

## Hodnocení bankrotních modelů litevských společností

## The Evaluation of Bankruptcy Prediction Models for Lithuanian Companies

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### Abstract:

**Purpose of the article:** Is to analyze the theoretical aspects of bankruptcy, to identify reasons of company's bankruptcy and its consequences both for the company itself and national economy. After comparison of chosen bankruptcy prediction models they were applied for five failed and five currently operating companies providing similar services.

**Methodology/ methods:** The methods of analyses and synthesis, description and comparison were applied in the article. Linear discriminant (Liss, Taffler&Tisshaw, Springate, and Altman) and logistic regression (Zavgren, Chesser) bankruptcy prediction models have been used to enable to judge the best of them for carrier companies. Graphical visualization is used for demonstration of results.

**Scientific aim:** Is to evaluate applicability of linear discriminant and logistic regression bankruptcy prediction models for Lithuanian carrier companies. Over the last few years the carrier industry was the fourth in Lithuania according to the number of failed firms, so, bankruptcy prediction for this industry is particularly relevant.

**Findings:** Obtained results show that in spite that Lithuanian companies' often use Altman model to predict possible bankrupt, Springate and Taffler&Tisshaw models are also appropriate for Lithuanian companies to predict possible failure. Unfortunately Liss, Zavgren and Chesser models are inappropriate for carrier enterprises.

**Conclusions:** The results confirmed that three from six analyzed models are fitting to predict failure of carrier sector companies', while three models are inadequate. Taffler&Tisshaw model is the most reliable for bankruptcy prediction.

**Keywords:** bankruptcy, the reasons and consequences of bankruptcy, linear discriminant analysis bankruptcy prediction models, logistic regression bankruptcy prediction models

**JEL Code:** G33

## Introduction

Financial status of a company, the future of its activities depends on its solvency – ability to cover current and long term obligations by own financial sources. It should be noted that only a sound company – stable financially and profitable – is appropriate for business relationship with all partners: suppliers, customers, banks, investors, stakeholders. Due to constantly varying market conditions and increasing competition more companies face insolvency in recent years. Hodiernal dynamic and rapidly changing business environment gives for companies more opportunities but at the same time they also face more threat. Unidentification of possible risks could cause irreversible effect – bankruptcy.

Competitive market formation, economic burden conditioned liquidity problems of company – bankruptcy procedures are sued for more and more enterprises. Bankruptcy became often not only in small companies but also in big, acting for a number of years, with old business traditions. Bankruptcy makes a negative impact not only for insolvent venture itself, but also for the state, society, thus it is very important to predict possible bankruptcy threats.

Business practice shows that since 1993 to mid 2011 the bankruptcy has been declared for 10,982 companies and 14 banks in Lithuania. Only 65% of the bankruptcy procedures initiated in 1993–2011 have been already completed. The rest 3842 bankruptcy processes continue till now (Statistics Lithuania, 2011). Too long bankruptcy procedures let wasting the company's assets and accumulating more debt. Due to this company as a business unit becomes unattractive to investors. If the danger of bankruptcy is not predicted in time, companies have lack of reserves for business reorganization (Stoškus, Beržinskienė and Virbickienė, 2007). More than 100 thousand people became unemployed due to companies' failure during 1993–mid 2011 in Lithuania (Statistics Lithuania, 2011). This leads not only to economic but also to social problems.

Rapid growth of the number of failed companies during economic downturn stimulates companies to look for methods and measures to manage bankruptcy risk and avoid insolvency. False decisions, absence of clear strategy and plan condition possible bankrupt for a number of companies. One of the most important tasks for enterprises became identification of early bankruptcy stages and causes, accurate prediction the probabilities of events in the future and the impact of these events for company's activities on purpose to avoid adverse situations.

Thus more significant becomes to look for possibilities and instruments to implement pre-emption of unfavourable processes in the company. Corporate executives should take measures to prevent the bankruptcy, one of which is bankruptcy prediction. Bankruptcy prediction models properly selected and applied in time allow not only to reduce but even to eliminate the threat of bankruptcy. Unfortunately, the existence of quite a number of models makes it difficult to choose the best one. Bankruptcy prediction models have been developed at different times, in different countries, by analysing different enterprises' data, so inadequacy of models for some countries or industries is possible.

A number of assessments of suitability of various models for Lithuanian companies were made but the controversial results show that the problem is still relevant and it is necessary to continue investigations. From a different angle the collapse of a number of companies engaged in similar businesses may determine slowdown in branch development so it is significant to evaluate bankruptcy probability of an industry and type of business. The majority of failed companies in 2011 were the wholesale and retail (171), construction (141) and manufacturing industries<sup>(77)</sup>. Slightly fewer bankruptcies were initiated in the carrier and storage, accommodation and catering, administrative and servicing, professional and scientific industries. In 1993 – mid 2011 the failing firms assets value was equal 14,414.6 million Lt in the beginning of bankruptcy procedure, what was 66 per cent of all creditors' claims according to data provided by Statistics (Statistics Lithuania, 2011). This shows that failing companies are not able to cover their obligations to creditors.

The subject of research – ten companies of Lithuanian carrier sector five of which have already failed (limited companies: Kseda, Haidaja, Transmota, Romas&Ko and Achemarida) and five are still operating (limited companies: Girtoka, Nostrada, Transimeksa, Autoverslas and Transporto Marisa). The aim of the research is to estimate applicability of chosen bankruptcy prediction models for Lithuanian carrier companies. The following six models were investigated: Altman, Springate, Taffler&Tisshaw, Liss, Zavgren and Chesser.

## 1. Causes and consequences of bankruptcy origin

For a number of years scientists have been exploring the reasons of bankruptcy. Most of them state that companies fail because they are unable to adapt

to rapidly changing environment, various internal and external factors. Lithuanian author Grigaravičius (2003a) mentions economic and macroeconomic factors as the fundamental cause of bankruptcy. Certain changes in economy may adversely affect the company; lead it to insolvency, and later to the bankruptcy.

Baldin (2011) affirms that bankruptcy of an organization – is a result of a number of internal and external factors for the activities of an enterprise. According to him, external factors that influence a company are general economic, political and market conditions. Internal factors cover financial and investment decisions. The similar conclusion made Jurevičienė and Skrickaitė (2011) – reasons for deterioration of company's financial situation could depend on external conditions (including situation in the country or in specific industry) as well as internal (comprising from financial position and character of the client or management peculiarities).

According to Stuart and Abetti (1990) company's failure can be caused by management factors – the top manager's personal characteristics, management culture, business vision, the company's organizational structure, technical capacity utilization, and strategic management factors, such as admission of

inappropriate strategic decisions, which odds with the changing business conditions. And the last is operational management factor, characterized by lack of critical attitude and a high debt's level.

Blach and Wieczorek-Kosmala (2012) specified that expansion of a company is related to raise of debts level which could be the cause of company's financial risk increase and may lead to serious consequence, including the bankruptcy.

Summarized views of various authors of internal and external causes of crunch are indicated in Table 1.

So it is obviously, that bankruptcy can be caused by many different factors, including changes in economy as well as in properly coordinated processes inside the company. Corporate bankruptcy is not only the company's problem; its consequences affect also the overall development of the state. Brigham and Ehrhardt (2008) analysing the causes of bankruptcy presented the investigation made by Dun&Brandstreet Inc. which summarizes the reasons of companies failure (Table 2).

Annotating this investigation authors emphasize that financial factors influencing companies' failure appear long before the bankruptcy, therefore nearly always it is possible to predict possible threat in advance (Brigham and Ehrhardt, 2008.)

Table 1. Internal and External Causes of Crunch.

Internal causes of crunch	External causes of crunch
<ul style="list-style-type: none"> <li>• <b>Failure of companies' financial management</b> (estimation of financial risk, irrational use of sources, high management costs, awful accounting system, incomplete financial control).</li> <li>• <b>Unqualified personnel policy</b> (low experience of personnel, inadequate distribution of duties, rights and responsibilities and assignment of jobs, inside conflicts, dishonesty of managers and stakeholders).</li> <li>• <b>Organization of activities</b> (inappropriate planning and prediction of activities, week internal control system, awful business administration).</li> <li>• <b>Work organization</b> (distribution of rights and responsibilities and division of jobs, use obsolete technologies).</li> <li>• <b>Management organization</b> (irrational management system of company, inappropriate companies organizational structure).</li> <li>• <b>Company's expansion</b> (consequently increase of debts).</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Economic</b> (unstable economic policy of the state, credit and tax policy of the state, high inflation rate, fluctuations f foreign Exchange rate, decreasing level of Standard of living).</li> <li>• <b>Unstable political situation in the country and abroad.</b></li> <li>• <b>Legal</b> (instability of laws regulating companies activities).</li> <li>• <b>Social</b> (changes in labor market).</li> <li>• <b>Origin of new competitors.</b></li> <li>• <b>Climatic and ecological</b> (natural disasters, contrary climate conditions and other unexpected circumstances).</li> </ul>

Source: Mackevičius, 2007; Liučvaitis, 2003; Gaškaitė-Milvydienė, 2011, Baležentis and Vijeikis, 2010; Stuart and Abetti, 1990; Baldin, 2011, Januševičiūtė and Jurevičienė, 2009, Jurevičienė and Skrickaitė (2011), Blach and Wieczorek-Kosmala (2012).

Table 2. Causes of Business 'Failure.

Causes of failure	Share of failure companies (%)
Financial	47.3
Economic	37.1
Losses	14.0
Other factors	1.6
<b>Total</b>	<b>100.0</b>

Source: Brigham and Ehrhardt, 2008.

Table 3. The Impact of Bankruptcy on the National Economy.

Negative bankruptcy impact on the economy	Positive bankruptcy impact on the economy
<p><i>Economic Issues:</i></p> <ul style="list-style-type: none"> <li>• Loss of production capacity, reduced competitiveness of the overall national economic.</li> <li>• Unpaid taxes.</li> <li>• Unsatisfied creditors' claims.</li> </ul> <p><i>Social Problems:</i></p> <ul style="list-style-type: none"> <li>• Unemployment increase.</li> <li>• Population's standard of living decrease.</li> <li>• Population's dissatisfaction with the country's poor economic condition.</li> <li>• Uncertainty about the future.</li> </ul>	<p><i>The Benefits to the National Economy:</i></p> <ul style="list-style-type: none"> <li>• Encourage concentration of capital.</li> <li>• Get rid of inefficient businesses.</li> <li>• Liquidation of unused capacity.</li> <li>• An opportunity to dismiss surplus workers.</li> </ul> <p><i>Benefit to the Company:</i></p> <ul style="list-style-type: none"> <li>• An opportunity to restructure.</li> <li>• Allow to pay debts in time.</li> </ul>

Source: Jurevičienė and Bercevič 2012.

Bankruptcy costs to all the parties involved: creditors, shareholders, employees and to the public in general (Shkurti and Duraj, 2010). A large number of bankruptcies adversely affect the economy as big, long-established companies' which employ many people failed. Instead new, small companies with small number of employees are creating. The new companies have no experience and management skills (Purlys, 2001). The bankruptcy weakens the country's economic competitiveness, the taxes are not paid to state and local budgets, social insurance, other state funds and affects society as a whole, companies don't repay debts, what often leads other firms to economic hardship and bankruptcy (Valackienė, 2005). On the other hand a positive impact of bankruptcy on economy is also identified. Bankruptcy encourages the concentration of capital, economy is disposed of non-perspective companies that often produce obsolete products and there also arises possibility to dismiss inefficient workers (Table 3).

However, bankruptcy is more often seen as a negative phenomenon. The negative factors listed above show how failed companies can affect the entire

economy, so, top managers should care about the welfare of society too. They should have very serious look at the potential threat of bankruptcy and take all necessary steps to avoid it.

## 2. Review of bankruptcy prediction models

It is evident that the consequences of bankruptcy are very costly, so companies must find methods how to ensure the continuity of their business and avoid bankruptcy. One of these methods can be forecasting bankruptcy with bankruptcy prediction models. Such models are very useful for responsible persons, who can take appropriate actions to prevent business failure (Kim, 2011). There can be found a multitude of different bankruptcy prediction models in the literature. Scientists are trying to find ways how to predict bankruptcy in the early stage. Significant contribution to such researches has made such scholars as Altman, Taffler & Tishshaw, Chesser, Springate, Zavgren and others. Some of them use similar methodologies, so their models have been grouped

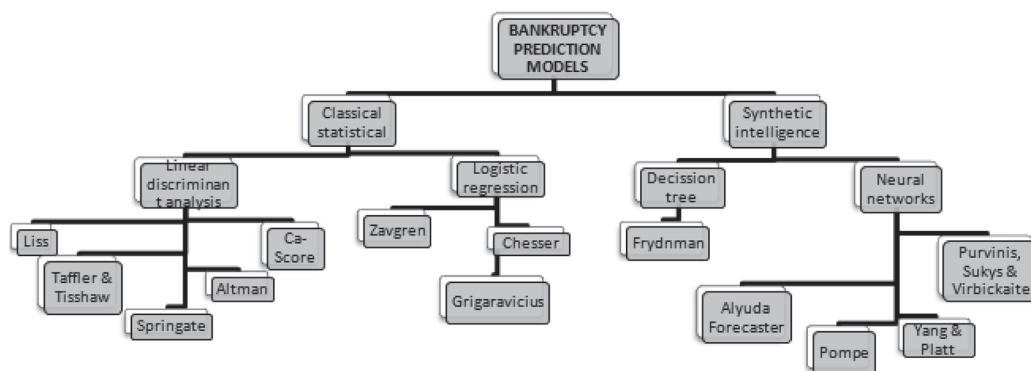


Figure 1. Classification of Bankruptcy Prediction Models. Source: Mackevičius, Silvanavičiūtė, 2006, Jurevičienė, Bercevič 2012.

into several groups. Adnan and Dar (2006) identified three main groups of models in bankruptcy prediction in their article: statistical, synthetic intelligent expert system and theoretical models. Other authors (Balcaen and Ooghe, 2004) summarized methods discussed in the scientific literature and concluded that the best is to divide these models into classic statistical: univariate discriminant analysis, threat index model, multivariate discriminant analysis, conditional probability model) and alternative: neural networks, decision tree, survival analysis models. Meanwhile, Mackevičius and Silvanavičiūtė (2006) classified bankruptcy prediction models into categories: classical statistical models and synthetic intelligence (Figure 1). This classification is very close to already mentioned foreign authors' grouping.

Linear discriminant analysis and logistic regression bankruptcy prediction models are discussed most often in the literature. The most popular and commonly used are Altman, Springate, Taffler & Tisshaw and Liss models among the first group. Meanwhile, Zavgren, Chesser and Lithuanian author's Grigaravičius models can be assigned to logistic regression group.

All models have many similarities. Firstly, relative indicators for predicting the probability of bankruptcy are used. The greatest similarity is observed between the linear discriminant regression models, especially between Altman, Springate and Liss models. Moreover bankruptcy prediction models can be compared by their correctness. Authors had calculated reliability of their models and accuracy for one year before bankruptcy is placed in Table 4, in which Taffler&Tisshaw model predicts bankruptcy most accurately while Chesser model is the least.

In summary, it appears that all models have similarities, repetitive indicators, but at the same time, they are very different, as they are adapted to differ-

ent countries and different industries. Frequency of ratios used in various bankruptcy prediction models are presented in Table 5.

Authors in offered models used 27 various relative ratios. Mostly profitability, solvency and liquidity estimation was used. The most frequent ratios were: Working capital/Assets; Profit before taxes/Assets; Sales income/Assets – they are used in four models, others 23 were used twice or once.

So all analysed methods have some similarities, repeated ratios but on the other hand all of them are different as they were adjusted to different countries and various branches.

### 3. Advantages and disadvantages of bankruptcy prediction models

Importance of bankruptcy forecasting models is self-evident, but they have some disadvantages too. Often, researchers have different opinions on certain aspects of these models. Many authors write about bankruptcy prediction models advantages and support their use in business. Sung, Chang and Lee (1999) praise bankruptcy prediction models as they are able to incorporate multiple financial ratios, simultaneously combine independent variables and it is very easy to apply them once a model is developed. Borges, Lima and Filho da Silva (2011) says that the main advantage of these models is that they quantify common characteristics of the companies, what helps fixing whether the company is solvent or insolvent.

Other authors (Shkurti and Duraj, 2010) mark out that bankruptcy prediction models are very convenient to use, as for calculation of the probability of bankruptcy often is enough to have companies' financial statements. In most cases the financial statement is public or available in some databases what makes them a replicable source of data. Moreover Kim (2011) says that such methods are useful not only for the managers by helping them to prevent business failure, also they can be useful in evaluating and selecting companies to collaborate with or to invest in. For such decisions one has to take into account not only the opportunities, but also the risk of failure. Therefore, the ability to accurately predict bankruptcy is important to anyone who relies on a particular business for income.

On the other hand bankruptcy prediction models are not only praised but also disparaged by different authors. Iwan (2005) is not satisfied with limitation in models accuracy. Often models are precisely accurate only a year before failure. While Shkurti

Table 4. The Accuracy of Classical Statistical Bankruptcy Prediction Models.

Model	Accuracy (before one year)
Altman	90%
Springate	92.5%
Taffler&Tisshaw	97%
Liss	–
Zavgren	82%
Chesser	78%
Grigaravičius	–
Purvinis, Šukys&, Virbickaitė	92%

Source: Mackevičius and Rakštelienė, 2005;  
Garškaitė, 2008.

Table 5. Ratios Used in the Bankruptcy Prediction Models and their Frequency.

Ratio	Model							Frequency of ratio
	Altman (1968)	Springate (1978)	Taffler (1977)	Liss (1973)	Zavgren (1985)	Chesser (1974)	Grigaravičius (2003a)	
<b>Working capital/Assets</b>	+	+		+			+	<b>4</b>
Undistributed profit/Assets	+			+				<b>2</b>
<b>Profit before taxes/Assets</b>	+	+				+	+	<b>4</b>
Own capital/Liabilities	+							<b>1</b>
<b>Sales income/Assets</b>	+	+			+		+	<b>4</b>
Own capital/ Borrowed capital				+			+	<b>2</b>
Inventory/ Sales income					+			<b>1</b>
Profit before taxes/ Current liabilities		+	+					<b>2</b>
Receivables/ Inventory					+			<b>1</b>
Current liabilities / Liabilities			+					<b>1</b>
Current liabilities /Assets			+					<b>1</b>
(Current assets-Current liabilities)/ Operating expenses			+					<b>1</b>
Gross profit/ Assets				+				<b>1</b>
Cash/Assets					+	+		<b>2</b>
Cash/ Current liabilities					+			<b>1</b>
Profit on ordinary activities/ (Capital/ Current liabilities)					+			<b>1</b>
Long term liabilities/(Capital-Current liabilities)					+			<b>1</b>
Sales income/ Cash						+		<b>1</b>
Liabilities/Assets						+	+	<b>2</b>
Long term real assets/Own capital						+		<b>1</b>
Working capital / Sales income						+	+	<b>2</b>
Current assets/Current liabilities							+	<b>2</b>
Assets/ Own capital							+	<b>1</b>
Profit before taxes/ Interests							+	<b>1</b>
Profit before taxes / Capital							+	<b>1</b>
Net profit/Sales income								<b>1</b>
Current assets-Inventories)/ Current liabilities								<b>1</b>

Source: Altman (1968), Taffler and Tisshaw (1977), Mackevičius (2010), Gaškaitė (2008), Zavgren (1985), Grigaravičius (2003b), Purvinis, Šukys and Virbickaitė (2007).

and Duraj (2010) claim that financial data used in models does not reflect common firm's situation.

There are also other exogenous factors such as political variables as well as ethical, social and psychological factors that should be considered when deciding about companies' probability to fail (Hu and Ansell, 2005). Shkurti and Duraj (2010) also say that including qualitative and non-accounting variables in a model can increase considerably its

accuracy, but sometimes it is too difficult to measure them. They also mark out that it is not clear whether a bankruptcy prediction model can be successfully transferred across countries and models based on different databases should be applied very carefully, as they can be not suitable for other countries or branches.

The following arguments show that although it is important to analyse the company's financial



condition and periodically check whether it can go bankrupt, the results should be evaluated critically. It is not enough only to calculate the probability of bankruptcy, there is necessary to carry out a deeper analysis in order to find the company's problems and fix them.

#### 4. Application of linear discriminant and logistic regression models for carrier enterprises

Various scientists try to evaluate whether bankruptcy prediction models are suitable for predicting bankruptcy for a quite a number of years. Many foreign experts, analysing Altman model, claim that it is one of the best models, but also recognize that it needs to be improved. Meanwhile, the Lithuanian researches analysing this model for more than a decade did not reach consensus on the Altman model's suitability for Lithuanian companies'. Mackevičius and

Silvanavičiūtė (2006) showed that Altman model is appropriate to predict bankruptcy, but they do not advise to rely fully on this model and recommend comparing its results with the short and long-term solvency and profitability indicators. Garškaitė (2008) also claims that Altman model is suitable for Lithuanian companies and have shown true situation for almost all analysed companies. Stundžienė and Boguslauskas (2006) were more critical. In their research more than half of companies received very high probability of bankruptcy, but in reality only six of them failed. Springate model is not so popular in Lithuania as Altman. Although researches of several authors (Mackevičius and Silvanavičiūtė, 2006; Garškaitė, 2008) showed that this model is suitable for predicting bankruptcy of Lithuanian companies as well as Taffler&Tisshaw model. Obtained results allowed concluding that the latter is one of the most reliable and suitable for predicting bankruptcy of Lithuanian companies. Meanwhile, Liss model was evaluated rather critically. Garškaitė (2008) does not

Table 6. Basic Characteristics of Failed Companies' Chosen for Investigation.

Name of the company	City/town	Average number of employers before bankrupt	Year of bankrupt
UAB „Kseda“	Kaunas	50	2010
UAB „Haidaja“	Kaunas	68	2010
UAB „Transmota“	Klaipėda	63	2010
UAB „RomasirKo“	Marijampolė munic., Skaisčiunų village	67	2011
UAB „Achemarida“	Klaipėda	66	2011

Source: Database “Amadeus”.

Table 7. Basic Characteristics of Operating Companies' Chosen for Investigation.

Name of the company	City/town	Origin	Average number of employees during analysing period	Description of activities, services
UAB „Girteka“	Vilnius	1996	812	Carrier of freeze, ordinary, selected goods by motor carrier in entire Europe and CIS, logistic services in Vilnius logistic centre.
UAB „Nostrada“	Šiauliai	1998	300	Services: auto car transit, goods transit: domestic and international, small cargo, passenger transit.
UAB „Transimeksa“	Šiauliai	1994	180	One of the biggest Lithuanian carrier companies. Suggests all logistic services: carrier of goods, customs intermediation and storage.
UAB „Autoverslas“	Vilnius	1993	102	Holds 82 own truck for auto cars, 100 trucks, 4 spur tracks, collaborates with the biggest shipping companies, runs three modern logistic centres. In addition intermediates in customs and holds auto service and cleaning.
UAB „Transporto Marisa“	Alytus	2003	39	Services: carrier of international goods, booking of ferries for goods traffics, carrier of ground and building engineering's.

Source: Database “Amadeus”.

advise to use Liss model for Lithuanian companies as results were not relevant to the actual situation.

The logistic analysis models in Lithuanian enterprises have hardly been studied. The most attention is devoted to the min Mackevičius and Silvanavičiūtė (2006) research there Zavgren and Chesser models were analysed. Their study showed that in different periods logistic regression models showed different results. The authors also stated that calculated probability of bankruptcy was not accurate for all companies, and only partially overlapped with linear discriminant analysis models results (Garškaitė, 2008). So, according to these authors Zavgren and Chesser models are not reliable and suitable for Lithuanian companies to predict the likelihood of bankruptcy.

The following small and medium sized companies failed in 2010–2011 are analysed in this article (Table 6).

Also five currently successfully operating companies are analysed. They were selected because during investigated period there were no bankruptcy lawsuit and the legal form of these companies was not changed. Four of them belong to large and one to medium-sized companies' group, number of employees is ranging from 39 to 812 (Table 7).

Corporate financial documents, such as balance sheets, profit and loss statements and others related to companies' activity were used. Companies' financial data was analysed in the three-year period: for operating companies – from 2008 till 2010 and for failed companies – three years before bankruptcy: 2007–2009 or 2008–2010. Due to the different periods the years have been marked as following: N-2,

N-1, N. Bankruptcy predictions were carried out in accordance with the following models: Altman; Springate; Taffler&Tisshaw; Liss; Zavgren; Chesser.

The results in case of Linear Discriminant models (Altman; Springate; Taffler&Tisshaw; Liss) are presented in ratio, while the results of Logistic Regression Models (Zavgren; Chesser) are presented as probability (in percentage). Grigaravičius model is used in this study as its implementation needs extra (specific) data that are not available from financial statements.

Allocation of Altman models probabilities is shown (Figure 2) and the dynamics contravene real valuations. Z values of some failed companies are higher than of operating in the period N-1.

This could be caused due to two reasons: majority of failed companies' data are from 2007–2009 periods while for still operating – from 2008–2012 periods; another reason is inadequacy of used ratios for carrier sector. In the period N coefficients Z are placed from the highest to the lowest and reflect the situation the best but are not appropriate to carrier sector. Companies could face bankrupt when Z coefficient is less than 1.914.

The results of Springate model's is shown in Figure 3 and is obvious that they are absolutely inadequate to the reality in the period N-2 – the two lowest positions were occupied by still operating companies, while failed companies landed up on the highest positions.

Distribution of values in the period N-1 is more realistic and it could be stated that critical line of this model is appropriate for Lithuanian companies, because two years before failure firms are considered

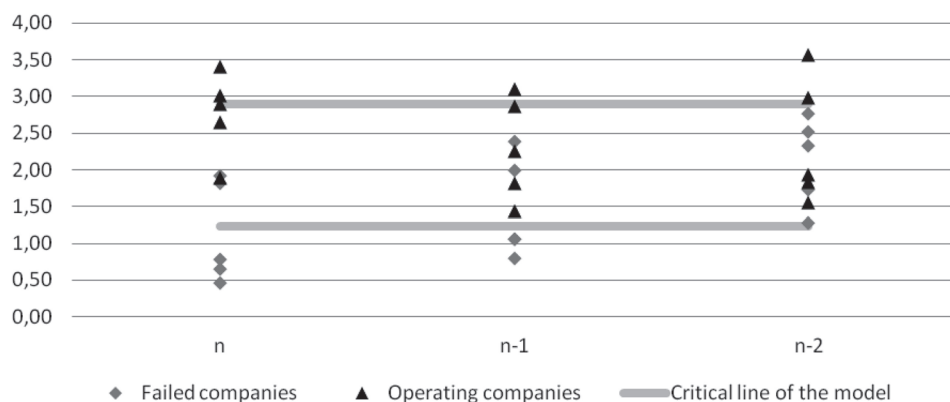


Figure 2. Distribution of Altman Models' Values (ratio). Source: Jurevičienė, Bercevič, 2012.



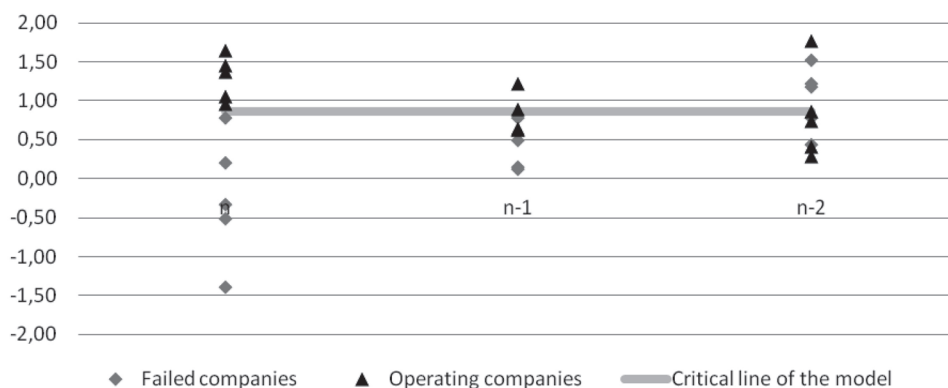


Figure 3. Distribution of Springate Models' Values (ratio). Source: Jurevičienė, Bercevič, 2012.

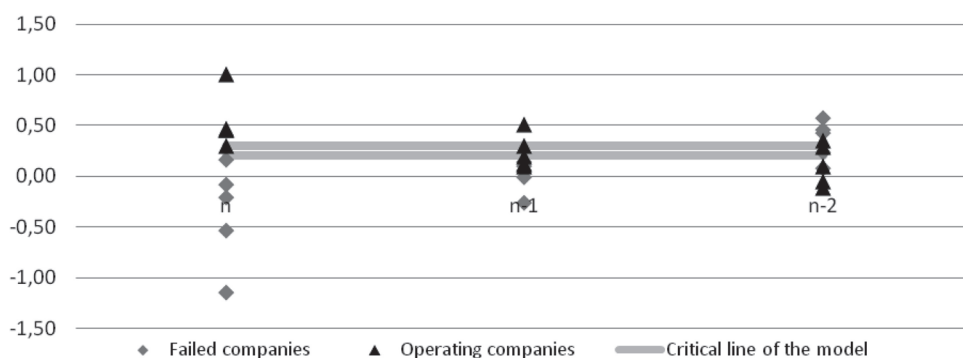


Figure 4. Distribution of Taffler&Tisshaw Models' Values (ratio). Source: Jurevičienė, Bercevič, 2012.

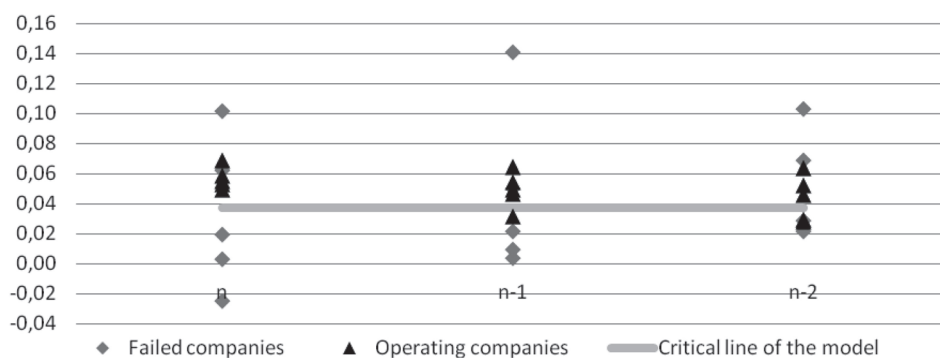


Figure 5. Distribution of Liss Models' Values (ratio). Source: Jurevičienė, Bercevič, 2012.

as bad. While the values in the period N reflects real situation according Springate model.

Whereas according to Taffler&Tisshaw model (Figure 4) in the period N-2 the obtained values are absolutely differentiate from the real situation. The failed companies have the highest ratio, still operating – the lowest ratio. Inappropriate distribution of values is in the period N-1.

But in this model the critical line of the model is probably too stringent to Lithuanian companies. In the period N the Taffler&Tisshaw models' values are adequate to the real situation and obtained results absolutely correspond to critical line.

Summarizing, this model fully reflect the real situation one year before the bankrupt. Applying it in earlier periods some inaccuracies or minor deviation could be noticed.

The Liss model evaluates failed companies the best in the period N-2. So these results do not correspond to the real situation and not predict bankrupt some years before for companies that have failed (Figure5).

Similar situation is also in the period N-1. Status of failed companies is estimated as good while Girteka's – as bad, but this company is still operating in the market. This means that Liss model is absolutely inappropriate for Lithuanian carrier industry as ratios used in it do not help to predict possible bankrupt.

Summarizing investigation of linear discriminant models, we could state that three years before bankrupt neither from observed models could precisely predict possible failure of a company. Medium bankrupt probability for all investigated companies shows only Altman method. Sprigate and Taffler&Tisshaw models are the best to predict bankruptcy for Lithuanian carrier companies – two and one year before failure. Altman method is also appropriate, but it not always shows accurately whether the probability is

high or medium. This means that the critical line of this model is a bit high. Liss model is absolutely inadequate for Lithuanian carrier sector; its critical line is too high. For this reason this model evaluates companies' financial status better than it is in reality.

Calculating bankruptcy probabilities using logistic regression models Z coefficient is inserted into logistic regression formula, thus probability of bankruptcy is presented in percentage.

The results of Zavgren model is shown in Figure 6. As we see Zavgren model for all companies forecasts bankruptcy. Probability distributed in range from 85 to 100 per cents. This means that the model does not separates still operating companies from failed. The reason of it can be too strict critical point or improperly selected indicators. According to this model, there are used few indicators with such factors as stocks, which does not reflect the logistics companies' state. Carrier companies usually do not hold stock at all or have them at a low level.

So, Zavgren model is absolutely inappropriate particularly for carrier companies as all companies – failed and operating – estimates equally poorly.

Looking at the dynamics of the Chesser model results we see that calculated probabilities did not reflect the real situation in the N-2 period (see Figure 7). Failed companies were evaluated very well and for operating companies were predicted 60–98 per cent probability of bankruptcy.

Similar situation is a year later. This model represents real situation only in the year N – failed companies are located lower than operating. This means, that Chesser model can predict possible bankrupt only a year before failure. In addition, according to critical line for some still operating companies a low probability of bankrupt is predicted. This means, that critical line is not absolutely relevant for carrier and logistic sector.

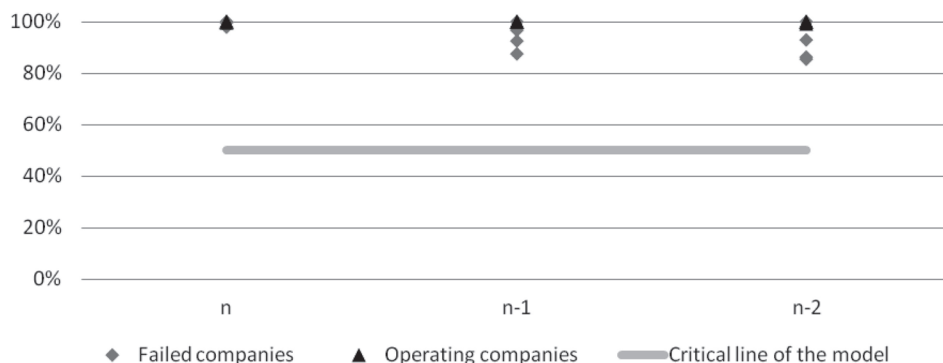


Figure 6. Distribution of Zavgren Models' Values (probability). Source: Own work.

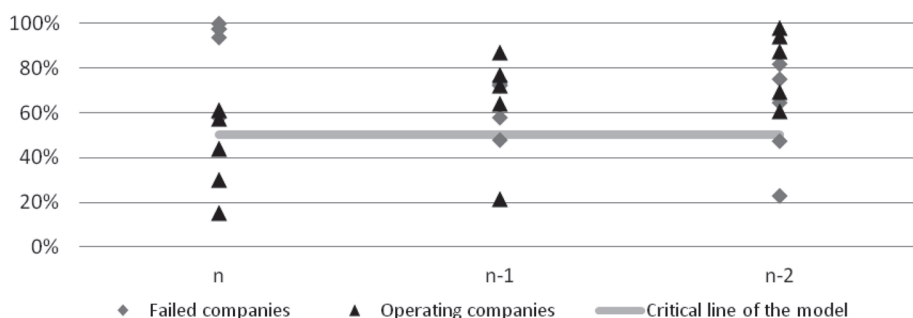


Figure 7. Distribution of Chesser Models' Values (probability). Source: Own work.

So, logistic regression models also can't precisely predict bankruptcy for Lithuanian carrier companies.

In summary, investigation of adaptability of linear discriminant and logistic regression models states that neither of six analysed models could help to predict precisely bankrupt of a carrier company three years before failure. The best models for Lithuanian carrier companies are Springate and Taffler&Tisshaw methods as they predicted the possible failure for the companies in two and one year before bankrupt. Liss model is absolutely inappropriate as its critical value is too high, so it estimates the situation of the company better than it is reality.

Obtained results show that in spite that Lithuanian companies often use Altman model for prediction of possible bankrupt, others are more appropriate.

## Conclusions

Origin of bankrupt could be determined not only by internal factors of a company, but also by sectors', country's' or even world's economic development. Consequences of company's failure are severe for entire economy of a country. Not only owners and employees suffer losses from company's failure but also other enterprises, creditors, partners, state or municipalities. Failure of a company leads to increase of unemployment, unpaid taxes for country's

or municipality's budget, the government need additional money to pay allowances for workless, decreases the level of business competitiveness. So, top managers willing to ensure successful development of an enterprise must undertake all possible tools to prevent bankrupts.

During 1993-mid 2011 in Lithuania failed 10982 companies. During 2011 the bankrupt process was initiated for 1273 enterprises. This very high level of failed companies indicates the lack of consideration for bankruptcy diagnostics and too late proceeds.

It was stated after analysis of four chosen linear discriminant analysis (Altman, Springate, Taffler&Tisshaw and Liss) and two logistic regression (Zavgren and Chesser) bankruptcy prediction models that some of them are very similar as several repetitive ratios are used. No one of six analysed models could help to predict precisely bankrupt of a company three years before failure.

Application of these models to Lithuanian carrier companies shows that using Altman model it is possible to predict possible failure even three years before bankrupt but with medium accuracy. Springate and Taffler&Tisshaw models are also appropriate for this sector's enterprises, however they could help to predict possible failure only two years (Springate) or one year (Taffler&Tisshaw) before bankrupt, while Liss, Zavgren and Chesser models are unreliable for carrier enterprises due to ratios used for bankruptcy prediction.

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