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SELECTING THE RIGHT TOOL FOR EVALUATING OF SOLVENCY: THE CASE OF LATVIAN ENTERPRISES

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Abstract. Today the role of insolvency turns out to be crucial for the operation of business enterprises and its evaluation is one of the basic tasks of financial analysis. The authors of this article have made research of solvency measurement in Latvia on the basis of national and international statistical data bases Lursoft and Amadeus, as well as tackled theoretical and practical issues of solvency measurement. The objective of the authors is to develop classification methods for solvency measurement and prediction of corporate bankruptcy with the aim to apply these methods in practice, thereby helping the companies to select the alternative methods appropriate for research tasks and company opportunities.

Key words: solvency, methods, solvency measurement classification, solvency measurement methods, grade scale.

1. Introduction

The study of solvency has long been a subject of deeper interest to scholars with most of published material restricted to business and journals specializing in esoteric and other sophisticated subjects.

Bankruptcy predictions and solvency measurements have become important research topics after Altman [1] used the financial ratio methodology in analysis. As the world's economy has been facing several challenges during the past decades, more and more companies are addressing the problems of fighting insolvency.

More than 7.5 thousand Latvian companies have been announced bankrupt during the recent 15 years. During that period the dynamics of growth of insolvency cases on average constituted 13 per cent a year [2]. In the European Union more than 200 thousand companies become insolvent every year, 90 per cent of them are small and medium enterprises being in business not longer than 6 years [3].

Having made the analysis of the values of solvency coefficients of enterprises (ratio of equity versus assets total), the authors came to conclusion that during the period of recent three years the average solvency indicator of Latvian enterprises is the following: in manufacturing – 34 %, in retail – 20 %, in wholesale – 21 %, in construction – 32 %, in business management – 48 % and in art and entertainment industry – 55 %.

The results of the analysis of statistical information taken from the data base Amadeus [4] show that Latvian enterprises apply an incredibly high ratio of loan capital that may expose them to the risk of insolvency.

The findings encouraged the authors to apply grade assessment of the existing models of prediction of corporate bankruptcy and evaluation of insolvency in the world today, taking into account the following characteristics:

- accuracy of information on the basis of which the models were developed
- factor completeness of the model affecting the stability of the enterprise
- complexity of calculations
- effectiveness of results – possibility to use the results achieved in further decision-making processes, as well as opportunity to come to the right conclusions.

The aim of this research is to develop recommendations for enterprises to effectively apply the methods of solvency measurement and prediction of corporate bankruptcy in contemporary businesses with clearly fixed objectives and tasks as well as limited business resources.

2. Evaluation of solvency and prediction of corporate bankruptcy

In the 20th century the application of solvency measurement methods underwent great changes due

to the expansion of exchange of information as well as the expansion of global crisis. Researchers started differentiating between liquid and non-liquid assets and traced the changes of absolute indicators. The relative coefficients of solvency have been used since 1930 [5]. The following methods of solvency measurement and prediction of corporate bankruptcy are widely referred to:

- Two-factor model is one of the simplest methods developed in USA [5]. From the author's point of view this method is not appropriate for use in contemporary Latvian enterprises due to the differences in inflation rate, micro and macroeconomic cycles as well as different business environment.
- Five-factor model (Altman coefficient) was created by Edward Altman in 1968 and was based on the analysis of 66 enterprises. The mathematical accuracy of this model approaches 95 % [1].
- The modified model by Altman allows analysing the situation in the enterprises with nonquoted shares on the Stock Exchange [1].
- Four-factor model by Taffler may be used for enterprises with shares quoted on the Stock Exchange [6].

The model created by Altman has been more than once modified by different researchers, among others by Russian scholars Safuilin and Kadikov who developed it into R-model [7]. It should be mentioned that there exist also less popular methods, such as expert valuation method, analogy method, etc.

The expert valuation methods focus on the expertise of experienced scholars and researchers evaluating the factors affecting solvency measurement, putting greater emphasis on factors themselves. Therefore, the results obtained depend on the human factor, i.e., on the experience and know-how of the employees [8].

The analogy method offers to make analysis of the enterprise in different stages of its development. The principal objective for the analyst is to find analogies and to compare the findings and make conclusions about the future development of the enterprise [9]. The drawback of this method is that it is complicated to find analogues and identify the development stage of the enterprise.

The coefficient of solvency, financial flow analysis, profitability threshold analysis as well as operational leverage may also be effectively used in the process of solvency measurement.

3. Latest achievements in solvency measurement

One of the latest achievements in solvency measurement has been the bankruptcy prediction model for Middle market public firms called D-score. This model was created by Martin Blums in 2003.

He constructed a conceptual model to measure 3 key indicators of company's health basing it on the popular theory of financial indicators, the Gambler's Ruin and Merton models [10]:

$$\text{Probability of bankruptcy} = f(L, P, W), \quad (1)$$

where L – liquidity, P – profitability, W – wealth.

Blums analyzed 462 companies in USA for the time period of 15 years, the precision of his models being 90 %.

In 2001 a new model of credit risk was developed by experts of Norges Bank in the corporate sector. The model was estimated using the entire population of enterprises in Norges bank's accounts data base for the period of 1990–1996. The total data base comprises about 400,000 enterprise surveys. In this model the following explanatory variables were selected [11]:

- Earnings as a percentage of total assets
- Liquidity – liquid assets less short-term debt as a percentage of operating revenues; unpaid indirect taxes as a percentage of total assets; trade accounts payable as a percentage of total assets
- Financial strength – equity as a percentage of total assets; dummy variable for book equity less than paid in capital; dummy variable for dividend payments during the last accounting year
- Industry – industry average for variable equity as a percentage of total assets; industry average for variable trade accounts payable as percentage assets; industry standard deviation for the variable earnings as a percentage of total assets
- Age – dummy variable for number of years since establishment
- Size – total assets.

Taking into account the specifics of industry a new method of prediction corporate bankruptcy was developed by Russian researchers who suggested to breakdown all the companies by classes of solvency basing it on the classification of current assets and their liquidity. The levels of liquidity of current assets were estimated on the basis of mean values of similar enterprises in the industry. The researchers developed criteria for such industries as manufacturing, trade, construction, design practice and science. Criteria are presented as a range of solvency indicators for every class of enterprise depending on the industry.

In 2002 Grachov developed a model of enterprise solvency measurement for a period of time [12]. The author of this model based his calculations on the following criticism of globally practised methods:

1. Financial analysis most often is made at the beginning or at the end of the accounting year. Objective conclusions may be drawn only on reporting dates
2. It is improper to apply conclusions made on the financial state of the accounting period for the future accounting period.
3. The coefficients of liquidity reflect the current situation and cannot be used for evaluation of the future.

4. It is necessary to calculate the minimum permissible level of current assets and liabilities.
5. The parameter of liquidity equal to 2 is determined for all enterprises not taking into consideration the specific features of the industry and specifics of company operations.
6. The reasons of insolvency should be traced back in pecuniary resources, not only in the amount of debts.

The author of this model introduced an indicator of solvency that would allow determining the financial state of an enterprise in dynamics.

The development of this indicator is based on the following principles:

- Not only short-term, but also long-term liabilities should be covered
- Value-added is the main criterion showing the revenue level of the company
- Revenue, financial resources and assets are the solvency sources.
- Taking into consideration that value added, assets and financial resources pass through the stages of formation, distribution and application, calculations of solvency level must be based on determining the state of the company in any of these stages.

The basic characteristic features of Grachov's model are the following:

- It is necessary to build balance of revenue, asset and financial resources movement.
- It is necessary to build balance in formation, distribution and application of value-added.
- 6 zones of solvency are proposed.
- Applying this model it is possible to calculate the margin of liabilities taking into account pecuniary resources.
- The model exposes the causes of insolvency and risk zones.
- The users of the given model should have good knowledge in financial analysis and accounting.
- The process of solvency calculations is long enough.
- The model takes into account the dynamics of the development of the enterprise.

Another method of solvency measurement to be considered is the qualitative method A-score by Argenti [13]. This method evaluates the management crisis developing in 3 stages:

1. Drawbacks of the enterprise.
2. Errors occurring due to drawbacks.
3. Symptoms – specific features of insolvency.

This method suggests grade scaling of specific features of management crisis in each of the stages mentioned above.

4. Classification of solvency measurement methods and prediction of corporate bankruptcy

4.1. Specific features of classification

The authors of this article suggest classifying the method of solvency measurement taking into account the following specific features:

1. Credibility of information on the basis of which the models are developed
2. Factor completeness, when developing the model; its significance and amount
3. Complexity of calculations
4. Effectiveness of results, their possible use in future

From the author's point of view every specific feature of classification may include the following elements:

Credibility of information:

- Current data
- Accessibility to the information required
- Impartiality and objectivity of information
- Source of background information is average industry statistics during the previous periods or current data about the company undergoing analysis

Factor completeness:

- Specifics of industry
- Specifics of business operation
- Intellectual capital
- Specifics of legislation
- Market situation
- Number of factors included in the model and their significance
- Time factor

Complexity of calculations:

- Mathematical expertise of analyst
- Complexity of algorithm calculations and possibilities to make mistakes
- Expertise in business processes
- Expertise in accounting
- Labour intensity of calculations

Effectiveness of Results:

- Likelihood of using results achieved in decision-making
- Mathematical accuracy of results
- Evaluation of dynamics
- Dependence of accuracy of results on expert qualification.

Table 1 presents the specific features of classification prioritising the elements estimated with the help of the comparative matrix based on assessment made by the authors.

The following elements of the specific features of classification – current data, specifics of business operation, legislation, expertise in business processes and dependence of results on qualification of experts were prioritised.

Table 1. Priorities of elements

Elements by classification position		Priorities, Fi	Elements by classification position		Priorities, Fi
Credibility of information	Current data	1.5	Validity of results	Likelihood to use results achieved in decision-making	2
	Accessibility to information required	1.5		Mathematical precision of the model	1.5
	Impartiality and objectivity of information	3.5		Evaluation of dynamics	1.5
	Source of background information is average industry statistics over the previous periods or current data about the enterprise undergoing analysis	1.5		Dependence of accuracy of results on expert qualification	3
	Total	**8**		**Total**	**8**
Factor completeness	Industry specifics	3	Complexity of calculations	Mathematical expertise of analyst	0.5
	Enterprise business specifics	5.5			
	Intellectual capital	0.5		Complexity of algorithm calculations and possible miscalculations	2.5
	Legislation specifics	5.5			
	Market situation	5		Expertise in business processes	1.5
	Quantity of factors included in the model	1.5		Expertise in accounting	4
	Time factor	3.5		Labour intensity of calculations	4
	Total	**24.5**		**Total**	**12.5**

4.2. Grade assessment of solvency measurement methods

The authors have evaluated the solvency measurement methods by 10 grade scale with a step 1. The main categories of the grade scale (A_i) are presented in Table 2.

On the whole, if the grade value equal to 0 is added to the element, it means that the element of the specific feature of classification has a negative effect on the application of the particular model in practice.

The grade value equal to 5 means that the element to be analysed either leaves neutral effect on practical application of this model or it is difficult to state the level its impact. Grade 10 means that the element to undergo analysis certainly has a positive effect on the degree of practical application of this particular model.

The authors of this article made an experimental assessment of the above mentioned methods of solvency measurement and prediction of corporate bankruptcy.

The evaluation of the methods of solvency measurement on the basis of the approach mentioned above is presented in Table 3. The models may be classified taking into consideration their specific features using the weighted average grades:

$$K_j = (\sum_{i=1}^{n} A_{ij} * F_{ij}) / \sum_{i=1}^{n} F_{ij} \rightarrow \max \qquad (2),$$

where

K_j – weighted average grade of the model by the specific feature of the classification j, F_{ij} – priority of i^{th} factor of j^{th} specific feature of classification, i – element of the specific feature of classification i={1,…,n}, j – specific feature of classification j={1,..,4}, A_{ij} – grade of i^{th} element of j^{th} specific feature of classification.

Table 2. The main criteria of the scale

Elements of classification	Grade assessment		
	A_i=0	A_i=5	A_i=10
Current data	The model is based on past statistics of a particular country	The model is either based on outdated information or on information of one particular country	Background information is relevant for any corporate analysis
Accessibility to the information required	It is impossible to gain access to all information required for the application of the model	It is possible only to gain limited access to information or it is a time-consuming procedure to gain all information required	The user has access to all information he needs for the application of the model
Objectivity of information	In contemporary market situation the background information is not objective or its	Evaluation of the background information depends on expert competence or presents numeri-	Background information presents numerical parameters

	evaluation to a great extent depends on the expert's point of view	cal parameters	
The source of background information is average industry statistics for previous periods or current data about the company undergoing analysis	Background information is based on statistics for previous periods	Background information is based on current average industry statistics or on indicators of the previous periods of a particular company undergoing analysis	Background information is based on current data of a particular company undergoing analysis
Specifics of industry	The model does not consider the specific features of the industry the company is operating in	The model considers only some of the specific features of the industry or considers the specifics of particular industries in a particular country for a definite period of time	The model allows taking into consideration all necessary features leaving impact on the level of solvency of a particular industry, the company undergoing analysis is operating in
Specifics of business operation	The model does not consider the specifics of business the company is operating in	The model partially considers the specifics of the particular business	The model allows taking into consideration all particular features of leaving impact on the level of solvency of the operations of the company
Intellectual capital	The model does not consider the impact of intellectual capital on the level of solvency of the company	The model partially considers the impact of intellectual capital on the level of solvency of the company	The model evaluates the impact of intellectual capital on the level of solvency of the company
Specifics of legislation	The model does not take specifics of legislation into account	The model partially takes into account the specifics of legislation or considers the specific features of legislation of a particular country for a definite period of time	The model allows taking into account the effect of legislation on the degree of solvency or possible bankruptcy
Market situation	The model does not include the specific features of market situation of the period to be analysed or the country undergoing analysis	The model considers the specific features of the market situation of the recent years or of a particular country	The model allows taking into consideration all specific features characteristic for the market situation
The number of factors included into the model and their significance	Factors considered in the model are not the primary ones and do not play a vital role in determining the level of solvency	The model includes some factors leaving an impact on the level of solvency	The model includes all the basic and most important factors leaving an impact on the level of solvency
Time factor	The model does not consider the time factor	Time factor is either partially addressed or not properly considered by the model	Time factor is addressed by the model
Opportunity to use results achieved in decision-making	It is not possible to use the results of analysis in decision-making	The results may be used in decision-making after making some additional analysis	The results achieved may be used in making particular decisions
Mathematical accuracy of results	Mathematical accuracy of the model is less than 90 %	Accuracy of the model is 90–98 %, or not identified	Mathematical accuracy of the model is 98–100 %
Evaluation of dynamics	The model assesses the solvency only for a particular date	On the basis of the results achieved it is possible to predict the level of solvency in the future	The model allows assessing risk of insolvency in the future due to evaluation of parameters, leaving impact on it, in dynamics
Dependence of the accuracy of results on the qualification of experts	The level of solvency is determined by expertise	The level of solvency is partially determined by experts during the calculation process	The results do not depend on expert assessment
Mathematical expertise of an analyst	The user of the model needs high level of knowledge in mathematics	The user of the model needs average level of knowledge in mathematics	The user of the model needs basic level of knowledge in mathematics
Expertise in business processes	The user of the model needs high level of knowledge in the area of business processes	The user of the model needs average level of knowledge in the area of business processes	The user of the model needs basic level knowledge in the area of business processes
Expertise in accounting	The user of the model needs high level of knowledge in accounting	The user of the model needs average level of knowledge in accounting	The user of the model needs basic level of knowledge in accounting
Complexity of algorithm calculations and possibilities to make mistakes	The process of calculations is based on complex algorithm calculations, so it is easy to make a mistake	The user has to be attentive enough, although the algorithm of calculations is simple	The process of calculations is easy and the algorithm of calculations is very simple
Labour intensity of calculations	The process of calculations is long and takes several days	The process of calculations takes several hours	The process of calculations takes several minutes

Table 3. Grade assessment of methods

factors:	Aij	models													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Position „Credibility of information"															
Current data	A11	0	0	10	7	10	0	5	6	6	10	9	10	10	10
Opportunity to collect data required	A21	7	7	5	4	9	6	7	8	8	7	6	10	10	7
Objectivity of data	A31	5	5	5	6	5	5	5	5	5	8	5	8	8	5
Source of background information is previous statistics or data provided by the enterprise undergoing analysis	A41	3	3	5	5	4	3	3	4	4	10	9	10	10	10
Weighted average grade of the model by the specific feature „Credibility of information" K1		**4.06**	**4.06**	**5.94**	**5.63**	**6.50**	**3.88**	**5.00**	**5.56**	**5.56**	**8.56**	**6.69**	**9.13**	**9.13**	**7.25**
Position: „Factor completeness"															
Specifics of industry	A12	0	0	5	7	0	0	0	7	10	5	5	0	0	7
Specifics of business operation	A22	0	0	5	7	0	0	0	5	0	10	10	0	4	10
Intellectual capital	A32	0	0	0	2	0	0	0	0	0	0	0	0	0	5
Specifics of legislation	A42	0	0	0	2	0	0	0	0	0	0	0	0	0	5
Market situation	A52	0	0	0	6	0	0	0	0	0	9	5	0	5	5
Number of factors included into the model and its significance	A62	2	5	4	7	7	4	5	8	5	8	8	0	5	10
Time factor	A72	0	0	0	7	0	0	0	0	0	10	7	0	0	5
Weighted average grade of the model by the specific feature „Factor completeness" K2		**0.12**	**0.31**	**1.98**	**5.57**	**0.43**	**0.24**	**0.31**	**2.47**	**1.53**	**6.61**	**5.37**	**0.00**	**2.22**	**6.67**
Position: " Complexity of calculations"															
Mathematical expertise of an analyst	A13	10	10	6	6	10	10	10	10	10	4	6	10	10	5
Expertise in business processes	A23	8	8	6	5	10	2	8	8	8	3	4	10	7	5
Expertise in accounting	A33	8	8	6	5	10	5	8	7	7	3	3	8	7	4
Complexity of algorithm calculations and possibilities to make mistakes	A43	8	8	5	6	10	10	8	7	8	3	5	10	10	5
Labour intensity of calculations	A53	10	10	3	4	5	8	7	6	8	4	5	10	10	3
Weighted average grade of the model by the specific feature „Complexity of calculations" K3		**8.72**	**8.72**	**4.72**	**5.04**	**8.4**	**7.16**	**7.76**	**7**	**7.96**	**3.36**	**4.6**	**9.76**	**9.04**	**4.24**
Position: " Validity of results"															
Opportunity to use results achieved in decision-making	A14	3	3	3	8	4	3	3	5	3	8	7	3	5	5
Mathematical accuracy of results	A24	4	7	5	7	4	5	6	7	7	8	5	3	5	5
Evaluation of dynamics	A34	6	6	6	8	8	7	6	5	5	5	7	3	5	3
Dependence of accuracy on the qualification of experts	A44	10	10	3	5	3	9	10	9	9	3	4	8	8	4
Weighted average grade of the model by the specific feature „Validity of results" K4		**6.38**	**6.94**	**3.94**	**6.69**	**4.38**	**6.38**	**6.75**	**6.88**	**6.38**	**5.56**	**5.50**	**4.88**	**6.13**	**4.25**

Explanation:

1. – Two factors model
2. – Altman coefficient
3. – Taffler model
4. – Analogy method
5. – A-score
6. – R-model
7. – D-score
8. – Credit risk analysis
9. – Method of bankruptcy prediction taking into account specifics of industry
10. – Solvency measurement for a period
11. – Downstream dumping analysis
12. – Bankruptcy coefficient
13. – Profitability analysis
14. – Expert valuation method

The results of assessment testify that, when analysing the solvency issues, the role of intellectual capital was not taken into consideration by the model developers. It is rather difficult to assess the intellectual capital, nevertheless it plays a significant role in managing the company in an anticrisis situation.

5. Recommendations for application of methods to be analysed

During the grade assessment the authors classified the methods taking into consideration the significance of the specific features of the model in the following way:

- **Credibility of information:** Taffler Model, Solvency measurement for a definite period, Downstream dumping analysis, Profitability analysis, Expert valuation method
- **Factor completeness**: not any of methods analysed
- **Complexity of calculations**: Two factor model, Altman coefficient, A-score, R-model, D-score, Credit risk analysis, method of bankruptcy prediction taking into account industry specifics
- **Validity of results**: Analogy method. Taking into account the purpose of the analysis the selection of the method may be done on the basis of the information given below.

Table 4. Breakdown of methods by the purpose of analysis and existing resources

Purpose of analysis, existing resources	Most appropriate methods
To take into account most part of factors	Analogy method , method of financial flows, expert valuation method
To make analysis on the basis of internal information	Solvency measurements for a definite period of time, profitability analysis, expert valuation method
To make analysis in conditions of limited resources, such as time and human resources	Coefficient of bankruptcy, two factor model, Altman coefficient
To reach the most precise and appropriate results for future applications	Altman coefficient , credit risk analysis, D-score

Taking into account the specific features of model development, geography and the time the models were developed, the authors recommend Latvian enterprises to make solvency measurements on the basis of internal information making use of the following methods: solvency measurement for a period, profitability analysis, expert valuation method.

6. Conclusions

The classification developed by the authors helps to make the right selection of solvency measurement model considering the opportunities of the particular enterprises, expertise of employees, the purpose of research, free time and the accessibility of the information required.

Solvency measurement issues require additional research. The economists have not yet come to common grounds on issues related to solvency measurement indicators and models for corporate bankruptcy prediction. Without a scientific approach to evaluation and proper analysis of solvency, enterprises cannot ensure economic growth and general welfare.

The authors consider that only by integration and modification of the methods analysed it is possible to timely and properly predict a bankruptcy and measure the degree of solvency. It may be effected by updating the information which is at the disposal of the enterprise with respect to real market situation and internal business environment as well as by follow-up analysis of solvency and bankruptcy indicators.

References

1. ALTMAN, E. Financial Ratios, Discrimination Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance*, Vol 23, No 4, September 1968, p. 589–610.
2. LURSOFT – insolvency data base, [Electronic resource] – Read 09 November 2007 - http://www.lursoft/lv. (in Latvian).
3. LACARS, Insolvency and Bankruptcy in Europe, [Electronic resource] – Read 12 April 2007 - http://www.creditreform.lv/ru/par_mums. (in Russian).
4. AMADEUS – Enterprises Data Base, [Electronic resource] – Read 01 November 2007 - http://amadeus.bvdep.com
5. SHNEIDERE, R. Financial Methods Historical Development and Implementation in Enterprises Solvency Prediction (Finansu metozu vesturiska attistiba un to pielietojums uznemumu maksatspejas prognozesana). Riga: LU, 2004. 412 p. (in Latvian).
6. TAFFLER, R. Forecasting Company Failure in the UK Using Discriminant Analysis and Financial Ratio Data, the Royal Statistical Society. No 3, 1982. 126 p.
7. DAVIDOVA, G. Quantity Method of Bankruptcy Risk Evaluation (Metodika kolichestvennoj ocenki riska bankrotstva). *Risk Management*, No 3, 1999, p. 13–20. (in Russian).
8. SMIRNOVA, I. Efficiency Management (Upravlenie proizvoditeljnostju). Moscow: Feniks, 1997. 22 p. (in Russian).
9. STREKALOV, B. Crisis in Enterprises and Project Management (Krizisi v organizacii I upravlenie projektami). Kazanj: Kazan's Technological university, 1997. 160 p. (in Russian).
10. BLUME, M. D-Score: Bankruptcy prediction Model for Midde Market Firms, [Electronic resource] – Read 08 October 2007 - http://www.minneapolisfed.org
11. TROND, E. Model for Analysing Creditrisk in the Enterprises Sector, [Electronic resource] – Read 08 October 2007 - http://www.norges-bank.no/Pages
12. GRACHOV, A. Solvency Evaluation for Period (Ocenka platezhesposobnosti za period). *Financial Management*, No 6, 2002, p. 11–12 (in Russia).
13. ARGENTI, J. Corporate Collapse: Practical Corporate Planning. London: G. Allen and Unwin, 1990. 221 p.