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SOCIALLY RELEVANT FACTORS OF ORGANIZATIONAL MORTALITY OF ENTERPRISES: CONTEXT OF CORPORATE SUSTAINABILITY IN EUROPEAN COUNTRIES

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ABSTRACT. The business-demographic problem of organizational mortality of enterprises is considered an essential area of social welfare in a society. It affects the lives and activities of many people and their organizations, as well as the corporate sustainability and the overall socioeconomic situation in the country. The study aims to determine relevant factors influencing the organizational mortality of enterprises from the group of social indicators by using data mining methods. The paper identifies the most influential among such social factors, using the Sigma-restricted parameterization method and correlation analysis. The significance of these social factors is explored through the univariate tests, the Pareto chart of t-values, and a correlation matrix of their interdependence. The factors' force and areas of the influence have been quantified. A model of a linear relationship in multiple regression between organizational mortality of enterprises and relevant social factors is constructed using the ordinary least squares method (OLS method). Meanwhile, a graph of the normal distribution of residuals is built for an analogous linear regression model. The research results highlight the problematic social aspects and factors of enterprises' activity for corporate sustainability, suggesting a practical use for the calculated dependencies between relevant indicators. The application of the methodology will make it possible to influence the pattern of entrepreneurial activity in developing countries to reduce the national economic downturn.

JEL Classification: D02, O17, P31

Keywords: social factors, relevant factors, organizational mortality of enterprises, corporate sustainability, sigma-restricted parameterization, correlational analysis, multiple linear regression, OLS method, Data Mining

Introduction

In the context of global problems of socioeconomic development of countries worldwide, studying the organizational mortality of enterprises is essential to ensuring social welfare in a society. This concept of business demography provides for the liquidation of a set of production and operation factors of the enterprise, which does not provide for exit from the market through restructuring, separation, merger, accession, absorption, change in the type of economic activity when the enterprise has not been operating for two years. The organizational mortality of enterprises affects the life and activities of many people, their employment, purchasing power, finances of companies and institutions, cost of capital, investment attractiveness, liquidity, sales volumes, logistics, the solvency of organizations, employees, the corporate sustainability, and the general socioeconomic situation in the country. Therefore, the government, management and owners of organizations strive to have a clear idea of the probability and factors of such a stage in the life cycle of an organization.

The basis of such a study should be the determination of significant factors of mortality of enterprises. At the same time, a significant aspect of the implementation of scientific work is the issue of methods and models for studying the factors of mortality of enterprises. Classical methods, usually used in factorial analysis models of enterprise mortality, which are based on single-factor and multi-factor regression methods for analyzing socioeconomic phenomena and processes (although they work quite effectively in forecasting), still have certain limitations when the analysis involves the processing of multidimensional information databases, identification of possible implicit interactions It is necessary to use comprehensive methods of identifying and evaluating the factors influencing the organizational mortality based on the management of large statistical economic, social, and political data. Modern methods should be based on a deep study of data, data mining, identification of patterns and trends, potential, dynamics, and formation of enterprise mortality forecasts, which are based on statistical, econometric, and mathematical research methods.

Therefore, determining relevant social factors influencing mortality enterprises for corporate sustainability of European countries based on Data Mining methods is a particularly relevant issue in the current socioeconomic situation in the world.

The **goal** is to determine relevant factors influencing the organizational mortality of enterprises from the group of social indicators by using Data Mining methods.

1. Literature review

On an ongoing basis, scientists from various branches of entrepreneurial activity seek and study the factors that affect the operation of enterprises at different stages of their life cycle, identifying the most important, influential factors among them. Clear examples are papers on relevant factors of enterprises by the following scientists: Kartanaite et al. (2021) research essential factors for industrial enterprises; Ouyang et al. (2022) determine factors in the construction industry using dynamic econometric analysis; Camilleri et al., (2022) review factors affecting family businesses in tourism and hospitality; Ahmad et al. (2022) perform a multi-group analysis of essential factors of enterprise architecture; Shvindina et al. (2022), Kravchenko et al. (2022), Kazeem et al. (2022) examine important factors for institutions in the

medical field; Kaya (2022) analyze the factors of small and medium-sized enterprises using an adaptive model; and many others who study essential factors influencing the functioning of enterprises Maris (2022), Ozkan et al. (2022), Seguer and Hasna (2022).

Currently, among the factors influencing the activities of enterprises, international society attaches particular importance to social factors of enterprises, which are described in their works by the following scientists: Castro (2022), Hazem and Sharif (2022), Vidic (2022) shift the focus of their research to social value in capital markets; Xu et al. (2022) suggest a model for making managerial decisions in an enterprise with social responsibility in mind; Kuzior et al. (2021) explore the characteristics and factors of a socially oriented entrepreneur; Safarov et al. (2022), Shazly et al. (2022), Habib (2022), Swiatkiewicz (2022) study the nexus between social and corporate environment, and governance performance and cost of enterprise capital; Beisland et al. (2021) carry out a global study of measuring social performance in enterprises; and other contemporary scientists Adda et al. (2021), Baharudin and Nik Azman, (2019), Bilan et al. (2022), Melnyk et al. (2021), Skrynnyk et al. (2020), Yang et al. (2021).

In recent years, the problems of **organizational mortality of enterprises**, which are revealed in various aspects in the treatises of the following scientists, are relevant for research: Garcia et al. (2022) – on the study of mortality risk factors in micro and small businesses; Kychko et al. (2021), Michalkova et al. (2021) – in part of the implementation of the health-centrist policy in the context of the development of corporate social responsibility; Kücher et al. (2020), Durana et al. (2021) – regarding age dependent explanations for business failure, i.e., approach to age dependence in organizational mortality; and other Poliakov and Zayukov (2022), Kljucnikov et al. (2022).

The study of mortality of enterprises is inextricably linked with **corporate sustainability** in the country. Therefore, within the framework of the issue under study, it is also necessary to investigate the features of this concept. Yes, corporate sustainability the following scholars cover in their treatises: Ofori - Parku and Koomson 2023) consider corporate sustainability as a hegemonic discourse of globalization; Oe et al. (2022) explores the relationship between corporate sustainability and the firm's business strategy; Singhania et al. (2023) study the social issue of connection gender diversity and corporate sustainability; and others: Lahouirich et al. (2022).

For factor analysis, the specific practice of applying **sigma-restricted parameterization**, using sigma-restricted coding to display effects for categorical types of predictor variables used in the practice of building general linear models and generalized linear models, is of interest. An example of this is the work of scientists: Gockel et al. (2009), who developed a prediction model in the medical field, where they used the technique of sigma-restricted parameterization; He and Zelikovsky (2006) proposed a prediction method based on multivariate linear regression in sigma-limited coding; and others Kuzmenko et al. (2020).

Especially popular is the **correlational analysis** technique, which allows a statistical analysis of relationships, and their strength, between random variables. Although the application of correlation analysis of enterprises to enterprise research is a less commonly used method, the practice of using it is described in the works of the following scientists: Siqueira and Lobo (2022) uses correlation analysis for factors that affect the ability of business entities to use research results in their fields; Bokhari and Aftab (2022) used a multi-correlation survey to study employee traits in small and medium-sized enterprises; Owusu et al. (2022) apply a quantitative correlation approach using questionnaires to study predictors of fraud in enterprises; Urban and Lehasa (2022) investigate financial investment in a social enterprise through correlation analysis; Kafaji (2022) uses modeling of correlation relationships that influence the study of project impact factors and business performance; and others.

In recent years, a particularly popular modeling technique has been one of the most effective modern methods of **Data Mining**, which provides for extracting information, deep data mining. Modern examples of the application of this technique in various fields of science are as follows: in Ocean Engineering – a data mining method for automatic identification and analysis (Liu et al., 2022); in the medical field – evaluation of factors using data mining techniques (Eskandari et al., 2022); in Bioinformatics – data mining for prediction model (Yang et al., 2022); in Financial Innovation – data mining approaches for analysis of economic recession (Taylan et al., 2022); in Computer Science and Engineering – protection of data privacy with an algorithm in data mining (Dhinakaran et al., 2022); and many others (Kuzmenko et al., 2019).

The **multivariate adaptive regression splines (MARSplines)** procedure is quite common. This form of regression analysis, a non-parametric type of regression, is used to expand the construction of linear models and build more flexible models that allow automatic modeling of aggregate nonlinearities and relationships and influences by factors. They are the following: Naser et al. (2022) in the context of the application of multivariate adaptive regression splines (MARS) approach in prediction in the construction industry; (Chen et al., 2022) on forecast modeling in Applied Energy; (Cao et al., 2022) in terms of using multivariate adaptive in Engineering Structures; (Pramanik et al., 2022) on deterministic and probabilistic prediction using multivariate adaptive regression splines in transportation geotechnics; (Zhang et al., 2022) the use of multivariate adaptive regression splines for predicting in frontiers in environmental science; and many others.

The latest modeling technique is **VAR modeling**, which allows simulating of the dynamics of several time series, and such models do not have the limitations of structure modeling. The following scientists have recently used such models: Mody and Rangarajan (2022) - highlight sparse representations of high dimensional neural data using Conventional Vector Autoregressive (VAR) modeling methods; Apergis and Chatziantoniou (2022) - study the relations between partisan conflict and development of the stock market through the VAR model; Yang et al. (2022) – a multivariate time-series analysis of socioeconomic factors in China; Yousaf et al. (2022) – evaluation of relations in the study of energy cryptocurrencies using TVP-VAR modeling; Boukhatem and Djelassi (2022) – panel VAR modeling of monetary policy banking system; and many others Vasilyeva, (Vasilyeva et al. (2021).

2. Methodological approach

The definition of relevant factors influencing the organizational mortality of enterprises from the group of social indicators to ensure corporate sustainability of European countries is implemented in **3 stages**.

In **the first stage of the study**, the statistical base of the study is collected based on the data of the Eurostat and Unece statistical databases for European countries.

At the **second stage** of the study, factor analysis is carried out, i.e., **relevant social factors** of mortality of enterprises are determined for corporate sustainability of European countries using the **sigma-restricted parameterization** method, and **correlation analysis** is carried out. The second stage of the study was conducted using the Statistica 10 and Statistica Portable toolkits. At this stage, the Statistics toolkit was used, the package Advanced Linear/Nonlinear Models - General Regression Models - General Linear Models. The implementation of this stage includes conducting the univariate tests of the significance and building a Pareto chart of t-values of the significance of social factors for the organizational mortality of enterprises (graphical visualization of the 80 by 20 rule), analysis of the coefficients of the generalized regression model of the relationship between the selected social factors and

mortality of enterprises, which they determine. Statistical significance is determined based on the critically acceptable value of the Fischer criterion (p) 0.05 (the indicator must be less than 0.05) and on the highest levels of the sum of squares of deviations (SS).

As part of the second stage of establishing relevant social factors for European countries, it is also necessary to conduct **the correlation analysis.** At this stage, the Statistics toolkit is used, the Basic Statistics/Tables - Correlation Matrices package. The implementation of this stage includes the construction of a correlation matrix of the interdependence of important social factors influencing the organizational mortality of enterprises. The correlation coefficients calculated in the correlation matrix between the resulting indicator Death of Enterprises, D and factor social indicators, as well as separately between factor social indicators, describe the strength of the relationship between the selected features: strong relationship - the value of the correlation coefficients is more than 0.7, the average connection – the value of the coefficients correlations from 0.4 to 0.7, weak connection –the value of correlation coefficients from 0.1 to 0.4.

In the **third stage** of the study, the **strength of influence and the direction of influence** of the relevant social factors selected for Europe on the mortality of enterprises, are determined, affecting corporate sustainability. For this purpose, at the third stage of the study, one of the Data mining techniques was used: regression analysis, which has wide practical application among world scientists (Yang et al., 2019). Within this stage, **multiple linear regression is built using the least squares method – the OLS method**. One multiple linear regression panel data is built on the basis of prepared panel statistics (longitudinal data) in the context of all indicators, all years, all countries. The third stage of the study was conducted using the Statistica 10 and Statistica Portable toolkits. At this stage, the Statistics toolkit was used, the Multiple Regression - Summary Regression package. As a result, we obtain in tabular form the calculated indicators of the regression analysis of the relationship between the organizational mortality of enterprises and social factors, and relevant social factors, based on the data of which a multiple linear regression of the relationship between mortality of enterprises and social factors is constructed; multiple linear regression in the relation between mortality of enterprises and relevant social factors. An analysis of the model of a linear multiple regression relationship between the organizational mortality and relevant social factors is carried out, for which. Among other things, a **graph of correspondence** to the normal distribution of residuals of a linear regression model of the established relationship is built in Statistica 10 and Statistica Portable (the graph is built using the Statistics toolkit, the Multiple Regression package - Residuals/assumptions/prediction - Perform residual analysis - Normal plot of residuals).

3. Conducting research and results

3.1. Stage 1. Quantitative formalization of the statistical base of the study

Quantitative formalization of the statistical base of the study – **the collection of statistical information** characterizing the organizational mortality of enterprises and the selection of **social factors** in European countries that affect the mortality of enterprises, and including influence on corporate sustainability of countries.

Thus, the following four indicators are attributed to such the factors social: Total unemployment rate, Percentage of population in the labor force, S1 (includes people who are currently unemployed, also those who have been looking for work for a short period of time and are seeking immediate employment, including those who left without work at their own request); Emigration, Number, S2 (includes the total number of long-term emigrants who left

the reporting country in the reporting year); Hours worked per week of full-time employment, Hour, S3 (includes the average number of hours a person actually works); Gross Average Monthly Wages, US$, at current Exchange Rates, S4 (includes total wages before tax and social security payments). The effective indicator of enterprise mortality is the Death of Enterprises, number, D (includes enterprises that ceased operations during the reporting period, not including mergers, acquisitions, restructurings, or business changes). The study does not involve the use of descriptive statistics. The statistical database is based on Eurostat and Unece data from 2010 to 2020 for 29 European countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland. The following was prepared for analysis: statistical data generated in Table 1.

Table 1. Fragment of quantitative formalization of the statistical base of the study

		S1	S2	S3	S4	D
Austria	2010	5,2	51651,0	43,6	4021,3	29551,0
Belgium	2010	8,4	66013,0	41,2	4330,6	17376,0
Bulgaria	2010	11,3	20889,9	41,6	437,0	25650,0
Croatia	2010	11,7	13017,0	42,0	1395,8	23096,0
Cyprus	2010	6,3	4293,0	42,1	2535,5	3745,0
…	…	…	…	…	…	…
Austria	2011	4,9	51197,0	43,5	4307,2	30399,0
Belgium	2011	7,2	84148,0	41,3	4724,1	17944,0
Bulgaria	2011	12,3	18630,2	41,3	495.4	39183,0
Croatia	2011	13,7	12699,0	41,7	1460,3	17426,0
Cyprus	2011	7,9	4895,0	41,9	2736,4	5069,0
…	…	…	…	…	…	…
Austria	2020	6,0	62581,0	42,1	4253,5	17268,0
Belgium	2020	5,8	76562,0	40,9	4352,7	23019,0
Bulgaria	2020	6,1	6649,0	40,7	808.1	50139,0
Croatia	2020	7,5	34046,0	40,7	1392,9	17888,0
Cyprus	2020	7,6	21368,0	41,2	2286,1	5559,0
…	…	…	…	…	…	…
Slovakia	2020	6,7	2428,0	40,9	1450,6	44430,0
Slovenia	2020	5,0	17745,0	41,2	2494,7	9261,0
Spain	2020	15,5	248561,0	40,4	2520,2	252042,0
Sweden	2020	8,5	48937,0	40,4	4063,5	45386,0
Switzerland	2020	4,8	109376,0	42,7	7712,7	31078,0

Source: *own compilation*

3.2. Stage 2. Defining the most influential (relevant) social factors

Establishing the most influential (**relevant) social factors for European countries** that determine the organizational mortality of enterprises for corporate sustainability of European countries by implementing the **sigma-restricted parameterization method** and **correlation analysis.**

First, at this stage, the **univariate tests of the significance** of social factors were carried out for the mortality of enterprises (Table 2).

Table 2. Univariate tests of the significance of the impact of social factors on organizational mortality of enterprises in European countries

Effect	Univariate Tests of Significance for D (Spreadsheet1.sta) Sigma-restricted parametrization Effective hypothesis decomposition				
	SS	Degr. of Freedom	MS	F	p
Intercept	$8.873703*10^{8}$	1	$8.873703*10^{8}$	0.3810	0.5375
"S1"	$3.926080*10^{8}$	1	$3.926080*10^{8}$	0.1685	0.6817
"S2"	$1.416621*10^{12}$	1	$1.416621*10^{12}$	608.1629	0.0000
"S3"	$1.571969*10^{8}$	1	$1.571969*10^{8}$	0.0675	0.7952
"S4"	$3.997345*10^{10}$	1	$3.997345*10^{10}$	17.1608	0.0000
Error	$7.314140*10^{11}$	314	$2.329344*10^{9}$		

Source: *own compilation*

According to the data obtained in Table 2, reflecting the results of the univariate tests of the significance, two statistically significant effects were identified. This statement is based on the calculated significance levels of the Fisher criterion: for Emigration, S2, – p=0.0000 and Gross Average Monthly Wages, S4, –p=0.0000, which corresponds to the requirement – less critically acceptable p=0.05. These two effects make the greatest contribution to the overall regression model, which is also confirmed by the largest sums of squared deviations (SS): for Emigration, S2, - SS = $1.41*10^{12}$ and Gross Average Monthly Wages, S4, - SS = $3.99*10^{10}$. For other indicators, Total employment rate, S1 and Hours worked per week of full-time employment, S3, the contribution of effects is statistically insignificant.

The statistical significance of the two effects of social indicators S2 and S4 was confirmed by constructing a **Pareto chart of t-values** of the significance of social factors (Figure 1). The Pareto diagram allows for the graphical visualization of 80% of influential and 20% of non-influential factors.

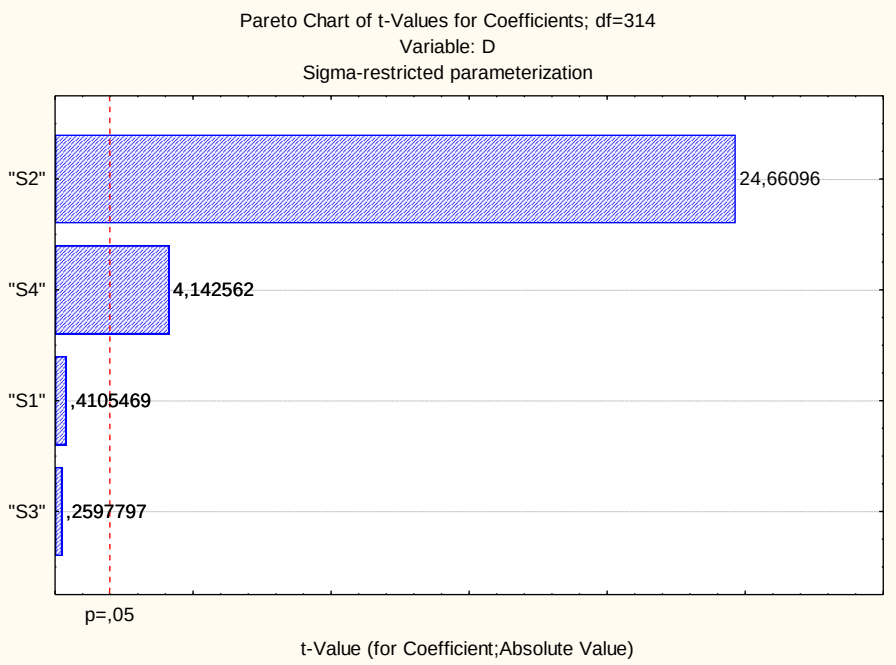

Figure 1. Pareto chart of t-values of the significance of the influence of social factors on organizational mortality of enterprises in European countries
Source: *own compilation*

As Figure 1 shows, the two bands of indicators S2 and S4 cross the red line – the limit of the critically acceptable level of the Fischer criterion (p) of 0.0500, which indicates their statistical significance. Thus, indicators S2 and S4 have 80% of the impact and are relevant to social factors proposed for use in further research. The Pareto chart helps in ranking indicators by their level of influence, i.e., from the most influential to least influential indicator.

The next step, within the framework of stage 2 of determining relevant social factors, is to **conduct a correlation analysis.** At this stage, a correlation matrix of the interdependence of relevant social factors influencing the mortality of enterprises is constructed (Table 3).

Table 3. Correlation matrix of the interdependence of relevant social factors influencing organizational mortality of enterprises in European countries

	Correlations (Spreadsheet1.sta) Marked correlations are significant at p<0.0500 N=319 (Casewise deletion of missing data)						
Variable	Means	Std.Dev.	S1	S2	S3	S4	D
S1	8.99	5.2	1.000000	0.056754	0.163687	-0.414758	0.121241
S2	85486.35	110763.0	0.056754	1.000000	-0.024408	0.056590	0.801424
S3	41.16	1.3	0.163687	-0.024408	1.000000	-0.057453	-0.017324
S4	3034.67	1972.5	-0.414758	0.056590	-0.057453	1.000000	-0.108930
D	66985.28	83031.3	0.121241	0.801424	-0.017324	-0.108930	1.000000

Source: *own compilation*

Table 3 shows that the calculated correlation coefficients between the performance indicator Death of Enterprises, D, and factorial social indicators have the following relationship: strong relationship – the correlation coefficient between Death of Enterprises, D and Emigration, S2 is 0.80; average relationship – the correlation coefficient between S1 and S4 is 0.41; weak relationship – the correlation coefficient between D and S1 is 0.12, between D and S4 is -0.10, between S1 and S3 is 0.16. Further, when studying the influence of social factors, features with a strong and medium relationship should be taken into account.

Thus, taking into account the results of checks conducted for European countries on the relevance of social factors influencing organizational mortality of enterprises, which was carried out by implementing univariate tests of the significance, building a Pareto chart of t-values of the significance of the influence of social factors on mortality of enterprises, building a correlation matrix of the interdependence of relevant social factors influencing organizational mortality to ensure corporate sustainability of European countries, the most influential two factors were established: Emigration, S2 and Gross Average Monthly weights, S4.

3.2. Stage 3. Determining the strength and direction of influence of relevant social factors

Determining **the strength of influence and the direction of influence** of the relevant social factors identified on the organizational mortality of enterprises to ensure corporate sustainability of European countries. At this stage, we build a **multiple linear regression** using the **ordinary least squares method** (OLS method). Based on the prepared panel data (quantitative formalization of the statistical base of the study-Table 1), a multiple linear regression was constructed in the context of all selected indicators (S1-S4, D) for the period from 2010 to 2020 for 29 European countries. To construct the multiple linear regression, we first use all the social factors that affect the mortality of enterprises: S1, S2, S3, S4, and the effective factor D. Table 4 shows the calculated indicators of regression analysis.

Table 4. Calculated indicators of regression analysis of the relationship between organizational mortality of enterprises and social factors

N=319	Regression Summary for Dependent Variable: D (Spreadsheet1.sta) R=0.81632106 R^2=0.66638007 Adjusted R^2=0.66213014 F(4.314)=156.80 p<0.0000 Std.Error of estimate: 48263.0					
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(314)	p-level
Intercept			55489.85	89903.78	0.61721	0.5375
S1	0.014949	0.036411	239.54	583.47	0.41055	0.6817
S2	0.808797	0.032797	0.61	0.02	24.66090	0.0000
S3	-0.008589	0.033064	-569.91	2193.83	-0.25978	0.7952
S4	-0.148992	0.035960	-6.27	1.51	-4.14256	0.0000

Source: *own compilation*

Further, according to the indicators of Table 4, we formulate relationship between the organizational mortality and social factors:

$$D = 55489.85 + 239.54 \cdot S1 + 0.61 \cdot S2 - 569.91 \cdot S3 - 6.27 \cdot S4 \quad (1)$$

The resulting model (1) is sufficiently adequate and accurate, taking into account the corresponding level of the coefficient of determination of 0.8163 and the value of the Fischer criterion of 156.80, which is greater than the critically acceptable level.

However, Table 4 also shows that not all social factors are statistically significant. Thus, the following social factors are statically significant: S2 and S4. This was also determined in the second stage of the study. Therefore, the regression analysis was performed repeatedly for the relationship between organizational mortality in enterprises and relevant social factors. Table 5 shows the calculated indicators of regression analysis.

Table 5. Calculated indicators of regression analysis of the relationship between organizational mortality of enterprises and relevant social factors

N=319	Regression Summary for Dependent Variable: D (Spreadsheet1.sta) R=0.81618585 R^2=0.66615935 Adjusted R^2=0.66404643 F(2.316)=315.28 p<0.0000 Std.Error of estimate: 48126.0					
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(314)	p-level
Intercept			34837.69	5284.422	6.59253	0.0000
S2	0.810183	0.032555	0.61	0.024	24.88630	0.0000
S4	-0.154777	0.032555	-6.52	1.370	-4.75428	0.0000

Source: *own compilation*

Next, according to the indicators of Table 5, we formulate the model of linear multiple regression relationship between organizational mortality of enterprises and relevant social factors:

$$D = 34837{,}69 + 0.61 \cdot S2 - 6.52 \cdot S4 \quad (2)$$

The resulting model (2) is adequate and accurate, which is confirmed by the coefficient of determination of 0.8162 (i.e., the variation of the effective indication by 81.62% is determined by the level of variations of the selected two factorial indicators and the value of the Fisher criterion 315.28 (which is more than the critically acceptable level)). All factors

selected in the model are statistically significant, as evidenced by the t-test and p-levels (which are not higher than the permissible critical level of 0.0500).

The following analysis of the model of the linear multiple regression relationship between organizational mortality of enterprises and relevant social factors (2) allows for the following conclusions:

- the incentive of mortality of enterprises is the indicator Emigration, S2 (an increase in this factor entails an increase as an effective factor in organizational mortality); an increase in Emigration, S2 by 1 unit entails an increase in the mortality of enterprises by 0.61 units;
- the disincentive of the mortality of enterprises is the indicator of Gross Average Monthly Wages, S4 (an increase in this factor causes a decrease in the effective factor of the mortality of enterprises); an increase in Average Monthly Wages, S4 by 1 unit causes a decrease in the mortality of enterprises by 6.52 units;
- the factors Total unemployment rate, S1 and Hours worked per week of full-time employment, S3, do not have a statistically significant impact on the mortality of enterprises.

The accuracy and adequacy of the model (2) are confirmed by plotting the compliance with the normal distribution of residuals of the linear regression model of the defined relationship (Figure 2).

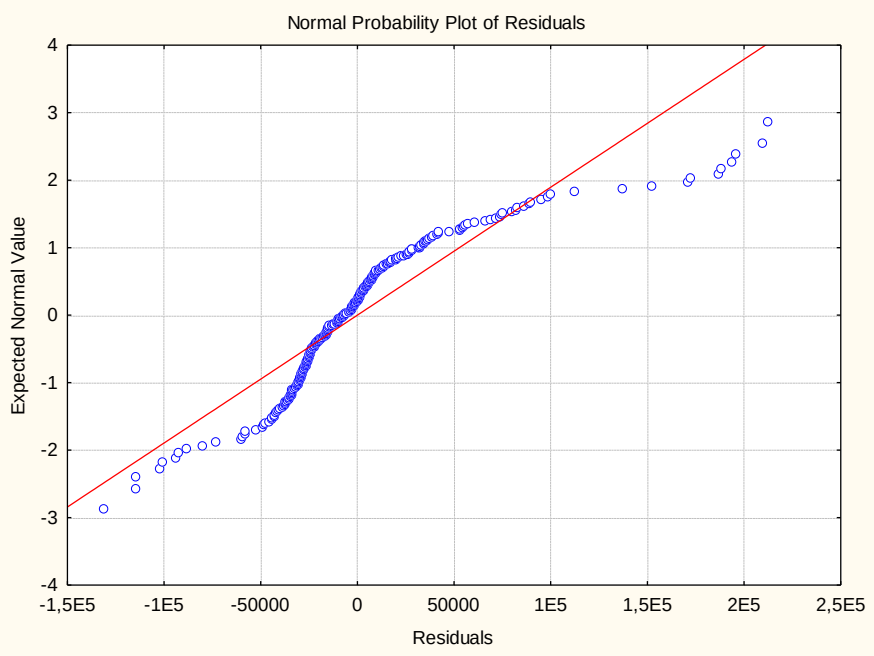

Figure 2. Graphical representation of compliance with the normal distribution of residuals of a linear regression model of the relationship between organizational mortality of enterprises and relevant social factors
Source: *own compilation*

Figure 2 shows that the residuals of the linear regression model of the relationship between mortality of enterprises and relevant social factors correspond to the normal distribution. That is, the model's compliance with the normal distribution law is graphically represented in Figure 2, and the corresponding values of the p-value are represented in Table 2, Table 4, and Table 5.

Conclusion

Organizational mortality of enterprises is an extremely negative phenomenon that profoundly affects the corporate sustainability of countries, the economic and social situation and development in Europe and the world, leading to recessions and crises that devastate the economy, causing social changes and worsening the population's well-being. Therefore, it is necessary to make comprehensive efforts to identify, analyze, predict and further neutralize negative factors affecting the mortality of enterprises.

The study quantitatively formalized the input statistical base of the study – the authors collected statistical information that characterizes the mortality of enterprises and selected social factors that affect the organizational mortality from 2010 to 2020 in 29 European countries.

For Europe, the most influential (relevant) social factors that determine the mortality of enterprises and affect the corporate sustainability of countries, have been established by implementing the sigma-restricted parameterization technique and correlation analysis. As part of this stage, univariate tests of the significance were conducted and a Pareto chart of t-values of the significance of social factors influencing the organizational mortality of enterprises was constructed; a correlation matrix of the defined interdependence was constructed. Based on the results of three checks, it was found that the most influential and relevant factors are two: Emigration, S2, and Gross Average Monthly Wages, S4.

The forces of influence and directions of influence of social factors relevant to the organizational mortality of enterprises have been determined for European countries, that determine corporate sustainability of European countries. The model is based on the Data mining method - regression analysis. Within this stage, indicators of the regression analysis of the dependence between the mortality of enterprises and, accordingly, all and relevant social factors were calculated; a model of multiple linear regression dependence between the mortality of enterprises and, respectively, all and relevant social factors was constructed using the method of ordinary least squares (OLS method). This allowed concluding that the Emigration indicator, S2, is an incentive to the organizational mortality; the Gross Average Monthly weights indicator, S4, is a disincentive to the mortality of enterprises. A graph of compliance with the normal distribution of residuals of the linear regression model of the relationship between organizational mortality of enterprises and relevant social factors has been constructed, which confirmed the adequacy and accuracy of the constructed linear regression model.

The results of this study highlight problematic social aspects and factors of activity of enterprises, the corporate sustainability and suggest practical use of calculated variations in mortality of enterprises under the influence of relevant factors.

Implementing the suggested methodology will allow influencing the scheme of entrepreneurial activity in countries, determining corporate sustainability of countries, the main ways and policies of enterprise development, and making appropriate, effective management decisions. This, on a global scale, will help to develop and reduce the national economic downturn.

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References

Adda, G., Dokor, G. A. B., Azigwe, J. B., & Odai, N. A. (2021). Management commitment and corporate sustainability integration into small and medium-scale enterprises: A mediation effect of strategic decision-making. *Economics, Management and Sustainability*, *6*(2), 6–20. https://doi.org/10.14254/jems.2021.6-2.1

Ahmad, N. A., Mohd Drus, S., & Kasim, H. (2022). Factors of organizational adoption of enterprise architecture in Malaysian public sector: A multi-group analysis. *Journal of Systems and Information Technology*, *24*(4), 331-360. doi:10.1108/JSIT-11-2020-0254

Apergis, N., & Chatziantoniou, I. (2022). US partisan conflict shocks and international stock market returns. *Empirical Economics, 63*(6), 2817-2854. doi:10.1007/s00181-022-02237-1

Baharudin, D. M., & Nik Azman, N. H. (2019). Corporate social responsibility reporting within the Malaysian oil and gas industry: A questionable publicity stunt. *Economics, Management and Sustainability*, *4*(1), 29–36. https://doi.org/10.14254/jems.2019.4-1.3

Beisland, L. A., Djan, K. O., Mersland, R., & Randøy, T. (2021). Measuring social performance in social enterprises: A global study of microfinance institutions. *Journal of Business Ethics, 171*(1), 51-71. doi:10.1007/s10551-019-04417-z

Bilan, S., Šuleř, P., Skrynnyk, O., Krajňáková, E., & Vasilyeva, T. (2022). Systematic Bibliometric Review of Artificial Intelligence Technology in Organizational Management, Development, Change and Culture. *Business: Theory and Practice,* 23(1), 1-13. doi:10.3846/btp.2022.13204

Bokhari, S. A. A., & Aftab, M. (2022). Personality traits and social loafing among employees working in teams at small and medium enterprises: A cultural perspective data from emerging economies. *Data in Brief, 42* doi:10.1016/j.dib.2022.108085

Boukhatem, J., & Djelassi, M. (2022). The bank-lending channel of monetary policy transmission in a dual banking system: Empirical evidence from panel VAR modeling. *Cogent Economics and Finance, 10*(1) doi:10.1080/23322039.2022.2107765

Camilleri, M. A., & Valeri, M. (2022). Thriving family businesses in tourism and hospitality: A systematic review and a synthesis of the relevant literature. *Journal of Family Business Management, 12*(3), 555-576. doi:10.1108/JFBM-10-2021-0133

Cao, M. -., Nguyen, N. -., & Wang, W. -. (2022). Using a heterogeneous evolutionary ensemble of artificial neural network and multivariate adaptive regression splines to predict bearing capacity in axial piles. *Engineering Structures, 268*.doi:10.1016/j.engstruct.2022.114769

Castro, F.A.O. (2022). The Asian entrepreneurship core in COVID-19 period: value chains, specialized education, massive participation of women and strategic accompaniment. *SocioEconomic Challenges, 6*(3), 132-147. https://doi.org/10.21272/sec.6(3).132-147.2022

Chen, W. -., Lo, H. -., Aniza, R., Lin, B. -., Park, Y. -., Kwon, E. E., Grafilo, L. A. D. R. (2022). Forecast of glucose production from biomass wet torrefaction using statistical approach along with multivariate adaptive regression splines, neural network and decision tree. *Applied Energy, 324* doi:10.1016/j.apenergy.2022.119775

Dhinakaran, D., & Joe Prathap, P. M. (2022). Correction to: Protection of data privacy from vulnerability using two-fish technique with apriori algorithm in data mining. *Journal of Supercomputing, 78*(18), 19754. doi:10.1007/s11227-022-04652-8

Durana, P., Michalkova, L., Privara, A., Marousek, J., & Tumpach, M. (2021). Does the life cycle affect earnings management and bankruptcy?. *Oeconomia Copernicana*, *12*(2), 425–461. https://doi.org/10.24136/oc.2021.015

Eskandari, M., Alizadeh Bahmani, A. H., Mardani-Fard, H. A., Karimzadeh, I., Omidifar, N., & Peymani, P. (2022). Evaluation of factors that influenced the length of hospital stay using data mining techniques. *BMC Medical Informatics and Decision Making, 22*(1). doi:10.1186/s12911-022-02027-w

Garcia, F. T., Ten Caten, C. S., de Campos, E. A. R., Callegaro, A. M., & de Jesus Pacheco, D. A. (2022). Mortality risk factors in micro and small businesses: Systematic literature review and research agenda. *Sustainability (Switzerland), 14*(5). doi:10.3390/su14052725.

Gockel, I., Domeyer, M., Sgourakis, G. G., Schimanski, C. C., Moehler, M., Kirkpatrick, C. J., Hansen, T. (2009). Prediction model of lymph node metastasis in superficial esophageal adenocarcinoma and squamous cell cancer including D2-40 immunostaining. *Journal of Surgical Oncology, 100*(3), 191-198. doi:10.1002/jso.21336

Habib, A. M. (2022). Does the efficiency of working capital management and environmental, social, and governance performance affect a firm's value? Evidence from the United States. *Financial Markets, Institutions and Risks, 6*(3), 18-25. https://doi.org/10.21272/fmir.6(3).18-25.2022

Hazem, F., & Sharif, F. (2022). Empowering human resources to achieve the strategic goals of business companies. *SocioEconomic Challenges, 6*(3), 62-79. https://doi.org/10.21272/sec.6(3).62-79.2022

He, J., & Zelikovsky, A. (2006). Tag SNP selection based on multivariate linear regression doi:10.1007/11758525_101 Retrieved from www.scopus.com

Kafaji, M. A. (2022). Interchange roles of formal and informal project management on business operational success. *Production Planning and Control*. doi:10.1080/09537287.2022.2089265

Kartanaitė, I., Kovalov, B., Kubatko, O., & Krušinskas, R. (2021). Financial modeling trends for production companies in the context of industry 4.0. Investment Management and Financial Innovations, 18(1), 270-284. doi:10.21511/imfi.18(1).2021.23

Kaya, H. (2022). Regulations and the characteristics of entrepreneurs. *SocioEconomic Challenges, 6*(3), 80-96. https://doi.org/10.21272/sec.6(3).80-96.2022

Kazeem, B. L. O., Adewale, O. V., Kayode, K. I., & Kayode, O. J. (2022). Challenge of COVID-19 and Nigerian Economic Change: The Way Forward. *Health Economics and Management Review*, 2, 69-77. http://doi.org/10.21272/hem.2022.2-08

Ključnikov, A., Civelek, M., Krajčík, V., Novák, P., & Červinka, M. (2022). Financial performance and bankruptcy concerns of SMEs in their export decision. *Oeconomia Copernicana*, *13*(3), 867–890. https://doi.org/10.24136/oc.2022.025

Kravchenko, O., Kaminska, B., & Boiko, V. (2022). Motivation as a Determinant of the Personnel Management System in Medical Institutions. *Health Economics and Management Review*, 1, 25-30. http://doi.org/10.21272/hem.2022.1-03

Kücher, A., Mayr, S., Mitter, C., Duller, C., & Feldbauer-Durstmüller, B. (2020). Firm age dynamics and causes of corporate bankruptcy: Age dependent explanations for business failure. *Review of Managerial Science, 14*(3), 633-661. doi:10.1007/s11846-018-0303-2

Kuzior, A., Ober, J., & Karwot, J. (2021). Stakeholder expectation of corporate social responsibility practices: A case study of PWIK Rybnik, Poland. *Energies*, 14(11) doi:10.3390/en14113337

Kuzmenko, O. V., Boiko, A. O., Yarovenko, H. M. and Dotsenko, T. V. (2019), Data mining-based assessement of the risk of using financial intermediaries for money laundering, *Efektyvna ekonomika*, 10, DOI: 10.32702/2307-2105-2019.10.6

Kuzmenko, O., Vasylieva, T., Vojtovič, S., Chygryn, O., & Snieška, V. (2020). Why do regions differ in vulnerability to COVID-19? Spatial nonlinear modeling of social and economic patterns. *Economics and Sociology*, 13(4), 318-340. doi:10.14254/2071-789X.2020/13-

Kychko, I., Kovalchuk, S., Kopochynska, Y., Glynyana, O., & Zub, I. (2021). Implementation of the health-centrist policy of the system functioning of healthcare and labor relations in the context of the development of corporate social responsibility. *Universal Journal of Public Health, 9*(6), 367-377. doi:10.13189/UJPH.2021.090603

Lahouirich M. W., El Amri, A., Oulfarsi S., Sahib Eddine, A., El Bayed Sakalli H., Boutti, R. (2022). From financial performance to sustainable development: A great evolution and an endless debate. *Financial Markets, Institutions and Risks*, 6(1), 68-79. https://doi.org/10.21272/fmir.6(1).68-79.2022

Liu, C., Musharraf, M., Li, F., & Kujala, P. (2022). A data mining method for automatic identification and analysis of icebreaker assistance operation in ice-covered waters. *Ocean Engineering, 266* doi:10.1016/j.oceaneng.2022.112914

Maris, M. (2022). Management of Competitiveness in the EU Member States: The Main Strengths and Weaknesses. *Marketing and Management of Innovations*, 2, 110-120. https://doi.org/10.21272/mmi.2022.2-10

Melnyk, L., Kubatko, O., Matsenko, O., Balatskyi, Y., & Serdyukov, K. (2021). Transformation of the human capital reproduction in line with industries 4.0 and 5.0. *Problems and Perspectives in Management*, 19(2), 480-494. doi:10.21511/ppm.19(2).2021.38

Michalkova, L., Kovacova, M., Cepel, M. Belas, J. (2021). Insolvency Prediction and Corporate Bankruptcy Model in Visegrad Group Countries. *Transformations In Business & Economics.* 21, 2A (56A), 529-549. http://www.transformations.knf.vu.lt/56a/article/inso

Mody, S. K., & Rangarajan, G. (2022). Sparse representations of high dimensional neural data. *Scientific Reports, 12*(1) doi:10.1038/s41598-022-10459-7

Naser, A. H., Badr, A. H., Henedy, S. N., Ostrowski, K. A., & Imran, H. (2022). Application of multivariate adaptive regression splines (MARS) approach in prediction of compressive strength of eco-friendly concrete. *Case Studies in Construction Materials, 17*. doi:10.1016/j.cscm.2022.e01262

Oe, H., Yamaoka, Y., & Duda, K. (2022). How to Sustain Businesses in the Post-COVID-19 Era: A Focus on Innovation, Sustainability and Leadership. *Business Ethics and Leadership, 6*(4), 1-9. https://doi.org/10.21272/bel.6(4).1-9.2022

Ofori-Parku, S. S., & Koomson, P. (2023). Corporate sustainability as a hegemonic discourse of globalization: The discourse-historical approach as a critical issues and stakeholder analysis tool. *Public Relations Review, 49*(1) doi:10.1016/j.pubrev.2022.102275

Ouyang, T., Liu, F., & Huang, B. (2022). Dynamic econometric analysis on influencing factors of production efficiency in construction industry of Guangxi province in China. *Scientific Reports, 12*(1) doi:10.1038/s41598-022-22374-y

Owusu, G. M. Y., Koomson, T. A. A., Alipoe, S. A., & Kani, Y. A. (2022). Examining the predictors of fraud in state-owned enterprises: An application of the fraud triangle theory. *Journal of Money Laundering Control, 25*(2), 427-444. doi:10.1108/JMLC-05-2021-0053

Ozkan, S. A., & Ardic, K. (2022). Business Innovation Management: a General Overview to Virtuous Leadership. *Marketing and Management of Innovations*, 2, 184-197. https://doi.org/10.21272/mmi.2022.2-17

Pramanik, R., Mukherjee, S., & Sivakumar Babu, G. L. (2022). Deterministic and probabilistic prediction of maximum wall facing displacement of geosynthetic-reinforced soil

segmental walls using multivariate adaptive regression splines. *Transportation Geotechnics, 36* doi:10.1016/j.trgeo.2022.100816

Rodion Poliakov and Ivan Zayukov (2022). Model for preventing bankruptcy of Ukrainian enterprises in force majeure circumstances. *Problems and Perspectives in Management, 20*(4), 365-381. doi:10.21511/ppm.20(4).2022.28

Safarov, Q., Sadiqova, S., & Urazayeva, M. (2022). Methodological Approach to Identification of Innovative Determinants of Human Capital Management. *Marketing and Management of Innovations*, 2, 255-267. https://doi.org/10.21272/mmi.2022.2-23

Seguer, Z.S., & Hasna, A.M. (2022). Business Intelligence as a Challenge for the Managerial Function: Case Study on Managerial Decision Making in Algerian Companies. *Business Ethics and Leadership, 6*(3), 35-46. https://doi.org/10.21272/bel.6(3).35-46.2022

Shazly, M. A., AbdElAlim, K., Mortaky, A. N., & Sayed, M. N. (2022). The Impact of Corporate Governance and Audit Quality on the Investment Decision. *Financial Markets, Institutions and Risks, 6*(3), 5-12. https://doi.org/10.21272/fmir.6(3).5-12.2022

Shvindina, H., Veckalne, R., Balahurovska, I., & Khrin N. (2022). Development Features and Directions of Modern Management: In the Case of Ukrainian Health Care Institutions. *Health Economics and Management Review*, 3(1), 19-24. https://doi.org/10.21272/hem.2022.1-02

Siqueira Lobo, C. S. (2022). *A Correlational Analysis of the Factors Influencing the Transfer of Research and Development to Entrepreneurs. In Mathematical, Computational Intelligence and Engineering Approaches for Tourism, Agriculture and Healthcare* (pp. 315-327). Springer Singapore.

Skrynnyk, O. , & Vasilyeva, T. (2020). Comparison of open learning forms in organizational education. *Paper presented at the CEUR Workshop Proceedings*, 2732 1314-1328. Retrieved from http://ceur-ws.org/

Swiatkiewicz, O. (2022). Subsidiarity in Management & Business Activity: The Two Sides of the Phenomenon. *Business Ethics and Leadership, 6*(3), 77-91. https://doi.org/10.21272/bel.6(3).77-91.2022

Taylan, O., Alkabaa, A. S., & Yılmaz, M. T. (2022). Impact of COVID-19 on G20 countries: Analysis of economic recession using data mining approaches. *Financial Innovation, 8*(1) doi:10.1186/s40854-022-00385-y

Urban, B., & Mapula-e Lehasa, O. (2022). Investing in a social venture to generate social impact or financial return. *Business Perspectives and Research*. doi:10.1177/22785337221132614

Vasilyeva, T., Kuzmenko, O., Kuryłowicz, M., & Letunovska, N. (2021). Neural network modeling of the economic and social development trajectory transformation due to quarantine restrictions during covid-19. *Economics and Sociology*, 14(2), 313-330. doi:10.14254/2071-789X.2021/14-2/17

Vidic, F. (2022). Knowledge asset as competitive resource. *SocioEconomic Challenges, 6*(4), 8-20. https://doi.org/10.21272/sec.6(4).8-20.2022

Xu, F., Lu, X., & Zhao, X. (2022). The implications of socially responsible retailing platform on channel structure choice and product quality decisions. *Sustainability (Switzerland), 14*(9) doi:10.3390/su14095691

Yang, C., Kwilinski, A., Chygryn, O., Lyulyov, O., & Pimonenko, T. (2021). The green competitiveness of enterprises: Justifying the quality criteria of digital marketing communication channels. *Sustainability (Switzerland)*, 13(24) doi:10.3390/su132413679

Yang, H., Wang, S., Ren, Z., Liu, H., Tong, Y., & Wang, N. (2022). Life expectancy, air pollution, and socioeconomic factors: A multivariate time-series analysis of Beijing city, China. *Social Indicators Research, 162*(3), 979-994. doi:10.1007/s11205-021-02872-8

Yang, Q., Gao, S., Lin, J., Lyu, K., Wu, Z., Chen, Y., & Chen, M. (2022). A machine learning-based data mining in medical examination data: A biological features-based biological age prediction model. *BMC Bioinformatics, 23*(1). doi:10.1186/s12859-022-04966-7

Yousaf, I., Riaz, Y., & Goodell, J. W. (2022). Energy cryptocurrencies: Assessing connectedness with other asset classes. *Finance Research Letters*. doi:10.1016/j.frl.2022.103389

Zhang, G., Bateni, S. M., Jun, C., Khoshkam, H., Band, S. S., & Mosavi, A. (2022). Feasibility of random forest and multivariate adaptive regression splines for predicting long-term mean monthly dew point temperature. *Frontiers in Environmental Science, 10* doi:10.3389/fenvs.2022.826165.