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Building a Scoring Model for Small and Medium Enterprises

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Abstract. *The purpose of the paper is to produce a scoring model for small and medium enterprises seeking financing through a bank loan. To analyze the loan application, scoring system developed for companies is as follows: scoring quantitative factors and scoring qualitative factors. We have estimated the probability of default using logistic regression. Regression coefficients determination was made with a solver in Excel using five ratios as input data. Analyses and simulations were conducted on a sample of 113 companies, all accepted for funding. Based on financial information obtained over two years, 2007 and 2008, we could establishe and appreciate the default value.*

Keywords: scoring; small and medium enterprises; credit risk management; banking system; logistic regression.

JEL Codes: C52, G21, G32, M21, O16.
REL Code: 14K.

1. Introduction

The purpose of the paper is to produce a scoring model for small and medium enterprises seeking financing through a bank loan. This has considered aspects of company management, product or service quality and customer profitability, market position, results of economic and financial, banking experience and, finally, determine customer ability to repay the loan. To analyze the loan application, scoring system developed for companies is as follows: Scoring quantitative factors (Current ratio, Duration of restraint inventory, Receivables collection period, Duration of payment of suppliers, Solvency Ratio, *Gross profit* margin, ROA) and Scoring Qualitative factors (Management, Shareholders, Market position, Transactional behavior).

We have estimated the probability of default using logistic regression - *logit* type. Regression coefficients determination was made with a solver in Excel using the following ratios as input data: working capital/total assets; gross profit/total assets; earnings before interest and taxes (EBIT)/total assets; net worth/total liabilities; sales/total assets.

Analyses and simulations were conducted on a sample of 113 companies, all accepted for funding. Based on financial information obtained over two years, 2007 and 2008 respectively, we could establishe and appreciate the default value. For comparison a linear regression was used, too.

2. Scoring quantitative factors

2.1. Current Liquidity = Current Assets/Current Liabilities

Table 1

Margins and score

Min		Max	Score
1,30	**<= X <**		**7**
1,10	**<= X <**	1,30	5
1,00	**<= X <**	1,10	3
0,00	**<= X <**	1,00	1

2.2. Duration of restraint inventory = *No. days * Inventory/COGS*

Table 2

Margins and score

Min		Max	Score
90	**< X =<**		0
60	**< X =<**	90	1
30	**< X =<**	60	2
0	**< X =<**	30	**3**

2.3. Receivables collection time = *Number of days * Customer/Sales*

Table 3

Margins and score

Min		Max	Score
90	< X =<		0
60	< X =<	90	2
30	< X =<	60	3
0	< X =<	30	**4**

2.4. Duration of payment of suppliers = *Number of days * Suppliers/COGS*

Table 4

Margins and score

Min		Max	Score
90	< X =<		0
60	< X =<	90	2
0	< X =<	60	**4**

2.5. Solvency = Equity/Total liabilities

Table 5

Margins and score

Min (%)		Max (%)	Score
10.00	<= X <		**9**
7.00	<= X <	10.00	6
5.00	<= X <	7.00	3
	< X <	5.00	0

2.6. Indebtedness = *Debt/Equity*

Equity includes also loans from shareholders if they are subordinated bank debt.

Table 6

Margins and score

Min (%)		Max (%)	Score
0.00	< X <=	200.00	**6**
200.00	< X <=	400.00	5
400.00	< X <=	600.00	3
600.00	< X <=		0

2.7. Increased Turnover = *(S1-So) / So*

(Turnover this year – turnover of the previous year)/turnover of the previous year).

Table 7

Score	
Increasing trend	**7**
Constant	4
Decreasing trend	0

2.8. *Gross profit* **margin = gross profit/***turnover*

where gross profit = turnover - cost of goods sold

Table 8

Margins and score

Min (%)		Max (%)	Score
10.00	**<= X <**		**8**
0.00	**<= X <**	10.00	4
	< X <	0.00	0

2.9. ROA = Net profit/Total assets [%]

Table 9

Margins and score

Min (%)		Max (%)	Score
5.00	**<= X <**		**2**
0.00	**< X <**	5.00	0

2.10. Interest Coverage (Time interest earned) = Earnings *before net interest costs and tax/Interest expense*

Table 10

Margins and score

Min		Max	Score
3	**< =X <**		**10**
2	**< =X <**	3	8
1	**< =X <**	2	5
	X <	1time	0

2.11. Risk in the FX rate = revenue/expenditure on FX

(Where neither revenue nor expenditure in FX will be given the maximum score)

Table 11

Margins and score

Min		Max	Score
1.50	< =X <		5
1.00	< =X <	1.50	3
	X <	1time	0

Quantitative factors TOTAL: 65 points

3. Scoring qualitative factors

3.1. Management

The score given to each criterion assesses the quality of senior management and it is divided into four intervals bounded by values and corresponding grades, as follows:

-9 (very bad)	-5 (low)	0 (satisfactory)	5 (good)	9 (very good)

The most important and suggestive information is:

1. Previous experience and achievements in other companies or existing company.
2. Reputation and integrity of management according to a third source (the company, the business community, industry).
3. Assessment of leadership in terms of how work is organized both in terms of carrying on (set-up) and the organization.
4. Frequent changes in management team over the last three years with negative impact on company business.
5. Relationship with Bank X (refers to how customers respond to Bank requirements, transparency, flexibility etc.).
6. There is currently litigation or other potential liabilities arising from past experience with other management companies?

3.2. Shareholders

The score given to each criterion assesses the quality of senior management and it is divided into four intervals bounded by values and corresponding grades, as follows:

-12 (very bad)	-6 (low)	0 (satisfactory)	6 (good)	12 (very good)

They established the following criteria:

1. Quality of ownership (financial analysis/listing and stock performance/references from banks or other recognized institutions, other information).

In case of individual shareholders will be considered also the personal property.

2. Reputation and integrity of the shareholders according to a third source (community business sector).

3. The shareholders successors (maximum points will be awarded if the criterion does not apply (Ex: companies listed on stock exchanges); if there is a consistent concern of shareholders on the company's development policy.

4. Involvement and support of the shareholders to the company drives (in terms of experience in the field, of financing the company or any other assistance, support).

5. There is currently a dispute or a potential obligation arising from activities of the shareholders that could affect the company image? (If no information this criterion does not apply).

3.3. Market position

Scoring offered:

-6 (very bad)	-3 (low)	0 (satisfactory)	3 (good)	6 (very good)

Criteria:

1. Coverage of market/market share should be judged strictly related to company size (local/national/multinational)

2. Recognition/reputation of the trademark as a result of marketing efforts.

3. Potential development opportunities? Developing core business? Entering new market segments in growing? Diversification of products?

4. Market reputation due to information received from third party/sources (customers, suppliers, competition etc.).

5. The company's ability to develop or maintain a competitive advantage to a better market position.

3.4. Transactional behavior

- Will be evaluated based on customer history from the database of the host bank and NBR (CIP and CRB) and after its availability to provide information requested by the bank.

Table 12

Transactional behavior

	Event	Observations	Score
CIP	major incidents (prohibition to issue checks)		**-2**
	minor incidents, more than one case (insufficient resources to pay promissory notes)	reasonable explanation	**-1**
	minor incidents (one case)	reasonable explanation	**0**
	any incident		**2**
CRB x = number of days of delay	x > = 30		**-2**
	15 < x < 30		**-1**
	x <= 15	reasonable explanation	**0**
	x = 0		**2**
OUTSTANDING x = number of days of delay	x > = 30		**-6**
	7 < x <30	reasonable explanation	**-4**
	2 < x <= 7	reasonable explanation	**0**
	x <= 2	reasonable explanation	**4**
	x = 0		**6**
Audit opinion or **CPA** report	minor discrepancies		**-2**
	no mentions regarding potential discrepancies in financial statements		**2**
Transparency	opposition		**-1**
	can not be appreciated		**0**
	availability		**1**

Qualitative factors TOTAL: 40 points

Total factors: 105 points

Depending on financial performance and debt service, loans are classified into five categories (Table 13).

Table 13

Categories

CLASSIFICATION					
Classification		**Category**	**Score**		
1	Standard	A	**70**	<= X <	105
2	In observation	B	**50**	<= X <	70
3	Substandard	C	**30**	<= X <	**50**
4	Doubtful	D	**15**	<= X <	**30**
5	Loss	E	**0**	<= X <	**15**

Source: www.bnr.ro

After placing the credit in one of these categories the bank should determine the cost of credit that will be granted.

4. Setting score by logistic regression

Score function is a linear expression as follows:

$$Scor = b_0 + b_1 \times x_1 + b_2 \times x_2 + \ldots + b_n \times x_n \tag{1}$$

where

x_i representative factors influencing the probability of default;

b_i are coefficients to be determined by the k factors.

If we consider a logistic regression *logit* type, the default probability can be written:

$$\begin{aligned} &\log it(p_1) = \log \frac{p_1}{1-p_1} \\ &\vdots \\ &\log it(p_1 + p_2 + \ldots + p_k) = \log \frac{p_1 + p_2 + \ldots + p_k}{1-(p_1 + p_2 + \ldots + p_k)}, p \in [0,1] \end{aligned} \tag{2}$$

where

$$p = \frac{1}{1 + \exp(-(b_0 + b_1 \times x_1 + b_2 \times x_2 + \ldots + b_n \times x_n)} \tag{3}$$

or

$$\Pr ob(default) = \frac{1}{1 + \exp(-(b_0 + b_1 \times x_1 + b_2 \times x_2 + \ldots + b_n \times x_n)} \tag{4}$$

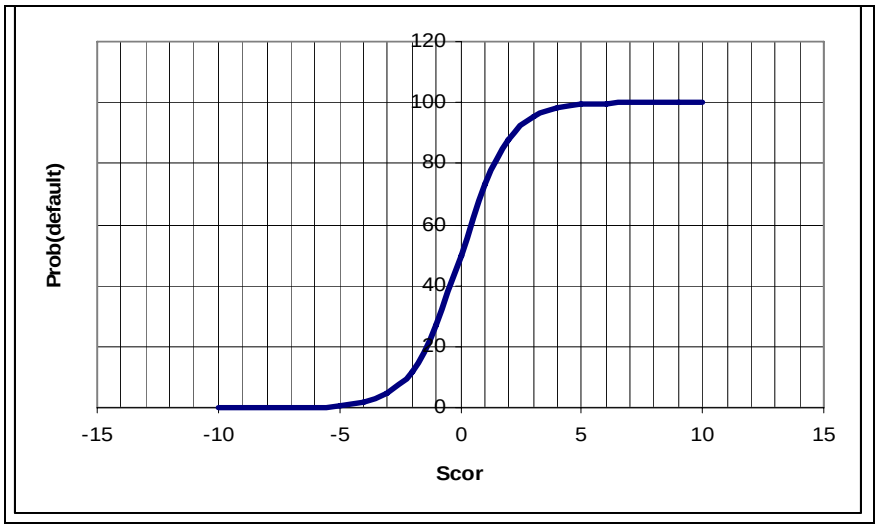

Figure 1. *Graph function LOGIT*

Regression coefficients determination was made with a solver in Excel using the following ratios as input data:

- working capital/total assets;
- **gross profit/total assets;**
- **earnings before interest and taxes (EBIT)/total assets;**
- **net worth/total liabilities;**
- **sales/total assets.**

Analyses and simulations were conducted on a sample of 113 companies, all accepted for funding. Based on financial information obtained over two years, 2007 and 2008 respectively, we could establishe and appreciate the default value.

Depending on the original values there are obtaining b_i values and their corresponding standard error (SE)(Table 14).

Table 14

Coefficients

Variable	Estimate	SE
Intercept	-4.12804	1.101179
0.639162530388979	-0.64749	2.215812
2.11E+11	-2.25454	10.05861
1.19E+11	6.440458	12.48921
1.86E+11	0.040253	0.169492
0.541852377093463	-0.87148	1.243482

In the column *Variable* is passed the first value of each vector of data considered for identifying the position of each factor and in *Estimate* and *SE* are shown the coefficients and the corresponding error.

Insert Report $t = \frac{b}{SE(b)}$. Its values are listed in Table 15.

In the logit model, the ratio *t* distribution is not similar to a classical linear regression. To make a comparison with a standard normal distribution one can introduce *p* according to the relationship:

$$p_{value} = (1 - normsdist\ (abs\ (t))) \times 2 \quad (5)$$

where *normsdist* is a command in Excel that returns the function of cumulative standard normal distribution.

Table 15

Output data for the logit function

	CONST	WC/TA	GP/TA	EBIT/TA	NW/TL	S/TA
b	-4.12804	-0.64749018	-2.25454	6.440458	0.040253	-0.87148
SE(b)	1.10118	2.2158119	10.0586	12.48921	0.169492	1.243482
t	-3.75	-0.29	-0.22	0.52	0.24	-0.70
p-value	0.000	0.770	0.823	0.606	0.812	0.483

In non linear models estimated with maximum probability one should calculate pseudo-R^2. It is calculated as one minus the ratio of estimated log likelihood *(ln* L) and a constant *(ln* L_0). Log-likelihood probability function is given by the last iteration of the Newton procedure, already available.

$$PseudoR^2 = 1 - \frac{\ln L_{Model}}{\ln L_{Intercept}} \quad (6)$$

Table 16

Pseudo R squared

Logit Maximum Likelihood Results For Dependent Variable: 0	
Number of X Variables	6
Iterations	10
Mean of Dep Var	0.008889
lnL	-10.8841
Pseudo R Squared	0.04834

In addition to the above values, the program displays: total number of iterations, the average distribution, standard deviation (Table 17).

Table 17

Mean and standard deviation

X Variable	Mean	SD
Intercept	1	0
0.639162530388979	-0.00401	0.332337
2.11E+11	0.080309	0.200469
1.19E+11	0.037573	0.11534
1.86E+11	0.117623	3.424879
0.541852377093463	1.278489	1.664995

After determining the regression coefficients can be calculated probability of default by the relationship (3) or (4). For comparison a linear regression was used too. Results are presented in Table 18:

Table 18

Logit and linear default probability

ID	Default probability(logit) (%)	Default probability (linear) (%)
1	0.66193	0.26756
1	0.53995	0.00563
2	0.89525	0.84165
2	1.05141	0.52110
3	1.01928	0.58549
3	1.54093	0.71955
4	0.21304	1.11656
4	0.87286	0.86190
5	0.16954	0.89517
5	0.77050	0.76761
6	1.29973	0.99094
6	1.56317	0.78703
7	0.98216	1.03161
7	1.48393	0.74989
8	0.61607	0.97087
8	1.38981	1.32849
9	1.18117	0.74076
9	0.99528	0.64885
10	0.03026	1.17659
10	0.12365	0.91237
11	0.85893	0.89360
11	0.79313	1.27316
12	1.00790	0.85077
12	0.66196	0.64860
13	3.57742	1.60194
13	3.38023	1.09414

From the table above it results that corporate default probabilities are very small so that the maximum probability of default for logistic regression is 3.57742% for the company corresponding to position 13, in year 2007, and 2.86947% for linear regression corresponding to position 53, year 2007.

Based on the obtained values there can be positive or negative development scenarios. A concrete example is presented for the company 13 (Table 19).

Table 19

Scenario analysis

	WC/TA	GP/TA	NW/TL	S/TA
Scenario for variables				
better	0.10	0.65	-0.20	1.20
worse	-0.46	0.20	-1.50	0.40
Scenario default probability				
better	2.64%	2.32%	3.69%	2.81%
worse	3.75%	6.15%	3.51%	5.48%

If the company increases the value (WC/TA) to 10%, then the probability corresponding to this ratio decreases from 3.75% to 2.64%. The same process is repeated for each element analyzed.

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