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THE LIKELIHOOD OF FARMS BANKRUPTCY: THE CASE OF LITHUANIAN FAMILY FARMS

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In developing the measures of agriculture policy and purposeful usage of EU funds, also for financial organisations, farmers, advisors and scientists it is important to predict farm bankruptcy. This makes it possible to formulate the scientific problem: what is the likelihood of bankruptcy of different kinds of family farms? The aim of the investigation is to present the likelihood of the Lithuanian family farms bankruptcy based on the economic size and type of farming by analysing financial indicators of farms. Farm-level panel data for the year 2014–2016 from Farm Accountancy Data Network (FADN) was used. The estimated distribution of farm groups based on farm economic size demonstrated that about 40–60% of small farms were in the low likelihood of bankruptcy area. The share of cereals, oilseeds and protein crop farms in the high likelihood of bankruptcy area fluctuated from 13% till 30% during the year 2014–2016. The farm distribution by economic size and type of farming showed that more than 40% of small dairy farms had the high likelihood of bankruptcy in the year 2015–2016, as well as 30% of medium and large cereals, oilseeds and protein crops farms in 2016.

Key words: Altman model, likelihood of bankruptcy, economic size, FADN data, family farms, farming type, Lithuania.
JEL Codes: Q12, Q14.

1. Introduction

Evaluation of the farm financial situation is an important issue for farmers and their strategic decision making and for policy makers: for better understanding of sector evolution, and for financial organizations that provide loans to agricultural producers. Assessing the farm financial direction is meaningful to other stakeholders as well: workers, suppliers, clients, the community (Stulpinienė, 2011; Zhang, 2006). Agricultural business differs from other activities because there is a large range of risks: input and output price risk, political risk, changes in biophysical environment, etc. (Streimikiene, 2016). From a policy perspective, the farm sector is dependent upon a prolonged biological production process that generates considerable physical and financial risk (D'Antoni, 2009). According to Streimikiene (2016) financial risk arises from fluctuations at financial markets (increasing interest rates might render difficulties in repaying loans) and farmers' decisions regarding capital structure.

This usually leads to the likelihood of bankruptcy, i. e. to a degree of value fluctuations in debt instruments and derivatives due to changes in the primary credit quality of borrowers and counterparties (Lopez, 2000) that is significant issue for financial institutions. A number of studies and researches tried to find the business ratio that would help to predict a firm's bankruptcy. Bankruptcy prediction is an essential problem in finance, with significant economic and social implications. Predicting future financial situations of individual corporate entities is even more significant (Almansour, 2015). Statistical methods for assessment the likelihood of bankruptcy methods were discussed by Altman (2013), Keenan (1999), Blöchlinger (2006). According to Almansour (2015), a statistical model to predict the likelihood of firms bankruptcy was first used by Altman (1968) that calculates Z score by using a standard discriminate model. But Stulpiniene (2013) identified that bankruptcy prediction models proposed for business firms cannot unconditionally be applied for predicting the financial risk in the agricultural business due to the specificity of agricultural activity and the status of a family farm. It was proposed that prediction models and approaches need to be carefully adapted to the available, specific information of the farm business (Stulpiniene, 2013; Zhang, 2006). Studies about the likelihood of farms bankruptcy applying financial prediction modules were carried out by Zhang (2006), bankruptcy assessment by Janova (2012), financial distress prediction by Stulpiniene (2013), financial risk analysis by Streimikiene (2016). The problem is that there are no investigations on bankruptcy prediction for farms based on to their economic size of farm and type of farming. That could help to identify the likelihood of bankruptcy depending on these criteria mentioned. In developing the measures of agriculture policy and purposeful usage of EU funds, as well as for financial organisations, farmers, advisors and scientists it is important to predict farms bankruptcy as this makes it possible to formulate the scientific problem: what is the likelihood of bankruptcy in different kinds of family farms? The data of Farm Accountancy Data Network (FADN) is used in the research proposed. The aim of the investigation is to present the likelihood of the Lithuanian family farms bankruptcy based on to the economic size and type of farming by analysing financial indicators of farms. The object of investigation: the likelihood of farms bankruptcy. The following research methods were used: scientific literature, document analysis and synthesis, mathematical and econometric research techniques.

2. The model specification, methodology and data

The analysis of selected farms' bankruptcy probability is based on Z score model and its modifications Z'. The original Z score model was developed by E. I. Altman in 1968. The purpose of the original Z score model is to measure a firm's financial health. According to the model specification, it has 72–80% reliability of predicting the firm's bankruptcy. However, the modification of the original Altman model was developed (Altman, 2004). The modified Z' score model is able to manage the likelihood of bankruptcy for private manufacturing companies like farms

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(Zhang, 2006). Z' score model has the same variables (financial ratios) as the original however the coefficients of the modified model were re-estimated. The modified Altman Z' score model has the following specification:

$$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$

where: X_1 – working capital/total assets. In this study working capital is described as the difference between current assets and current liabilities. This indicator measures the net liquid asset of a farm relative to the total assets. It has to be noted that shrinking of X_1 leads to consistent losses of a farm (Zhang, 2006). X_2 – retained earnings/total assets. Retained earnings are defined as a farm's net income in this investigation. This is the most suitable definition of retained earnings in a farm's studying case. X_2 indicator measures cumulative profitability of a farm. X_3 – earnings before interest and taxes/total assets. This indicator measures the profitability of a farm (i. e., the productivity of a farm's assets). X_4 – total equity/total liabilities. Because there is no data of equity's market value for a farms, total equity is defined as the difference between total assets and total liabilities of a farm in this study. X_4 indicator measures the solvency of the farm. X_5 – sales/total assets. In this investigation sales are formed from the sum of crop product, livestock product, other gainful activities (processed products, agro-tourism etc.) related to farm sales. X_5 indicator measures revenue generating ability of the farm's assets. It has to be mentioned that all indicators' raw components are described in FADN terms.

The value of Z' score determines in which group of the likelihood of bankruptcy the farm can fall. If Z' score < 1.23 the likelihood of the farm bankruptcy is high. If 1.23 < Z' score < 2.9 the bankruptcy of the farm cannot be predicted and falls into the medium area. If Z' score > 2.9, the likelihood of farm bankruptcy is low.

The required financial data of farms are collected from Lithuanian FADN database from the accounting period of 2014–2016. It should be mentioned that farms which have entries for all 3 accounting years were considered in order to estimate more precise dynamic of the likelihood of bankruptcy in group changes over the period. Farms with less than 1000 EUR of total liabilities are also excluded from the survey because these farms are financially strong enough to deal with the likelihood of bankruptcy. The farms were grouped into three categories according to their economic size: small farms (from EUR 4000 to EUR 25000), medium farms (from EUR 25000 to EUR 250000), large farms (over EUR 250000). It should be noted that only commercial farms were grouped into these categories. Farms below EUR 4000 threshold are not commercial and were not considered in this investigation. An additional criteria for selected farms was applied: for initial data security reason if less than 5 farms took place in a certain type and size category such cluster was eliminated from the investigation. As a result, 480 farms were participating and distributing among the following groups: cereals, oilseeds and protein crops (type 15), dairying (type 45), grazing livestock (type 46) and field crop-grazing livestock combined type (type 83) farming in three economic size groups in the period from 2014 to 2016.

3. Results and discussion

The analysis of financial ratios (or variables of the modified Altman model) is presented in Table 1. The survey shows that the mean values of net liquid asset of a farm relative to the total assets (X_1) and the solvency of the farm (X_4) were higher for grazing livestock farms all over the period (significantly higher at 0.05 level in 2016).

Table 1. The financial ratios for different types of farming in 2014–2016

	2014					2015					2016				
Type	X_1	X_2	X_3	X_4	X_5	X_1	X_2	X_3	X_4	X_5	X_1	X_2	X_3	X_4	X_5
(15)	0.21	0.06	0.07	15.9	0.33	0.24	0.10	0.11	12.0	0.36	0.19	0.00	0.01	9.30	0.35
(45)	0.22	0.13	0.14	16.7	0.28	0.24	0.04	0.04	16.9	0.26	0.25	0.06	0.07	12.3	0.25
(46)	0.26	0.08	0.09	26.8	0.16	0.27	0.03	0.04	21.8	0.17	0.29	0.11	0.12	28.2	0.13
(83)	0.22	0.09	0.10	10.2	0.26	0.23	0.07	0.08	9.7	0.28	0.20	0.04	0.05	9.60	0.25

However, the analysis indicates a less stable situation with cumulative profitability of a farm (X_2) and productivity of a farm's assets (X_3): these variables were significantly higher for dairying in 2014, for cereals in 2015 and for grazing livestock in 2016. Cereals, oilseeds and protein crops farms show significantly higher values of revenue generating ability of a farm's assets (X_5) all over the period. It has to be noted that mixed farms (type 83) showed more stable results of the financial ratios analysis: the values of variables were at the average level in farming type group for each X_n.

Financial ratios X_n allowed to estimate the Altman Z' score for each farm. According to model specification estimated Z' scores were combined into the low, medium and high likelihood of a farm's bankruptcy, depending on their values. The analysis of the likelihood of a farm's bankruptcy for small, medium and large farms is presented in Figure 1.

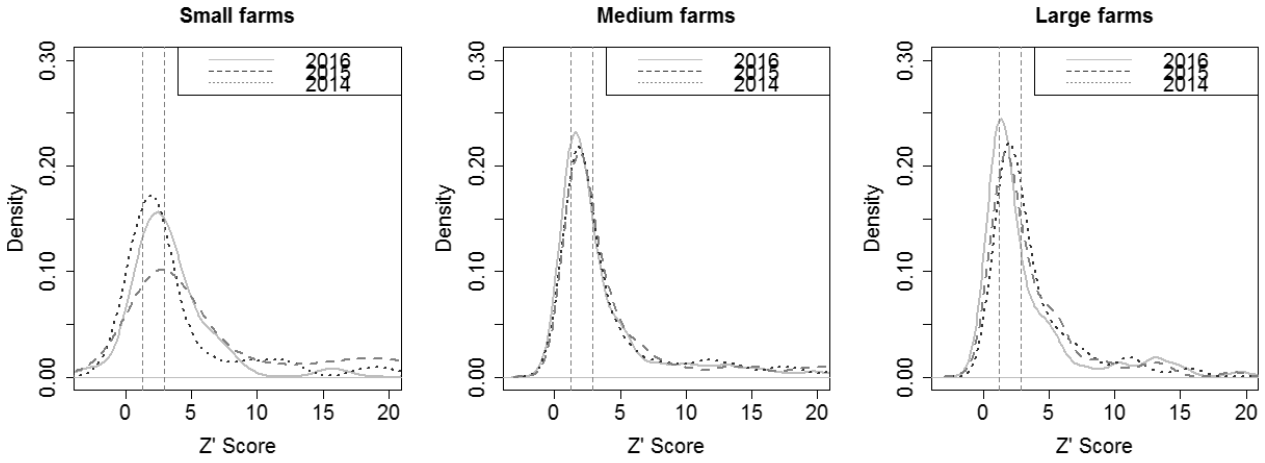

Fig. 1. Distribution of the likelihood of small, medium and large farms bankruptcy in 2014–2016

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Estimated distributions for each group of farms showed that small farms had the lowest probability to deal with difficulties. Because of good financial indicators and relatively low level of liabilities about 40–60 percent of small farms were placed into a safe area (the low likelihood of bankruptcy) depending on year.

The probability of falling into the likelihood of bankruptcy area had not changed for medium and large farms all over the period and was higher compared to small farms. Moreover due to a high level of a farm's liabilities the probability of meeting the high likelihood of bankruptcy was higher for medium farms in 2014–2015 and for large farms in 2016.

Table 2 presents the distribution of grouped Z' scores for different types of farming during the year 2014–2016. It can be seen that majority of dairying and grazing livestock farms had relatively high Z' score values and were dealing with the low likelihood of bankruptcy opportunity. The situation is opposite for cereals farms: they faced higher probability to enter the group of the high likelihood of bankruptcy comparing to other farming types. Due to significantly decreased selling prices of crop products one third of cereals farms have not reached the value 1.23 of the Z' score, so they were placed into the high likelihood of bankruptcy area in 2016. The estimated dairy and crop sector's results were the same as the results in the research presented by Streimikiene (2016). Based on this research – cereal farms faced the highest financial risk, whereas dairy farms were the least exposed.

Table 2. Distribution of the likelihood of bankruptcy for different types of farming in 2014–2016, %

	2014			2015			2016		
	High	Medium	Low	High	Medium	Low	High	Medium	Low
Cereals, oilseeds and protein crops	17.0	43.0	40.0	13.0	45.9	41.0	30.0	40.0	30.0
Dairying	7.0	39.0	54.0	18.0	31.1	51.0	19.0	30.0	50.0
Grazing livestock	8.0	41.0	51.0	11.0	35.1	54.0	5.0	37.0	58.0
Field crop-grazing livestock combined	13.0	47.0	40.0	13.0	52.7	34.0	17.0	45.0	37.0

Due to the average financial ratios X_n the majority of mixed farms occupied grey area (the medium likelihood of bankruptcy) and the probability of difficulties for these farms was lower than for cereals farms.

A deeper analysis was performed in order to estimate the low, middle and high likelihood of farms bankruptcy based on their economic size and a type of farming. Table 3 shows detailed distribution of the likelihood of farm's bankruptcy based on mentioned criteria in 2014–2016. The analysis shows that small dairy farms had the biggest possibility of bankruptcy during 2015–2016 as more than 40% of all small dairy farms had such possibility. These farms are very sensitive because of milk selling price which has been declining over the mentioned period.

Table 3. Distribution of the farm bankruptcy likelihood based on their economic size and types of farming in 2014–2016, %

		Small farms			Medium farms			Large farms		
		High	Middle	Low	High	Middle	Low	High	Middle	Low
2014	(15)	6.7	26.7	66.7	17.6	45.6	36.8	16.4	42.6	41.0
	(45)	15.8	21.1	63.2	7.1	39.4	53.5	0	55.6	44.4
	(46)	11.1	33.3	55.6	5.3	47.4	47.4	NA		
	(83)	0.0	50.0	50.0	16.9	43.7	39.4	0	64.3	35.7
2015	(15)	18.2	36.4	45.5	13.9	46.4	39.7	8.6	46.6	44.8
	(45)	43.8	12.5	43.8	17.2	30.3	52.5	0	52.9	47.1
	(46)	10.0	45.0	45.0	11.8	23.5	64.7	NA		
	(83)	25.0	50.0	25.0	10.9	54.7	34.4	15.8	47.4	36.8
2016	(15)	0	57.1	42.9	30.1	42.3	27.6	34.4	32.8	32.8
	(45)	40.0	26.7	33.3	14.7	30.5	54.7	26.3	31.6	42.1
	(46)	7.7	23.1	69.2	4.0	44.0	52.0	NA		
	(83)	16.7	16.7	66.7	17.7	46.8	35.5	16.7	50.0	33.3

The Altman Z' score values distribution shows that medium and large cereal farms had the biggest likelihood of bankruptcy, especially in 2016. It was more than 30% of such farms in the high likelihood of bankruptcy area. The data was not available (NA) for large grazing livestock farms, because this cluster did not contain at least 5 farms (data security issue).

4. Conclusions

1. Grazing livestock farms featured a higher ratio of net liquid to the total assets (X_1) and more ensuring solvency of a farm (X_4). Cereals, oilseeds and protein crops farms had better revenue generating abilities of a farm's assets (X_5). Profitability and productivity of a farm's assets (X_3) were the point of interest for dairying, grazing livestock and cereals farms depending on a year of investigation.

2. Distribution of the likelihood of the farms bankruptcy groups based on to their economic size showed that about 40–60% of small farms were in the low likelihood of bankruptcy area. For medium and large farms the probability to be placed into the medium likelihood of bankruptcy area did not changed during the period and was higher compared to small farms.

3. Dairying and grazing livestock farm groups had relatively high Z' score values and deal with the low likelihood of bankruptcy. The amount of cereals, oilseeds and protein crop farms group in the area of high bankruptcy likelihood fluctuated from 13% till 30% during the year 2014–2016. Around 50% of field crop-grazing livestock combined farms were in the medium likelihood of bankruptcy area.

4. The farm analysis by their economic size and type of farming showed that more than 40% of all small dairy farm had the high likelihood of bankruptcy in 2015–2016, as well as more than 30% of medium and large cereals, oilseeds and protein crops farms in 2016.

5. The Altman model was used in this research, however, further studies could include comparison of the different likelihood of bankruptcy methods for family farms, as well as more detailed studies could be carried out for the farms with the high bankruptcy likelihood.

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ŪKIŲ BANKROTO GALIMUMAS: LIETUVOS ŠEIMOS ŪKIŲ ATVEJIS

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Formuojant žemės ūkio politikos priemones ir siekiant tikslingai panaudoti Europos Sąjungos paramos lėšas, svarbu numatyti galimą ūkio bankrotą. Tai labai aktualu ne tik politikams, bet ir ūkininkams, finansinio sektoriaus atstovams, konsultantams bei mokslininkams. Mokslinė problema sprendžiama atsakant į klausimą – koks bankroto galimumas skirtingų tipų šeimos ūkiuose? Tyrimo tikslas – išanalizavus Lietuvos šeimos ūkių finansinius rodiklius, pateikti bankroto galimumą pagal ekonominį ūkio dydį ir ūkininkavimo tipą. Tyrime analizuoti Ūkių apskaitos duomenų tinklo (ŪADT) ūkio lygio 2014–2016 m. tų pačių ūkių duomenys. Ūkių grupių pasiskirstymas pagal ūkių ekonominį dydį parodė, kad 40–60 proc. mažų ūkių bankroto tikimybė yra nedidelė. Javų, rapsų, ankštinių augalų grūdams ūkių grupėje bankroto tikimybė buvo nuo 13 iki 30 proc. ūkių, priklausomai nuo nagrinėjamų metų. Analizė pagal ūkių ekonominį dydį ir ūkininkavimo tipą parodė, kad aukšta bankroto tikimybė grėsė daugiau kaip 40 proc. mažų pieno ūkių 2015–2016 m. ir daugiau kaip 30 proc. vidutinių ir didelių javų, rapsų, ankštinių augalų grūdams ūkių 2016 m.

Raktiniai žodžiai: Altmano modelis, bankroto galimumas, ekonominis dydis, Lietuva, šeimos ūkiai, ŪADT duomenys, ūkininkavimo tipas.

JEL kodai: Q12, Q14.