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Bankruptcy prediction in the agribusiness sector: Lessons from quantitative and qualitative approaches

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ABSTRACT

This study used the complexity theory to present an asymmetric and critical thinking approach. Its main purpose is fsQCA implementation for bankruptcy prediction of agribusiness entities and comparison with classical quantitative methods. The research comprises three phases: (1) calculation and evaluation of the predictive abilities and classification errors of 35 selected quantitative bankruptcy methods, both domestic and foreign, namely, multivariate discriminant analysis and logistic regression models; (2) fsQCA implementation for bankruptcy prediction of 14 agribusiness entities, comprising conditions that are typical of the agribusiness sector and financial and macroeconomic data; and (3) indication and comparison of the advantages and disadvantages of fsQCA against a background of classical bankruptcy prediction models. The findings indicate that managers should carefully build or/and select existing methods of bankruptcy prediction, and adjust them to the type, size, and risk of business activity.

1. Introduction

The negative consequences of the global economic crisis that affected economies in various countries to different extents highlighted the essential role of bankruptcy prediction. To better understand the financial crisis, Hausman and Johnston (2014) presented its anatomy and the timeline of major events, drawing attention to important conditions and factors leading to the financial collapse.

The change of the external conditions deteriorated the condition of the Polish economy as well. However, Poland was one of the few EU countries that achieved a gross domestic product increase over that period, while, for other EU members, the reverse was found to be true (World Economic Outlook, 2010). One of the negative consequences of the crisis is enterprise bankruptcy. While the bankruptcy of individual companies is, in fact, a positive mechanism for the elimination of unprofitable entities, if it takes the form of a "knock-on effect," it may significantly upset economic equilibrium.

As a rule, bankruptcy is a long-term process, wherein first symptoms surface a few months or even a few years before the entity has the premises to file for bankruptcy. One of the visible symptoms of oncoming bankruptcy is the deteriorating financial condition of an enterprise. Zorn, Norman, Butler, and Bhussar (2017) built on the resource-based view to suggest that valuable resources can reduce the likelihood of downsizing, leading to bankruptcy. Their study suggests that downsizing firms are significantly more likely to declare bankruptcy than those that do not engage in downsizing, and intangible resources help mitigate this likelihood. However, the authors do not find support for the role of physical and financial resources in preventing bankruptcy (Zorn et al., 2017). For top managers, James (2016, p. 498) suggested that strategically filing for bankruptcy can help firms preserve value and long-term viability. By renegotiating unprofitable contracts with key stakeholders, they can implement strategic changes that facilitate sustainable performance improvements. The findings suggest that declining firms might benefit from strategic bankruptcy when they have more intangible assets (James, 2016, p. 498). Over the past three decades, liquidation, discontinuance, and bankruptcy studies have presented approaches to describe organizational failure and its consequences (Amankwah-Amoah, 2016; Evans & Borders, 2014).

Therefore, there are possibilities of predicting negative phenomena for both the company and its environment, which is a chance for effective "recovery" and upholding market presence. One method of predicting bankruptcy are the so-called early warning models, which are based on large-scale comparisons of two types of enterprises—one that went bankrupt, and one that enjoys a good financial situation. Most of these models use financial ratios and their corresponding weights. Based on the findings, a company is deemed either bankrupt or non-

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bankrupt.

Following this introduction, the next section presents the theory of fuzzy-set qualitative comparative analysis (fsQCA) and quantitative methods in corporate bankruptcy research. Additionally, the study discusses the approach, and presents the method, results, limitations, and finally, the conclusions and recommendations.

2. fsQCA and the quantitative approach in corporate bankruptcy research

2.1. fsQCA methodology

This section introduces the fsQCA methodology, focusing on a detailed description of fsQCA. Ragin (2008) defined the two major paradigms of the approach: quantitative and qualitative. According to Vaisey (2009), Ragin's work is an alternative to quantitative analysis (which disregards causal complexity) and qualitative case-based methods (which lacks tools for generalizing across cases). Both limitations, Ragin (2008) stated, can be overcome by making explicit the set-theoretic logic of case-based research, and extending this logic to quantitative data via Boolean algebra. Ragin (1987) developed the set theory for comparing cases as configurations of conditions. FsQCA allows indicating types of cases as different configurations of attributes. Ragin's research described the use of fuzzy sets to address phenomena that vary by level or degree, and unravel causal complexity, further elaborating the set-theoretic basis for linking variable-based and case-oriented thinking (Ragin, 2008). Ragin (2008) also developed “possibility analysis” as the study of the conditions that make an outcome possible, as an alternative to the analysis of outcome probabilities.

2.2. Quantitative methods in corporate bankruptcy research

Scholars conducted the first studies in the field under investigation as early as the 1930s (Fitzpatrick, 1932). However, Altman (1968) is commonly considered the forerunner of early warning models—the first one used for bankruptcy prediction in discriminant analysis. Springate (1978), Taffler (1982), and Fulmer, Moon, Gavin, and Erwin (1984) also carried out analyses using these models. Subsequently, Zavgren (1985), Aziz, Emanuel, and Lawson (1988), Platt and Platt (1990), and Beynon and Peel (2001) developed other early warning models on the basis of logistic regression. Yang, Platt, and Platt (1999) compared and examined four different methods, namely, Fisher discriminant analysis, back-propagation neural network (NN), probabilistic NN, and probabilistic NN without the patterns normalized to bankruptcy prediction, and used financial ratios (non-deflated and deflated) from the US oil industry. The study of probabilistic NN without pattern normalization and Fisher discriminant analysis achieves the best overall estimation results, while discriminant analysis produces superior results for bankrupt companies (Yang et al., 1999). The changing of conditions of enterprises functioning as a result of market globalization intensification and significant technical and technological progress reveal a need for new methods on bankruptcy processes diagnosis (Bauer & Agarwal, 2014; Calabrese, Marra, & Osmetti, 2015; Jones, 2017; Jones, Johnstone, & Wilson, 2016). Balcaen and Ooghe (2006), as well as Kumar and Ravi (2007), presented a synthetic overview of scientific publications on methods of bankruptcy prediction. Aziz and Dar's (2006) findings indicated that research into bankruptcy prediction uses statistical methods most often (64%), methods of soft calculation techniques in 25% of the cases, and theoretical models in 11% of them. The most popular methods of bankruptcy prediction are discriminative methods (30%) and logit analysis (21%), while other methods used are NN (9%) and decision trees (6%). Consequently, extant research focuses on models compiled on the basis of discriminative analysis and logistic regression. Ciampi (2015) applied logistic regression to a sample of 934 Italian small enterprises (SEs), and proposed an SE default prediction model built based on both financial ratios and corporate governance characteristics. The accuracy rates obtained by this model were then compared to those from a second model, based on the same sample of firms, which used only financial ratios as predictive variables. These primary findings suggest that the relationship between corporate governance mechanisms and firm survival has specific connotations for SEs, different from those of medium and/or large enterprises. Most notably, for SEs, CEO duality and a reduced number of outside directors on the board (no more than 50%) significantly and negatively correlate with small company default, while ownership concentration negatively correlates with SE default—the presence of a majority shareholder ensures stability, lowers conflict levels between owners, and is a key element in the realization of a broad convergence between strategic behaviors and entrepreneurial motivations, one of the main strengths of the SE. Finally, combining economic-financial with corporate governance variables improves SE default prediction accuracy rates, compared to predictions based only on economic-financial variables (Ciampi, 2015, p. 1013).

In the Polish economy, research on company bankruptcy emerged over 30 years later as a result of a change in the political system from a centrally planned economy into a market economy. The research was initially based on multiple discriminant analysis or logistic regression. Subsequently, other statistical methods gained more interest, such as probit analysis and NN. Hitherto, there are over 100 Polish early warning models in use (Grzegorzewska & Stasiak-Betlejewska, 2014; Korol, 2010).

Both foreign and Polish methods of bankruptcy prediction, as a rule, do not take into consideration the specificity of the line of business in which the companies function. Most have come into being on the basis of statistical material from industrial companies; they have limited use when it comes to bankruptcy prediction in specific economy sectors, including agriculture. One distinctive feature of this sector is the cyclical and seasonal character of the production process resulting from the dependence on seasons and climatic conditions. Additionally, climatic conditions may determine substantial deviations in production volume, which, in turn, affect the financial condition of these enterprises. Moreover, significant postponements of the inferred outlays and results influence sales income because of a relatively long process of production and the aforementioned seasonality of economic processes.

The first studies concerned with the evaluation of financial condition of the subjects operating in the agricultural sector were published in the 1960s and 1970s. One of the first to analyze the threat level of the inability to repay loans with the use of discriminant analysis were Reinsel and Brake (1966), Krause and Williams (1971), Bauer and Jordan (1971), Johnson and Hagan (1973), and Dunn and Frey (1976). Research that covered the solvency of agribusiness entities also applied logistic regression (e.g., Miller & LaDue, 1988; Mortensen, Watt, & Leistritz, 1988; Turvey & Brown, 1990). In the twenty first century, research into the insolvency of agribusiness enterprises continues to be valid (Argilés, 2001; Featherstone, Roessler, & Barry, 2006); however, the prognostic capabilities of the proposed systems of credit evaluation are diverse. Some authors worked out models for certain types of agricultural enterprises by allowing for size and location, or the type of the activity they run, for instance. These models typically contain ratio characteristics of farms, not agribusiness enterprises; hence, they have limited application possibilities for enterprises. In Poland, analyses referring to bankruptcy in agriculture are scarce; they commonly refer to individual farms (Grzegorzewska, 2016). The study by Boratyńska (2016) focused on implementing fsQCA and asymmetric thinking to corporate bankruptcy evaluation in the food industry. It examined the main reasons for corporate bankruptcy, namely, lack of financial liquidity, exceptionally high level of liabilities, losses, weak management, and late recovery actions.

3. Material and methods

The main purpose of this article is fsQCA implementation for bankruptcy prediction of agribusiness entities, and its comparison to classical quantitative methods, along with an effectiveness assessment. Qualitative methods that do not find frequent applications in corporate bankruptcy prediction and business practice, such as fsQCA, could be an alternative and additional early warning tool in agribusiness enterprise accounting, for both quantitative and qualitative conditions.

We thus hypothesize:

Hypothesis 1. The simultaneous application of quantitative and qualitative methods provides better bankruptcy prediction results than using each approach separately.

3.1. Research phases

The research comprises three phases to achieve the aims of the study, namely:

1. Calculation and evaluation of predictive ability and classification of errors for 35 selected quantitative bankruptcy methods, both domestic and foreign, namely, multivariate discriminant analysis and logistic regression models;
2. fsQCA implementation in bankruptcy predictions for agribusiness entities, comprising the conditions typical to the agribusiness sector. Apart from financial data, that is, the balance sheet and profit and loss account statements used in the first research phase, the study also includes macroeconomic data; and
3. Indication and comparison of the advantages and disadvantages of fsQCA against a background of classical bankruptcy prediction models.

The empirical research examines a sample of 14 agribusiness enterprises, which play a leading role in the creation and dissemination of biological progress in Polish agriculture. The main purpose of their activity is to produce innovative crops and farm animal breeding, and implement appropriate breeding programs. The key issue is to maintain a stable financial standing of these enterprises, and take proper restructuring actions in the event of critical situations.

The timeframe of the research is 2006–2013. In the researched sample, there are no companies declared bankrupt by court. However, some of them finished their economic activity or other enterprises took them over because of poor financial condition. Hence, those companies that ceased functioning under the legal framework were singled out. Subsequently, three experts of the agribusiness sector companies who were familiar with the specificity of the researched enterprises chose 14 of them, wherein there was no economic activity because of bankruptcy. Then, the experts indicated other 14 companies with favorable financial conditions. The shared opinion of the experts made it possible to single out two types of companies: B—potential bankrupts, NB—companies with the best financial condition. For B companies, the last year of their activity for research analyses is 2013, as is for NB companies.

In the next step, experts chose models for bankruptcy prediction. They agree that the models should meet the following criteria: 1) should be published in relevant literature, 2) should cover different independent variables carrying different types of information, and 3) all information necessary for calculations should be available. The research covering bankruptcy prediction for the given companies uses 35 early warning models. The research methodology derives from a synthetic review of Polish studies on bankruptcy prediction (Grzegorzewska, 2016; Korol, 2010). Among the analyzed models, the following are early warning models:

Altman (1968)—Z_{ALT}; Mączyńska (1994)—Z_{MAC}; Gajdka and Stos (1996)—Z_{GS1}, Z_{GS2}, Z_{GS3}; Hadasik (1998)—Z_{HAD1}, Z_{HAD2}, Z_{HAD3}, Z_{HAD4}, Z_{HAD5}, Z_{HAD6}, Z_{HAD7}, Z_{HAD8}, Z_{HAD9}; Hołda (2001)—Z_{HO}; Appenzeller and Szarzec (2004)—Z_{AS1}, Z_{AS2}; Hamrol, Czajka, and Piechocki (2004)—Z_{HCP}; Prusak (2005)—Z_{PR1}, Z_{PR2}, Z_{PR3}, Z_{PR4}; Stępień and Strąk (2004)—L_{SS1}, L_{SS2}, L_{SS3}, L_{SS4}; Gruszczyński (2004)—L_{GR1}, L_{GR2}, L_{GR3}, L_{GR4}, L_{GR5}, L_{GR6}, L_{GR7}, L_{GR8}; Grzegorzewska (2016)—L_{GRZ}.

When one author or a team of authors compiled a few early warning models, the findings have been presented synthetically for given groups, singling out the method with the greatest prediction effectiveness. It is measured as a percentage of proper classification of enterprises to one of two groups—potential bankrupts or companies with the best financial condition.

3.2. Research stages that use fsQCA methodology

The application of QCA to cross-case evidence comprises three distinct phases: (1) selecting cases and constructing a truth table that defines their causally relevant characteristics; (2) testing the sufficiency of causal conditions; and (3) deriving and interpreting the results (Section 4 presents the results).

A specific cause or combination of causal conditions constitutes one of several possible paths to an outcome. When this assumption holds true, cases displaying causal combination constitute a subset of the cases displaying the outcome. Set-theoretic consistency assesses the degree to which the cases share a given condition or combination of conditions. Consistency indicates how closely the subset relation is approximated. Moreover, set-theoretic coverage assesses the degree to which a cause or causal combination "accounts" for instances of an outcome. When several paths to the same outcome exist, the coverage of any causal combination may be small. Therefore, coverage gauges empirical relevance or importance (Ragin, 2006).

Ragin (2006) recommended a minimum consistency of 0.75. Establishing necessary conditions should highlight cases that lead to an outcome. Conversely, cases where the outcome is not present are irrelevant, and are thus, absent when testing propositions.

3.2.1. Data matrix

FsQCA is a program that uses combinatorial logic, fuzzy set theory, and Boolean minimization to point out what combinations of case characteristics are necessary or sufficient to produce an outcome.

The fsQCA 2.0 software was created by Ragin, Drass, and Davey (2006). Both the theory and mechanics of the fsQCA software program (Ragin, 2008; Ragin & Davey, 2014) are useful to obtain information on relevant uses and important for qualitative bankruptcy prediction, because "such analyses provide a useful match among the tenets of complexity theory and the inherent complexity of relationships in data" (Woodside, 2014, p. 2502).

The program begins with a data matrix. Although this lists the cases as rows, as with a conventional data matrix, in the columns, case characteristics are not variables in the usual sense, but degrees of membership of a defined category, namely, the corporate bankruptcy case. Membership may be binary—cases are either members or nonmembers of a category, namely, bankrupt and non-bankrupt cases. A fuzzy set allows the calibration of the degree of set membership, using scores in the interval 0.0 to 1.0. Membership scores above 0.5 indicate that a case is more in than out, while scores close to 1.0 indicate that a case is mostly in, and scores close to 0.0 indicate that a case is mostly out. Full membership (1.0) and full non-membership (0.0) are qualitative states, not arbitrary values (e.g., highest and lowest scores). Conditions use six-value fuzzy set measurement scale (the interval from 0.0 to 1.0, namely, 1 = fully in; 0.8 = mostly in; 0.6 = more or less in; 0.4 = more or less out; 0.2 = mostly out; 0 = fully out) or a dichotomous approach (1 = fully in, 0 = fully out). Fuzzy sets are binary and metric at the same time.

3.2.2. Truth table

The next step is the construction of a truth table. In QCA, the

fundamental unit of analysis is the truth table row, along with the cases conforming to each row. Casual combinations represent all logically possible sections that use the causal conditions. A truth table is the attempt to implement an exhaustive examination of sufficiency. Each row of the truth table constitutes a different logically possible selection, and each row contributes to the outcome. The truth table provides multiple selections of the independent variables and multiple tests of sufficiency (Ragin, 2000).

The first step in the minimization process is to select the rows displaying the outcome and comparing them. Here, the objective is to simplify them through a bottom-up process of paired comparison (Ragin, 1999). The next step is the analysis of the fsQCA results.

4. Calculation

The first research stage comprises a verification of the effectiveness of Polish and foreign quantitative bankruptcy prediction methods for animal and plant breeding companies. At first, statistical material for the research was collected and ratios calculated. On the basis of these ratios and the corresponding coefficients, the value of each of the models was worked out for each of the enterprise under analysis. Then, on the basis of the limit points, the authors divided the companies into two groups, B—bankrupt, NB—non-bankrupt. Research models with greater values mean a better financial condition of the company. The research was conducted on the basis of the most widely known model, that of Altman (1968), as well as other models that are an important part of Polish studies on bankruptcy.

Altogether, the research verified 35 quantitative methods for bankruptcy prediction. However, Tables 1 and 2 contain results with the greatest overall prognostic effectiveness; that is, from groups of models by one or a team of authors, the experts chose those methods characterized by the greatest prediction power. The findings show that only in the case of one, three, and six enterprises, the overall prognostic capability of the analyzed models was relatively high—over 80% of them properly evaluated the companies as facing bankruptcy. However, less than half of the models properly predicted bankruptcy in eight enterprises (2, 4, 8, 10, 11, 12, 13, and 14). In the remaining cases, the percentage of the models properly classifying companies characterized by an unfavorable financial situation did not exceed 70%.

Table 1 presents classification of the analyzed enterprises—bankrupts according to quantitative prediction methods that indicated the greatest overall prognostic capability.

From the research, it follows that full efficiency of type I, that is, the proper classification of companies threatened with bankruptcy, was achieved for the Z_{GR2} model compiled by Gruszczyński (2004). Prediction assets in this field also indicated G_{R3} (92.9%), Z_{GS1} (85.7%), Z_{PR3} (85.7%), and L_{GRZ} (85.7%). The lack of prediction capability of type I was encountered by the Hołda, 2001model and model 4 by Stępień and Strąk (2004). Other comparisons compiled by these authors do not allow for the proper evaluation of agribusiness enterprises wherein financial condition is poor. The percentage of proper classification of bankrupts was at the level of L_{SS1} 7.1%, L_{SS2} 14.3%, and L_{SS3} 7.1%. For 17 out of 35 of the researched early warning models, the proper classification of the entities threatened with bankruptcy was over 50%; that is, almost half of the researched agribusiness enterprises threatened by bankruptcy were incorrectly evaluated.

Table 2
Prognostic capacity of quantitative methods on bankruptcy prediction [%].
Source: Author's calculations.

Models	Efficiency type I	Efficiency type II	Altogether
Z_{ALT}	28.6	100.0	64.3
Z_{MAC}	64.3	100.0	82.2
Z_{GS2}	35.7	100.0	67.9
Z_{HAD5}, Z_{HAD6}, Z_{HAD7}, Z_{HAD8}, Z_{HAD9},	35.7	85.7	60.7
Z_{HOL}	0.0	100.0	50.0
Z_{AS1}, Z_{AS2}	64.3	85.7	75.0
Z_{HCP}	64.3	100.0	82.2
Z_{PR3}	85.7	92.9	89.3
L_{SS2}	14.3	100.0	57.2
L_{GR1}	64.3	92.9	78.6
L_{GRZ}	85.7	100.0	92.9

For evaluating the prognostic capability of quantitative prediction models, efficiency type II is also of great importance; that is, the proper classification of companies in a favorable financial condition. Full prediction capacity in this field was achieved by the following 11 models: Z_{ALT}, Z_{MAC}, Z_{GS2}, Z_{GS3}, Z_{HCP}, Z_{HOL}, L_{GRZ}, and all logit models by Stępień and Strąk (2004). Great prediction capability was observed in the case of the Gruszczyński (2004) model (L_{G1}: 92.9%) and Prusak (2005) model (Z_{PR1} and Z_{PR3}: 92.9%, Z_{PR4}: 90.5%). No prognostic efficiency for this group of companies was noted in the case of Z_{GS1}, Z_{GS2}, and Z_{GR2} models.

The overall prediction capacity of the early warning models amounted from 0.0 to 92.9%. The highest results were recorded by the L_{GRZ} and Z_{PR3} models. Their efficiency leveled at 92.9% and 89.3%, respectively. The former, in addition to the typical financial ratios (quick ratio, own capital debt ratio), also contains measurements characteristic for agribusiness companies; that is, net financial result per 1 ha UR and the level of employment per 100 ha UR. The good prognostic capacity of the L_{GRZ} model results, inter alia, from the fact that it was built of the basis of the data from animal and plant breeding enterprises. However, the teaching sample comprised production and financial ratios for 1996–2007, which signifies that despite the change in management conditions and the passing of time, the model is

Table 1
Classification of enterprises on the basis of quantitative prediction methods.
Source: Author's study.

Enterprises	Z_{ALT}	Z_{MAC}	Z_{GS2}	Z_{HAD5}	Z_{HOL}	Z_{AS1}	Z_{HCP}	Z_{PR3}	L_{SS2}	L_{GR1}	L_{GRZ}
1	B	B	B	B	NB	B	B	B	B	B	B
2	NB	B	B	NB	NB	B	B	B	NB	B	B
3	B	B	B	B	NB	B	B	B	NB	B	B
4	NB	B	B	NB	NB	B	B	B	NB	B	B
5	NB	B	NB	B	NB	B	B	B	NB	B	NB
6	B	B	B	B	NB	B	B	B	NB	B	B
7	B	B	NB	B	NB	B	B	B	NB	B	B
8	NB	NB	NB	NB	NB	NB	NB	B	NB	NB	NB
9	B	B	NB	NB	NB	B	B	B	B	B	B
10	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	B
11	NB	NB	NB	NB	NB	NB	NB	B	NB	B	B
12	NB	NB	NB	NB	NB	NB	NB	B	NB	NB	B
13	NB	NB	NB	NB	NB	NB	NB	NB	NB	NB	B
14	NB	B	NB	NB	NB	B	B	B	NB	NB	B

characterized by relatively high prediction assets. Regarding the Prusak (2005) model, it does not allow for agribusiness specificity, and it contains the following ratios: financial result from operating activity/balance sheet total, operating costs/short-term liabilities, current assets/short-term liabilities, sales financial result/balance sheet total, and short-term liabilities/balance sheet total.

A relatively high prediction capacity (82.2%) was registered by the models compiled by Mączyńska (1994) and Hamrol et al. (2004). An overall prediction capacity below 60% was noted in 14 out of 35 models. The least effectiveness in bankruptcy prediction of agribusiness enterprises was recorded by the Gajdka & Stos, 1996 model, Z_{GS1}. For the following models, the overall effectiveness in prediction was below 50%: L_{GR2}, L_{SS4}, Z_{HOL}, and Z_{HAD}.

We now present the results of fsQCA implementation to 14 agribusiness bankruptcy cases. FsQCA could be uses for small sample evaluation (10 to 50 cases). However, the number of variables should be adjusted to sample size, as the literature does not present any strict limit on variables. We analyze 38 conditions that derive from the corporate bankruptcy models this article presents, and compare fsQCA with these model results. We also consider 10 macroeconomic conditions that focus on expert opinions, presented by the rankings of the Fragile States Index, n.d. (Fragile States Index. The Fund for Peace, http://fsi.fundforpeace.org/ Accessed 05.01.2017), including uneven development and economic decline, and macroeconomic indices (Macroeconomic Indices, n.d.. http://stat.gov.pl/wskazniki-makroekonomiczne/. Accessed 15.12.2016.)

All 48 conditions comprise five main groups, namely, (1) illiquidity (ILL), (2) too high debt (DEBT), (3) lack of profitability (LPROF), (4) specify of agribusiness sector (AGRI), and (5) macroeconomic conditions (MACRO). The specify of the agribusiness sector conditions (AGRI) focuses on the specific features of agribusiness, namely, global agricultural production, crop production, animal production, and price "scissors" in agribusiness. This study proposes the following model of bankruptcy:

$$\text{Bankruptcy} = f(\text{ILL}, \text{DEBT}, \text{LPROF}, \text{AGRI}, \text{MACRO})$$

The outcomes and four out of 48 conditions correspond to the codification in Table 3. The outcome (i.e., corporate bankruptcy case) is a dichotomous variable, distinguishing bankrupt companies from those still on the market (coding a corporate bankruptcy as 1). The study focuses on 14 bankruptcy cases in the agribusiness sector. The analysis explains which conditions lead companies to bankruptcy.

The first step is to examine the conditions necessary for the outcome. Table 4 presents the analysis of selected necessary conditions that have a minimum consistency of 0.75. Consistency scores should be as close to 1.0 (perfect consistency) as possible. With consistency scores below 0.75, to maintain a subset relation is increasingly difficult. Consistency exceeds 0.75 for four conditions, namely, cash illiquidity, subsidy to revenues, gross sales margin, and net result (loss) (see Table 4). Therefore, according to the results, these conditions ensure corporate bankruptcy. Lack of profitability is extremely important here.

Considering that the necessary conditions represent only two out of the five condition groups, namely, illiquidity and lack of profitability,

Table 3
Codifications of outcomes and selected conditions.
Source: Author's study.

Outcomes and conditions	Coding
Outcome:	
Corporate bankruptcy case	Bankrupt case
Conditions:	
Cash illiquidity	cash_illiquidity_cal
Subsidy to revenues	subsidy_revenues_cal
Gross sales margin	gross_margin_cal
Net result (loss)	net_result_loss_cal

Table 4
Analysis results for the selected necessary conditions.

Outcome variable: bankrupt case.
Source: Author's calculations.

Conditions tested:	Consistency (minimum consistency of 0.75)	Coverage
cash_illiquidity_cal	0.757143	1.000000
~ cash_illiquidity_cal	0.242857	1.000000
subsidy_revenues_cal	0.857143	1.000000
~ subsidy_revenues_cal	0.142857	1.000000
gross_margin_cal	1.000000	1.000000
~ gross_margin_cal	0.000000	0.000000
net_result_loss_cal	0.928571	1.000000
~ net_result_loss_cal	0.071429	1.000000

Note: (~) means negation of condition.

the final model is as follows:

$$\text{Bankruptcy} = f(\text{ILL}, \text{LPROF})$$

The research indicates that illiquidity and lack of profitability lead to the outcome (bankruptcy). We also use subset analysis to verify if different configurations of the conditions could improve the outcome. This analysis confirms that the model Bankruptcy = f (ILL, LPROF) fits well and any other combinations of the input conditions give better results.

These conditions are internal; that is, managers could take proper recovery actions in advance to avoid bankruptcy. These companies are resistant to macroeconomic factors and specific agribusiness sector conditions. Agribusiness companies are reluctant to maintain high debt.

5. Results and discussion

Ragin (2008, p. 6) offered a "real alternative to conventional practices" that "is not a compromise between qualitative and quantitative," but rather "transcends many of their respective limitations." FsQCA leads to a more detailed understanding of the conditions, under which the outcome occurs more likely than in the regression analyses.

FsQCA works also with large sample studies. The downside is that the researcher's familiarity with each case declines, and some of the benefits of a case-centered approach are lost.

There is usually no single result, such as from a multiple regression analysis; instead, there may be several different causal expressions, each with its own level of consistency and coverage. The role played by any particular condition may thus vary considerably depending on which other conditions it is combined with. The sets of conditions can also change dramatically, depending on the frequency threshold and level of consistency selected for constructing the truth table.

FsQCA has been criticized for being static and cross-sectional, but it is possible to include a time dimension in several ways: (1) incorporate directional expectations into simplifying assumptions about remainders; (2) empirically record sequencing of events into a truth table and incorporate sequence $A \geq B$ or $B \geq A$ into the minimization process; (3) transform time-series data into QCA format, and focus on the cross-temporal variation of the data; (4) seeing cases as trajectories in a descriptive sense, and looking at changing configurations over time. Bankruptcy is a long-term process, and this fourth way would be the next step of this research, which includes time series.

From the research, it follows that, for most models, type I deviation (classifying the "bankrupt" into the non-threatened within the bankruptcy group) was much lower than type II deviation; that is, these models have too flexible classification criteria, which caused enterprises in difficult financial situations to be treated as non-threatened by bankruptcy. The consequences of type I deviation usually have more severe implications for the company, as well as its stakeholders. The lack of a significant dissymmetry in classification may only be observed

in the case of the models by Prusak (Z_{PR2}, Z_{PR3}, Z_{PR4}) and Grzegorzewska (2016).

The main limitation of the study is that bankruptcy prediction models constitute an element of a complex early warning system, and the findings of the research could be misleading because of classification errors.

6. Conclusions

The strengths of qualitative and quantitative analysis can be combined if we present cases as configurations of conditions, rather than *sui generis* or as the simple product of independent variables. Unlike more quantitative methods that are based on correlation, fsQCA seeks to establish logical connections between combinations of causal conditions and outcome, the result being rules that summarize the sufficiency between the subsets of all of the possible combinations of the causal conditions and the outcome. Each rule is a possible path from the causal conditions to the outcome.

One of the central goals of economic science is to generalize, and economists are trained to be wary of drawing general conclusions from a single case. Many studies of cross-case patterns appear to be based exclusively on the analysis of large Ns when, in fact, they are case studies.

This study thus contributes to theory and business practice, indicating the applicability of fsQCA to assess combinations of causal conditions that lead to corporate bankruptcy in the agribusiness sector. The fsQCA research shows that illiquidity and lack of profitability lead to the outcome (bankruptcy), and allows the inclusion of qualitative reasons for bankruptcy assessment. On the other hand, discriminant analysis focuses mainly on financial indicators. This study confirms Hypothesis 1 in that the simultaneous implementation of both quantitative and qualitative approaches brings broader and more valuable results for practitioners than using these two approaches separately.

The comparison of quantitative methods and fsQCA allows us to determine the primary advantages and limitations. FsQCA leads to a more detailed understanding of the conditions under which results are produced than regression analysis. Additionally, there is no single result, as in multiple regressions, which can be an advantage, but also a drawback, as it may detract from the robustness of the analyzed early warning model. Regardless of adopting quantitative or qualitative approaches, the internal indicators of enterprises, mainly financial, become more important in the diagnosis of agribusiness company bankruptcy. Managers act under complex economic conditions, which refer to complexity theory, and necessitate the use of different methods of bankruptcy prediction in practice. As such, the managerial learning role particularly matters for anticipative behavior.

This study has several important practical implications for examining the outcomes of the result comparison between fsQCA and quantitative bankruptcy prediction methods. The findings suggest:

1. Managers should carefully build or/and select existing methods of bankruptcy prediction, and adjust them to the type, size, and risk of the business activity; and
2. Managers should be aware of the advantages and limitations of the different types of bankruptcy prediction methods. Bankruptcy generates public and private costs, making it extremely important to avoid this negative phenomenon in business practice. The simultaneous implementation of quantitative and qualitative methods for bankruptcy prediction could help restructuring in advance.

The impact of management on delaying or avoiding threats of bankruptcy and the capability to design and implement early warning tools to overcome it could be the topic of subsequent research. It is also worth noting the temporal dimension in the evolution of the financial situation of the company, which can lead to bankruptcy. Furthermore, considering that bankruptcy is a medium- or long-term process, an interesting avenue for future research is to include a time span factor into further analysis in order to determine its importance to the effectiveness of forecasting methods.

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