Financial Stability in the Food Supply Chain

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ABSTRACT

This research was concerned about the determination of the possibility of limiting the financial risk in the food supply chain in the context of possible bankruptcy of companies involved in this cooperation. This research used data of companies from three sector: bakery and flour products production, road transport of goods, and food wholesale trade. In the course of this research, an original logistic regression model was developed to recognize companies at risk of bankruptcy in the analyzed case. In the model three variables were significant: Current assets/Total assets, (Short-term receivables + Short-term investments) / (Short-term liabilities), and Total liabilities / Equity. In addition, this research has shown that, in the case of cooperation within the supply chain, it is important to manage liquidity and the level of corporate debt.

Keywords: financial stability, food supply chain, bankruptcy

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1. INTRODUCTION

It should be emphasized that in the literature of the subject there is no unambiguous, generally accepted definition of the supply chain (Wu et. Al, 2018). For example, Bozarth and Handfield (2007) define the supply chain as a network of producers and service providers who cooperate with each other to process and transport goods - from the raw material phase to the final use level. In the logistic dictionary, the supply chain is defined as a group of companies implementing joint actions necessary to meet the demand for specific products in all its links (Fertsch, 2006). It can be stated that the supply chain is a kind of network of cooperating entities and implementing joint activities, starting to produce the product and ending with their delivery to the final recipient. The supply chain defined in this way makes it necessary to accept the complexity, limitations and risk of bankruptcy of enterprises operating in it. Therefore, the aspect of supply chain security gains in importance. Among the threats related to the functioning of the supply chain, among others: disruptions, delays, IT system failures, erroneous forecasts, loss of intellectual value, rising costs of raw materials and components, uncertain receivables, inadequate inventory volumes and inadequate production capacities (Wang, et al., 2018). Particularly noteworthy is the aspect related to financial security, which is largely influenced by the risk of payment bottlenecks as a result of the bankruptcy of one of the companies making up the supply chain. If one looks at bankruptcies more broadly, it would turn out that they are an integral element of the market economy, because they cause it to be recovered from economically ineffective enterprises (Balina, 2018). What is important, bankruptcies are one of the

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factors that make effective competition possible. In addition, in line with the theory of creative destruction, bankruptcy favors the growth of innovation, the elimination of barriers to business development and the efficient use of limited resources, for the benefit of owners and economies in which they operate. In the current economic conditions, a bankruptcy is an enterprise that for a long time is not able to pay liabilities in a timely manner, and the value of assets is not sufficient to cover them, even if the company operates continuously (Bhattarai, 2018). This means that the company may be in a bad economic and financial condition, although it does not have to be translated into a production dimension (Martin, 1977). Therefore, a bankruptcy is an enterprise that is unable to continue its statutory activity on its own and settle its obligations without receiving external assistance. That is why it is so important to identify the early threat of bankruptcy of companies that are the links of the supply chain.

Unstable economic environment, decrease in revenues, low level of competitiveness and innovativeness of Polish enterprises and lack of sufficient capital often contribute to the deterioration of the financial situation of many enterprises (Juszczyk et. al, 2014). As a consequence, many companies are late with payments to their contractors. This causes that a large number of suppliers have chronic problems with the timely payment of their debts, which contributes to the formation of so-called payment gridlocks, which in economic practice constitute one of the most important barriers and threats to the stable development of entrepreneurship. Relatively often, the financial problems of one company translate into problems of its contractors. The process is the stronger the stronger the mutual connections of entities. Too strong mutual relations between entities may lead to the so-called domino effect, the essence of which is that the bankruptcy of one company can lead to many more (Wedzki, 2008). Therefore, the problem of bankruptcy of the company, its definition and forecasting, is becoming an increasingly important issue from an economic point of view. The problem of bankruptcy and the related phenomenon of payment gridlocks is particularly important when considering the connections of enterprises operating within the food supply chain, as these entities are generally characterized by a strong degree of dependence.

Symptoms affecting the company's condition can be divided into two main groups, among others. Balina et. al (2014) points to the clear occurrence of symptoms of crisis in the operational sphere, directly related to the company's operations and its financial sphere, as this is the area that proves the deterioration of the company's condition. For several decades, both researchers and practitioners in the field of finance conducting research around the world are trying to construct such tools that advance and sufficiently precisely determine whether the enterprise is threatened with bankruptcy or not. The importance of this type of tools is particularly important in the case when we consider the functioning of enterprises within the supply chain, in which any kind of uncertainty appearing in their environment causes disruptions in the functioning of the entire supply chain.

2. SCOPE AND METHODS

The research covered a total of 120 enterprises from three industries that were links in the food supply chain. Namely, companies from the industry were examined: production of bakery and flour products, road transport of goods and wholesale trade in food. The research concerned a four-year period, ie 2014-2017. The research used

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balances and profit and loss accounts of enterprises from the above-mentioned industries operating on the territory of the Republic of Poland in the form of limited liability companies. The selection of the test sample was random. Sixty enterprises were used for research in two stages - bankrupts, 20 from each of the surveyed industries and 60 companies continuously operating – 20 from each industry. In the study, the group of bankrupts included those companies that published financial statements in Monitor Polski B, at least for the last three years before applying to court for bankruptcy, with negative equity and financial losses. These enterprises were opposed to enterprises which in 2017 had been operating continuously since January 1, 2014 and the value of their assets was close to the value of assets in the group of randomly drawn bankrupts, and the differences in this respect were not higher than PLN 500,000.

After selecting companies for research, 32 economic and financial indicators were calculated. The selection of indicators for research was dictated by their dissemination in the literature of the subject (Ohlson, 1908) and the suitability for prediction or lack of bankruptcy (Juszczyk et. al, 2014). Bearing in mind the above two criteria, the following indicators were selected:

X_1 = Fixed assets / Total assets,
X_2 = Current assets / Total assets,
X_3 = Current assets / Short-term liabilities,
X_4 = (Short-term receivables + Short-term investments) / Short-term liabilities,
X_5 = Short-term investments / Short-term liabilities,
X_6 = Sales revenues / Short-term receivables,
X_7 = (Short-term receivables / Sales revenues) * 365,
X_8 = Sales revenues / Short-term liabilities,
X_9 = (Short-term liabilities / Sales revenues) * 365,
X_{10} = Sales revenues / inventories,
X_{11} = (Inventories / Sales) * 365,
X_{12} = Debt rotation + Stock turnover - Debt turnover,
X_{13} = Net profit / Total assets,
X_{14} = Net profit / Current assets,
X_{15} = Net profit / Fixed assets,
X_{16} = Net profit / Sales revenue,
X_{17} = Total assets / Equity,
X_{18} = Total liabilities / equity,
X_{19} = Equity / Fixed assets,
X_{20} = Sales revenues / Total assets,
X_{21} = Sales revenues / Fixed assets,
X_{22} = Total costs of operations / Income from total activity,
X_{23} = Equity / Sales revenues.
X_{24} = $(\text{Sales revenue})_t$ / $(\text{Sales revenue})_{(t-1)}$,
X_{25} = $(\text{Total assets})_t$ / $(\text{Total assets})_{(t-1)}$,
X_{26} = $(\text{Current assets})_t$ / $(\text{Current assets})_{(t-1)}$,
X_{27} = $(\text{Non-current assets})_t$ / $(\text{Fixed assets})_{(t-1)}$,
X_{28} = $(\text{Equity})_t$ / $(\text{Equity})_{(t-1)}$,
X_{29} = $(\text{Foreign capital})_t$ / $(\text{Foreign capital})_{(t-1)}$,
X_{29} = $(\text{Short-term liabilities})_t$ / $(\text{Current liabilities})_{(t-1)}$,

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X_{31} = (Result on operating activity)$_t$ / (Operating result)$_{(t-1)}$,
X_{32} = (Net financial result)$_t$ / (Net financial result)$_{(t-1)}$.

At the same time, the economic category with the index t refers to the last full financial year before the bankruptcy of the enterprise, and with the index (t-1) it refers to the second year before bankruptcy.

To assess the accuracy of the classification of enterprises, the validity matrix of the discriminatory model was used. It is a tool that presents a summary of the correctness of the indications of the estimated model. This matrix is a square matrix with the dimensions k x k - where k is the number of decision classes. The rows of the matrix correspond to the correct decision classes, whereas the columns correspond to the decisions estimated by the model. Such presentation of results regarding the accuracy of forecasts allows determining the model's efficiency. In the case of discriminant analysis, it is possible to determine three types of its efficiency and classification errors.

In the case of efficiency of the model stands out (Altman, 1968):

- first degree efficiency (SP1), which determines what percentage of bankrupts has been
- qualified correctly by the model,
- second degree efficiency (SP2), which determines what percentage of enterprises
- without bankruptcy, was classified correctly,
- general efficiency (SP0), determines what percentage of all analyzed
- the enterprise has been classified correctly by the model.

A logit analysis was used to determine the function allowing estimating the probability of bankruptcy risk or its absence. This analysis, in addition to linear multidimensional discriminant analysis, is one of the more commonly used methods when building models of forecasting the risk of continuing operations. The result of the logistic regression function is the probability of a certain event. When assessing the risk of bankruptcy of an enterprise, this is the affiliation of the audited entity to one of two groups, ie: enterprises at risk or not at risk of bankruptcy and bankruptcy. In the binomial model, one of the groups is assigned the number 1 and the second digit 0. The logit function is expressed by the following formula (Witkowska, 2006):

$$P(Y = 1) = \frac{1}{1 + exp^{-z}}$$

where:
P (Y = 1) - explained variable or the probability of the Y variable taking 1 value,
Z - the value of the linear function Z, where: $Z = a_0 + a_1X_1 + a_2X_2 + ... + a_nX_n$ with a_0 - constant, and a_n - weights for individual variables, X_i - explanatory variables.

The value of the P index (Y = 0) ranges from 0 to 1, assuming that the number 0 means the company is not at risk, this means that the higher the value of P (Y = 0), the higher the probability of bankruptcy. The value of P (Y = 0) while closer to 0 means good financial situation of the enterprise. In the logit model, a certain limit value of the Z function should be assumed. In models estimated on the basis of a balanced sample, the limit point value is 0.5.

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3. RESULTS

The conducted research on the possibility of forecasting the bankruptcy risk of the surveyed enterprises allowed to estimate the linear regression function, which is defined as follows:

$$Z=2,627 + 2,9975X_2 + 0,02368X_{14} – 0,00581X_{19}$$

where:
Z - the value of the linear function,
X_2 = Current assets / Total assets,
X_4 = (Short-term receivables + Short-term investments) / Short-term liabilities,
X_{18} = Total liabilities / Equity.

According to the estimated regression function in the bankruptcy prediction of enterprises in the food supply chain, three variables turned out to be significant, with two being stimulants, ie the ratio of current assets to total assets and the quick liquidity ratio. The remaining variable defining the ratio of total liabilities to equity was a destimulant, i.e. its increase contributed to the deterioration of the company's condition and thus increased the risk of the company's insolvency. Such a state, things were dictated by the fact that the constructed model was intended for the prediction of enterprises from various industries, which contributed to the need to take into account their specificity. The first variable defining the ratio of current assets to total assets was characterized by a sufficient regression coefficient, which could indicate that for enterprises forming part of the food supply chain, it is important to maintain a relatively high level of total assets, which should translate into their liquidity. Moreover, the amount of this relationship should remain within the limits allowing the company to function freely. The liquidity issue is supplemented by the second variable, defining the level of quick liquidity, which is the quotient of the sum of short-term receivables and short-term investments in relation to short-term liabilities. A positive regression coefficient indicates that an important aspect of the functioning of enterprises in the supply chain is liquidity, which should be relatively high. This is confirmed by the fact that the third variable, which is a destimulant, indicates the adverse effect of excessive indebtedness on equity on the condition of enterprises. In the next stage of the research, the efficiency of the estimated regression model was broken down by sector and by the whole supply chain. When assessing the effectiveness of the estimated model for companies in the bakery and flour industry, it was found that the model sought to detect 14 enterprises threatened with bankruptcy before it occurred, while in the case of 6 enterprises from the manufacturing industry the model proved to be useless. In addition, the model mistakenly recognized four companies in good financial health. As a consequence, the overall efficiency of the model was set at 75%, i.e. the model indication in the case of enterprises from the bakery industry was not satisfactory.

Table 1. The model validity matrix in the industry of bakery and flour products production

Actual Group Membership	Predicted Group Membership	
	Bankrupt	Non-Bankrupt
Bankrupt	14	6
Non-Bankrupt	4	16

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In the case of enterprises engaged in road transport of goods, the estimated model was characterized by a general efficiency level of 82.5%, which should be considered as a satisfactory level. The estimated model applied to enterprises in the industry allowed to detect enterprises threatened with bankruptcy with an effectiveness equal to 90%. However, it did not recognize companies that were not threatened with bankruptcy, however due to the essence of the study regarding the possibility of preventing payment jams in supply chains, this element was considered less important.

Table 2. Model validity matrix in the road transport of goods sector

Actual Group Membership	Predicted Group Membership	
	Bankrupt	Non-Bankrupt
Bankrupt	18	2
Non-Bankrupt	5	15

Table 3 presents the effectiveness of the model in relation to enterprises dealing in wholesale trade in food. As results show, the estimated model in relation to this industry was characterized by the highest level of overall effectiveness. The important thing is that with similar effectiveness, it allowed to recognize both companies in good and bad financial condition.

Table 3. The model validity matrix in the food wholesale trade sector

Actual Group Membership	Predicted Group Membership	
	Bankrupt	Non-Bankrupt
Bankrupt	17	3
Non-Bankrupt	2	18

Next, the effectiveness of the estimated model was compiled for all enterprises included in the considered supply chain. Detailed results are presented in table 4. It is interesting that the model suits the recognition of both bankrupt and financially sound enterprises with equal efficiency. This efficiency amounted to 81.67% which should be considered a satisfactory level.

Table 4. Model validity matrix for the entire food supply chain

Actual Group Membership	Predicted Group Membership	
	Bankrupt	Non-Bankrupt
Bankrupt	49	11
Non-Bankrupt	11	49

Bearing in mind the obtained results of research on the model's efficiency, it should be stated that depending on the industry to which it was applied, it was characterized by different levels of effectiveness in identifying bankrupts and non-bankrupts. This may have resulted from a large variation in the nature of the operations of the surveyed enterprises. However, the effectiveness represented by the model can be considered satisfactory.

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4. CONCLUSIONS

It results directly from the estimated bankruptcy risk model for the surveyed enterprises, in which there are variables defining:

- the ratio of current assets to total assets,
- the level of fast liquidity ratio and
- the ratio of total liabilities to equity.

This research also showed that the estimated model was characterized by different effectiveness in identifying bankrupts and non-bankruptcies among enterprises from individual links in the analyzed supply chain. It can be assumed that this was mainly due to the fact that these enterprises were characterized by different scope of activity. However, the effectiveness of the model was characterized by a satisfactory level of effectiveness, which was above 75%. Bearing in mind the achievement of the results, it can be concluded that the use of early bankruptcy methods for enterprises operating within the food supply chain may contribute to reducing the effects of payment bottlenecks, as the application of the developed model reduces the risk of entering into cooperation with a bankruptcy entity.

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