	2.0794
Bank Gospodarstwa Krajowego	2.4633	Bank Gospodarki żywnościowej	2.0559
Credit Lyonnais Bank Polska	2.2008	Bank Gospodarstwa Krajowego	1.9586
Bank Pekao SA	1.9133	PKO Bank Polski	1.9554
Bank Przemysłowo-Handlowy PBK	1.7668	Bank Przemysłowo-Handlowy PBK	1.8854
Bank Gospodarki żywnościowej	1.6716	Gospodarczy Bank Wielkopolski	1.8774
PKO Bank Polski	1.5922	Bank Millennium	1.7586
GE Bank Mieszkaniowy	1.5901	Credit Lyonnais Bank Polska	1.5900
Gospodarczy Bank Wielkopolski	1.5130	Lukas Bank	1.5760
Bank Millennium	1.4503	Bank Zachodni WBK	1.5680
HypoVereinsbank Bank Hipoteczny	1.4123	GE Bank Mieszkaniowy	1.4350
GMAC Bank Polska	1.3732	Górnośląski Bank Gospodarczy	1.2808
Lukas Bank	1.3303	Kredyt Bank	1.2443
Deutsche Bank 24 Polska	1.3261	Deutsche Bank 24 Polska	1.2103
Bank Zachodni WBK	1.2726	Raiffeisen Bank Polska	1.1147
Fortis Bank Polska	1.1786	Fortis Bank Polska	1.0298
Górnośląski Bank Gospodarczy	1.0825	GMAC Bank Polska	0.9320
Raiffeisen Bank Polska	1.0477	Mazowiecki Bank Regionalny	0.7964

Kredyt Bank	1.0100	Bank Ochrony Środowiska	0.6280
Volkswagen Bank Polska	0.9447	LG Petro Bank	0.3127
Mazowiecki Bank Regionalny	0.8496	AIG Bank Polska	0.3023
Bank Ochrony środowiska	0.6007	ING Bank Śląski	0.1670
Bank Współpracy Europejskiej	0.4981	BISE	0.1626
AIG Bank Polska	0.3876	Bank Pocztowy	0.1583
LG Petro Bank	0.3375	Bank Współpracy Europejskiej	0.1419
FCE Bank Polska	0.3231	**FCE Bank Polska**	**-0.0082**
ING Bank Śląski	0.2138	**Invest-Bank**	**-0.0367**
Nordea Bank Polska	0.1601	**HypoVereinsbank Bank Hipoteczny**	**-0.0408**
Bank Pocztowy	0.0346	**Nordea Bank Polska**	**-0.2623**
Invest-Bank	**-0.0159**	**Dominet Bank**	**-0.2960**
BISE	**-0.0237**	**GE Capital Bank**	**-0.4150**
Dominet Bank	**-0.2681**	**CC-Bank**	**-9.3242**
GE Capital Bank	**-0.4197**		

Source: Authors' estimation

Note: Only those banks from the list published in "Gazeta Bankowa" are considered for which it was possible to compile ratios included in the models. Negative values of the discriminant functions indicate banks threatened with bankruptcy (marked in bold).

CONCLUSIONS

Models presented in the paper enable an easy classification of commercial banks in Poland on the basis of publicly available information. Negative discriminant scores (model values) indicate distressed banks, whereas positive discriminant scores (model values) indicate banks, which within one year are not likely to fail. The classification accuracy of the bankruptcy-threatened banks for both models is almost 80%. The models are identically precise in forecasting business failure. Model II is better in the recognition of banks in a good condition. The misclassification of several banks officially recognized as good, allow us to draw a conclusion that the general economic and financial condition of the commercial banks in Poland is worse than is publicly presented.

REFERENCES

Appenzeller D., Nowara W., *Procesy upadłościowe banków komercyjnych na tle ewolucji sektora bankowego w latach 1989–2001* [*Bankruptcy phenomenon of commercial banks and the evolution of the banking sector in 1989 –2001*], Ruch Prawniczy, Ekonomiczny i Socjologiczny no. 4, 2002.

Bartkowiak R., *Kryteria i metody oceny zagrożenia wypłacalności banku. Wnioski z doświadczeń Bankowego Funduszu Gwarancyjnego dla budowy systemu wczesnego ostrzegania* [*Criteria and methods for the evaluation of the impendency of bank insolvency. Conclusions from the experience of BFG for the construction of early warning systems*], Bezpieczny Bank no. 1, 1997.

Hadasik D., *Upadłość przedsiębiorstw w Polsce i metody jej prognozowania* [*Business failure in Poland and the methods for its forecasting*], Poznań 1998, Zeszyty Naukowe AE [Research Papers of the PUE] no. 153.

Herer A., Pszkit A., *Ocena sytuacji ekonomiczno-finansowej sektora banków spółdzielczych w 2002 roku* [*Evaluation of the economic and financial condition of the co-operative banking sector in 2002*], Bezpieczny Bank no. 1, 2003.

Konat W., Sowińska I., *System monitorowania w BFG sytuacji banków komercyjnych* [*System of monitoring the commercial banks condition at BFG*], paper presented at the BFG seminar on „Systems for financial and economic assessment of the banks", Warsaw February 28, 2002.

Miklaszewicz A., *Samopowielające się bankructwa* [*Self-duplicating bankruptcies*], Prawo i Gospodarka no. 78, 1999.

Sinkey J.F. Jr., *Commercial Bank Financial Management in the Financial Services Industry*, Macmillan Publishing Company, New York, 1992.

Solarz J., *Zarządzanie strategiczne w bankach* [*Strategic management in banks*], Poltext, Warszawa 1997.

Szewczyk R., Kryteria i metody analizy zagrożenia wypłacalności banku – wnioski dla budowy systemu wczesnego ostrzegania [*Criteria and methods for the analysis of the impendency of bank insolvency – conclusions for the construction of the early warning systems*], Bezpieczny Bank no. 1, 1997.

Zaleska M., *Identyfikacja przez deponentów banków zagrożonych upadłością* [*Identification of distressed banks by customers*], Bank i Kredyt no. 8, 2002.

Zdanowicz B., Obal T., *Pierwotne źródło – złe zarządzanie* [*Primary source – bad management*], Bank no. 3, 1991.