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Application of The Model of Risk Classes (MRC MODEL) In Covid Time*

Katarzyna CHŁAPEK
Cracow University of Economics, Cracow, Poland

Correspondence should be addressed to: Katarzyna CHŁAPEK; chlapekk@uek.krakow.pl

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Abstract

The phenomenon of economic risk is the subject of many scientific considerations, and measuring it has been identified as a challenge. In addition, the current situation of the COVID-19 pandemic has a significant impact on business security around the world. The aim of the article is to draw attention to the possibility of measuring economic risk using discriminatory analysis tools, in the form of a model of risk classes. The advantage of the model is the availability of data from a financial statement. The study used official financial data of companies listed on the Warsaw Stock Exchange (WSE) and information collected from the websites of the entities subject to the study. The study shows that it is possible to use the proposed model in the economic risk analysis of units. This article recognises the need for future studies on how to adapt the model to current conditions, especially in the areas of non-financial data, in order to include them in the model of risk classes. The results of the study can be useful to both scientists and practitioners interested in economic risk assessment in economic entities.

Keywords: measurement of the risk, model of classes of the risk, discriminatory analysis, COVID

Introduction

The widespread topic of risk indicates an increase in interest in the world literature, but it does not bring a model approach to measuring economic risk, which could be implemented in the Polish reality. The opportunities created by the market are at the same time threats which very often hinder the survival of individual units and may create a real threat to their survival in a broad global market (Brunnermeier *et al.*, 2019). The fact that the risks arising from the globalisation process itself is repeatedly highlighted, which is linked to the need for economic units to constantly adapt to the broadly defined changes taking place in the economy (Liu, 2012, p. 287).

The issue of risk and its quantification on the basis of data from financial statements is a challenge to accounting as a system. Already R.C. Merton (winner of *the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel i*n 1997) emphasised the possibilities of creating goodwill through better use of risk management in the entity, which can definitely lead to an increased competitive position (Girotra, Netessine, 2011, p. 104). The dynamic development and changes in the economic reality make the measurement of phenomena more and more complicated (Walińska, 2014, p. 509), hence the methods of its implementation should be constantly verified and adjusted, both to the requirements and conditions of the market and to the possibilities offered by modern computing techniques. It is believed that a great role in the sphere of measuring such a complex phenomenon as economic risk is played by modern measurement methods, together with their technical support in the form of IT systems, using exploratory techniques that make it possible to carry out extremely complex calculations in the field of advanced mathematics, statistics and econometrics, which are a tool of extraordinary information capacity and rapid impact on the perception of scientific cognition of the phenomena studied, and which also increase the cognitive and representative value of the issues studied.

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Confirmation of the need to create current models related to the subject of risk measurement is confirmed by the constant struggle on the theoretical ground in this subject, discussed among others in the Harvard Business Review (Merton, 2013, p. 51). The current situation of the COVID-19 pandemic poses another challenge and reveals the need for an in-depth analysis of the economic risk phenomenon (Noy *et al.*, 2020, p. 413).

The main aim of the article is to present the concept of measuring economic risk, based on data contained in financial statements in the form of a model of risk classes, as a tool to support the analysis of this phenomenon in the COVID-19 pandemic. According to the author, the model, which is based on data from the period after the recent crisis, that is to say, after 2008, can be a tool to support economic risk assessment in economic entities, especially in the current conditions. The concept of economic risk in the article is limited to risks related to the activities of business entities.

Through the use of the research method, which is a controlled experiment, it was possible to create a model verified by the tools of discriminatory analysis, which means criticising the resulting knowledge in order to determine its application in practice, which was the main assumption of the author, since the developed model is to have the properties of implementation in the measurement of risk, with the simultaneous indication of the development possibilities of economic theories, both in terms of measurement methods and in terms of research conclusions. The classification into a specific risk class derived therefrom, which is the measure of risk, determines the average, rather than the strict and accurate relationship between the phenomena being studied, given the uncertainty of economic life.

Economic risk as a threat to individual safety at the time of COVID-19

The concept of risk is associated with every area of social life, by putting all events dependent on active human activity at risk. The origin of the word risk has not yet been unequivocally explained, as its etymology dates back to ancient times, but nevertheless, in all expressions, risk has two different but closely related meanings:

- a risks caused by human activity, as processes taking place within the human environment, but outside of the human activity,
- a risk that is a dangerous undertaking, taken by a man characterised by courage (Kaczmarek, 2010, p. 64).

Particularly noteworthy is the system proposed by F. H. Knight to distinguish between risk and uncertainty, which is based on the division into measurable and non-measurable uncertainty (Karmańska, 2008, p. 29-30). Based on these assumptions, uncertainty is defined as a state of immeasurable uncertainty, and risk is a quantifiable form of uncertainty. Another example of interpretation, proposed by Mr Bromiley, K. D. Miller and D. Rau (Bromiley *et al.*, 2001; Urbanowska-Sojkin, 2013, p. 19) refers directly, in the definition of uncertainty and risk, to a business entity, defining uncertainty as the unpredictability of the situation both within the entity and in its environment, and risk in the context of strategic management as the unpredictability of the variability of results of undertakings related to revenues, costs, profits and market shares.

Given the omnipresence of risk in business activities and the dynamic emergence of new risk areas, it becomes necessary to seek to assess existing and future threats (Lai *et al.*, 2009, p. 44). The prerequisites for sound risk assessments are tests to identify risks in the light of current market conditions, measurement using appropriate methods and techniques and on the basis of reliable and credible information, and proper interpretation of the results obtained.

The role of accounting in this matter is not insignificant because of its informative function, based on fulfilling both the requirement of reliability and the reliability of the information, aimed at the particular importance of the qualitative characteristics of economic information according to quality theory (Micherda, Szulc, 2013, p. 43). In the context of economic rationality and current trends to which both accounting and management are trying to conform, any sign of risk that represents both an opportunity and a threat is relevant and therefore perceived according to a neutral concept of risk (Jajuga, 2008, p. 13). With regard to management, the role of the threats associated with risk is emphasised, and preference is given to seeking to exploit them in order to achieve benefits, both in the development and day-to-day operation of the entity (Merchant, 2012, p. 32). In view of the definition of risk, which includes in its scope the results achieved as a result of operations (Nowak, 2013, p. 497) in the accounting conclusions, each result (understood as net financial result) is of significant importance, with particular attention paid to the negative result (net loss), resulting in a decrease in the value of the capital and, consequently, a decrease in the value of the unit, which is also connected with a negative impact on its development capabilities (Micherda, 2005, p. 199). Measurement of risk is particularly important for business security because "the risk is to involve all kinds of resources into activity: physical, financial and human. It also concerns the results that are achieved as a result of the activities conducted" (Nowak, 2013, p. 497)

The situation of the COVID-19 pandemic, which is a global phenomenon, undoubtedly represents an extremely important risk, which can be identified in the process of identifying the risks of business units. The so far unknown consequences of the various activities of market participants will be reflected in the financial results of all entities, hence the particular need to examine the situation of entities on the basis of available data in the form of financial data generated by the accounting system.

Assumptions and classification capabilities of the model risk classes

The measurement of economic risk, based on the financial statements, is an attempt to assess the likelihood of a specific risk being realised and to evaluate the possible economic impact related to the realisation of the identified risk. In this respect, it means to determine first of all the impact of a specific risk factor on the financial situation of an enterprise (Walczak, 2008, p. 305). The market conditions of recent years have led to the concentration of the main objective of doing business not only on the increase in the value of the owners' assets (Skoczylas, 2009, p. 75), which responded to the postulated idea that "the main financial principle of a business enterprise is to maximise the owners' wealth" (Myddelton, 1996, p. 17), but also on the impact on social development and responsibility towards environmental problems.

The literature of the subject distinguishes a number of methods for a specific quantification of risk. The basic division, implemented from the analysis of the unit's activity, allows for separation of:

1. *the qualitative analysis methods* including:
   - analysis of the structure of financial statements,
   - analysis of the dynamics of the different values of financial statements (Skoczylas, 2009, 143).
2. *the quantitative analysis methods*, including methods of descriptive statistics: arithmetic mean, median, standard deviation. By classifying the methods of quantitative analysis it is possible to distinguish:
   - comparison methods, also called deviation methods,
   - deterministic methods,
   - stochastic methods, including:
     - econometric methods of causal analysis,
     - discriminatory methods (e.g. *Altman's Z-score model (*Altman, 1968, p. 589-609)).

Professor Edward I. Altman (Professor at *the Stern School of Business at New York University)* developed *the Altman model, the Z-score indicator,* which combines traditional indicator analysis with multidimensional discriminatory analysis to enable the best possible differentiation of units at risk of bankruptcy. At a conference in New York, *Asset and Risk Allocation,* held in April 2013, he identified areas of major risk (Altman, 2013). During the *Credit Risk Seminar* at the Cracow University of Economics in March 2019, Professor E. Altman presented in a speech entitled *Credit Cycle Outlook and the Altman Z-Score Models After 50 Years* the possibility of using this model in assessing the condition of individuals and their risk of bankruptcy.

The methods used to analyse an unit's activities on the basis of financial statements, using a discriminatory analysis, may at the same time, on the basis of their cognitive value, constitute basic methods for quantifying risk. Their interpretative support may be provided by the construction of diagrams defining the uncertainty levels of an entity's situation, *grouped into specific classes* (Monkiewicz *et al.*, 2010, p. 24). The concept of risk measurement using risk classes is commonly used in the insurance and banking industry, as well as in all types of ratings (Korol, 2010, p. 77-78).

Drawing on the experience in this area (Sierpińska, Wędzki, 2010, p. 154), under the conducted research, it was decided to measure the risk using this methodology, specifying in detail the conditions of belonging to a specific risk class, including indications of the use of discriminatory analysis in the classification of objects into classes (Hand, 1994). On the basis of the review of the scientific acquis, the legislation and recommendations laid down in national and international regulations, the market analyses carried out and the systematic observation of units operating in a market environment on a multi-annual basis, the items likely to have a significant effect on an undertaking's financial position have been identified. The current trend towards the multiplication of owners' capital has also been confirmed, according to which a particular area of interest should be beneficial financial results, unambiguous with:

- making profits,
- maintaining financial liquidity,
- maximising the market value of the unit (Micherda, 2005, p. 12).

The research carried out has made it possible to specify the following attributes, which may be of significant importance in the context of the theoretical issues referred to above and the provisions of ISA 570 (ISA 570), including:

1. *a decrease in the balance sheet total*, where the basis for assessment is the *Balance sheet*,
2. *a negative net cash flow*, where the basis for assessment *is the Cash Flow Statement*,
3. *no dividend payment*, where the assessment is based on data from the *Cash Flow Statement*,
4. *a negative net financial result stream*, the assessment of which is based on the data contained in the *profit and loss account*.

Due to the assumptions of the method of discriminatory analysis, determining its application to the division of comparable objects into groups of objects as similar as possible, due to the properties describing them, it was decided to use linear discriminatory analysis (Panek, 2009, p. 278). This choice is also supported by the fact that, in the light of the latest research on the effectiveness of the analysed methods, discriminatory analysis took second place, behind the classification tree method (Dębkowska, 2012, p. 182).

The determined scale of the economic risk classes allows for its measurement in five steps, from the lowest risk, marked R0, to the highest risk, marked R4. In addition, each risk class from R0 to R4 has been assigned a corresponding numerical identifier from 0 to 4, characterising each risk class. The classification assumed an increasing trend, according to the assumed designations, from level 0, which is characteristic of an unit with a low level of risk, to level 4, which is characteristic of an unit with the highest level of risk in the assumed scale.

On the basis of these assumptions, the units were analysed in terms of the four characteristics listed and classified, specifying detailed conditions in the following ranges:

1. trend of the balance sheet total - in the case of a decrease in the balance sheet total, the unit is defined as meeting the condition of an unfavourable situation (the condition is met),
2. net cash flow - in a negative net cash flow situation, an unit is determined as meeting the condition of an unfavourable situation (the condition is met),
3. dividend - in the absence of dividend payment, an entity is defined as meeting an unfavourable situation condition (the condition is met),
4. net financial result - in a situation of negative financial result, i.e. net loss, an unit is defined as fulfilling the condition of an unfavourable situation(the condition is met).

Detailed classification assumptions for determining the appropriate risk class are set out in Table 1.

Table 1: Principles for classifying units into risk classes

Risk class symbol	Numeric symbol of risk class	Determination of risk class	Qualification conditions
R0	0	Risk at level 0	Does not meet any condition of an unfavourable situation
R1	1	Risk at level 1	Meets 1 condition of an unfavourable situation
R2	2	Risk at level 2	Meets 2 conditions of an unfavourable situation
R3	3	Risk at level 3	Meets 3 conditions of an unfavourable situation
R4	4	Risk at level 4	Meets 4 conditions of an unfavourable situation

Source: own elaboration

The model uses a classification using the Mahalanobis distance concept and uses a *posteriori probability,* i.e. probability based on knowledge of the values of other variables that a given case belongs to a specific class (Kaczmarek, Czajka, Adamska, 2008). In the study, the highest classification capacity was obtained on the basis of data from 2009, where data analysis was used for all variables and for variables selected by using ANOVA, Levene and Brown Forsythe tests.

The result of the conducted research process is a model of risk classes, on the basis of which it is possible to classify the selected unit to the appropriate risk class. The shape of the classification functions is presented in Table 2.

Table 2: The shape of classification functions for individual risk classes

Indicator abbreviation/risk class	R0	R1	R2	R3	R4
Constant	-94.3895	-82.0821	-78.2784	-60.4243	-226.480
W2	-13.4492	-12.8185	-14.0382	-13.1956	-32.604
W4	0.7200	0.6575	0.7482	0.7074	1.620
W7	-32.4344	-34.1088	-28.0344	-24.4290	-46.021
W8	416.5322	394.7925	378.2531	338.3605	636.514
W12	-1.0660	-1.0503	-0.9966	-0.9659	-2.238
W16	287.9066	239.9838	320.8627	296.6303	649.887
W17	-12.9711	-11.6148	-13.7309	-11.9249	-28.694
W18	4.8679	4.5385	5.3328	4.3248	11.742
W21	-0.2616	-0.0186	-0.7448	-0.8879	-1.864
W24	41.6464	37.6495	43.4848	35.7551	81.443
W25	7.1539	4.6743	6.6784	6.8128	11.681

Source: own elaboration

Each risk class is assigned a function defined by parameters. The determination of qualification to particular risk classes is based on 11 financial indicators selected for the model, presented in accordance with the Bronisław Micherda concept, described in Table 3.

Table 3: List of indicators selected for the model

Indicator abbreviation	Indicator name
W2	Payables turnover ratio
W4	Productivity rate
W7	Debt to equity ratio (financing structures)
W8	Debt ratio
W12	Leverage ratio
W16	Ratio of coverage of borrowed funds by financial surplus
W17	Return of sales (ROS I)
W18	Return of sales (ROS II)
W21	Return on equity (ROE)
W24	Financial liquidity index II
W25	Ratio of monetary self-sufficiency of financial activities

Source: own elaboration

The indicators selected as variables of the classification function characterise all the areas under analysis, in accordance with the adopted concept of indicator analysis, namely:

- W2, W4, W7, W8, W12, W16 enable an assessment of the asset and capital situation of the entity,
- W17, W18, W21 may be used to assess the profitability of an entity,
- W24 i W25 are among the indicators characterising the entity's financial liquidity.

When concluding on the shape of the classification functions, it should be noted that all the areas mentioned in the assessment of an entity's performance are important in measuring its risk.

The results of the conducted discriminatory analysis, indicating the classification and forecasting capabilities of the model created, are presented in Table 4.

Table 4: Classification and forecasting capacities in annual analysis based on 2009 data, after elimination of extreme and outlier cases

	correctness for the teaching sample (u)	correctness for the test sample (t)
for all variables	87.50%	35.71%
for variables selected according to ANOVA test	70.83%	42.86%
for variables selected according to Levene test	83.33%	50.00
for variables selected according to Brown-Forsythe test	41.67%	42.86%

Source: own elaboration

On the basis of the results presented in Table 4, it can be concluded that:

- high diagnostic power in the teaching sample (u) was obtained both in the situation of the analysis carried out for all variables and the analysis carried out on the variables selected according to the Levene test, the lowest in the analysis on the variables selected according to the Brown-Forsythe test;
- the highest diagnostic power in the testing sample (t) was obtained when carrying out the analysis on variables selected by the Levene test, and the lowest when carrying out this analysis on all variables,
- diagnostic power for variables selected according to ANOVA test showed average diagnostic power, both in the teaching (u) and testing (t) sample.

In the light of the information presented, a detailed analysis of the obtained results of the partial classification was performed in two studies: for all variables and in the analysis on variables selected by the Levene test (Table 5). The detailed analysis also included an analysis of the wrong choices, which strengthened the researcher's conviction of the reliability of the proposed model, due to the classification discrepancies, which fall within the vast majority within one class.

Table 5: List of the highest classification ability (2009) in the teaching (u) and testing (t) sample

List of the highest classification ability in the teaching (u) and testing (t) sample						
	for the whole sample	**R0**	**R1**	**R2**	**R3**	**R4**
after elimination of extreme cases and outliers for all independent variables in the **teaching sample (u)**	87.50	80.00	80.00	85.71	100.00	100.00
after elimination of extreme cases and outliers for all independent variables in the **testing sample (t)**	35.71	0.00	33.33	50.00	0.00	100.00
after elimination of extreme cases and outliers for independent variables selected according to the Levene test in the **teaching sample (u**)	83.33	80.00	100.00	71.43	100.00	66.67
after elimination of extreme cases and outliers for independent variables selected according to the Levene test in the **testing sample (t)**	50.00	33.33	66.67	50.00	0.00	100.00

Source: own elaboration

When analysing the results presented in Table 5, it can be concluded that the highest classification power in the group of units classified in class R4 has a discriminatory analysis performed

on all independent variables (100% in the teaching sample (u) and 100% in the testing sample (t)). Among units classified in class R3 in both cases, the analysis showed the same results - 100% in the teaching sample (u) and - 0% in the testing sample (t). As regards the classification into the group of units in the risk class R2, significantly better results were obtained on the basis of the analysis carried out for all independent variables (85.71% in the teaching sample (u) and 50.00% in the testing sample (t)). In risk class R1, more favourable results were obtained on the basis of analysis conducted among units selected according to the Levene test - 100.00% in the teaching sample (u) and 66.67% in the testing sample (t). As far as the classification of units to the R0 risk group is concerned, in the teaching sample (u) the same results were obtained in both cases - 80.00%, while in the testing sample (t) better classification results were obtained by conducting the analysis on variables selected according to the Levene test.

Although the classification indicates some discrepancies, the proposed model of risk classes is a solution which supports the process of quantifying economic risk in units. Further research is needed to increase the credibility of the model and to adjust its parameters to the current market conditions, but it should be noted that the repeated attempts to build bankruptcy warning models have been characterised by a much lower level of effectiveness, which was even 50.6%(Sen *et al.*, 2004, p. 219-223). Despite the low credibility of the first models, they have become an inspiration for further attempts at scientific research. Currently, the bankruptcy warning models of E. Altman (Altman, 1968, 589-609) and A. Hołda (Hołda *et al.*, 2004, p. 169) are the models commonly used by auditors.

Model of risk classes (MRC model), as a tool to measure economic risk in COVID time conditions

The model of risk classes was developed on the basis of a survey which covered 54 entities (companies listed on the Warsaw Stock Exchange). The subject of the study were the financial statements together with the annexes for the years 2009-2012. This is a period in which economic entities have been confronted with the effects of the crisis which began in 2008. The verification of the model of risk classes was carried out on a sample of the same units from another period where the study included financial statements together with the annexes for 2013-2014. The scope of the study covered only financial information.

Taking into account the established research assumptions, the units surveyed were classified according to four specific attributes. The systematics carried out on the basis of the assumptions made allowed to group the units covered by the study into 5 risk classes, from R0 to R4. The units were then classified using the model of risk classes. The measurement results are presented in Table 6.

Table 6: Results of risk class classification for 2013 and 2014

Item	UNIT NAME	2013		2014	
		risk class by 4 attributes	risk class by the model of risk classes	risk class by 4 attributes	risk class by the model of risk classes
1	AWBUD	3	3	3	3
2	BUDIMEX	0	0	0	0
3	DECORA	2	2	2	2
4	ELEKTROTIM	0	0	0	0
5	NOWAGALA	3	3	1	2
6	RESBUD	2	2	1	4
7	ROVESE	4	4	4	4
8	TRAKCJA	2	2	2	2
9	UNIBEP	1	1	0	0
10	YAWAL	4	4	1	1

Source: own elaboration

Analysing the classifications received, it can be concluded that the model of risk classes achieved 100% effectiveness in 2013, but in 2014 there were differences in classification. The classification differences concern two units (Nowa Gala, Resbud), where the classification using the model of risk classes included the established companies in the group with a higher risk level. In the case of Nowa Gala, the classification discrepancies relate to a difference within a single risk class, while the Resbud classification indicates a divergent designation of a risk class as follows: according to four predefined attributes, the unit was classified as having a risk level 1, while the measurement of risk using the model of risk classes allowed the unit to be classified as having a risk level 4, which is a group of units with a significantly higher risk level. The reasons for this discrepancy are seen in the decline in the level of key indicators, the share of which in the classification function is high. Despite the discrepancies identified, there is a high level of credibility of the model of risk classes. The diagnostic capabilities of the model are confirmed by the observations made in subsequent years among the entities covered by the survey:

1. AWBUD - suspension of trading in shares on the WSE on 02.05.2019, then return to the WSE, but currently operates as PARTNERBUD S.A. in bankruptcy;
2. NOWAGALA - a decision is to be taken in November 2020 on the withdrawal of shares from the WSE;
3. RESBUD - suspension of trading in shares and return to the WSE in 2019;
4. ROVESE – deleted from trading on the WSE on 30.08.2016;
5. YAWAL – exclusion from the WSE on 27.10.2015.

All companies listed above have been classified according to the model of risk classes as entities with high risk (class 3 or 4).

Given the potential for misinterpretation using the model approach to measuring economic risk, it is planned to continue research on the tool developed. However, its high classification capacity is noted, which allows it to claim the possibility of using in COVID-19 time.

Conclusion and indication of future research

Remembering the words of Professor Elżbieta Burzym, quoted after E. Walińska (Burzym, 2008, p. 34; Walińska, 2014, p. 511), stating that:"(...) accounting is used to measure (or more broadly - to identify, measure, analyse and communicate), and this measurement concerns, based on prices, the value of economic states and processes and the results of these processes", one should aim at indicating methods supporting the appropriate quantification of economic life.

The proposed model of risk classes may make it possible to measure a very complex phenomenon, which is economic risk. It is a tool addressed both to the persons managing units, analysing financial statements, and to auditors, making it possible to assess the unit whose report is subject to the audit process. This is particularly important in the context of the threats faced by units, especially in view of the COVID-19 pandemic, which also implies the need for a thorough analysis of the situation of the units.

At the same time, the study also poses a challenge to continue research in the area of risk measurement in order to adapt the proposed model of risk classes to current market conditions, taking into account data from non-financial reports, including social and environmental issues.

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