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Developing a Composite Socio-Economic Resilience Index for Enterprises: Assessing the Role of Human Capital Indicators under Crisis Conditions

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ABSTRACT:
In times of crisis, the level of economic activity of companies and the ability to maintain social sustainability in terms of retaining human resources significantly decrease. The purpose of the research was to develop a composite index of socio-economic resilience of enterprises, taking into account indicators of human capital development. The methodology is based on a statistical analysis of indicators of socio-economic resilience of companies in EU member states in 2018–2023. The index method was used to calculate the socio-economic resilience index of enterprises in EU member states in 2018–2023. The results demonstrate a reduction in the level of ability to productively manage resources and retain human resources by enterprises in EU member states during and after the crisis. The closure of businesses during the 2020 economic downturn led to a reduction in employment in industry, construction, and the service sector. The social resilience of enterprises in the EU decreased in 2021–2023 in terms of labor productivity, the ability to retain personnel, and the provision of social benefits. As a result of the decrease in the social resilience in 2021–2023, the level of economic resilience of enterprises decreased in terms of value added per employee and value added in net income of European companies. The calculated composite index of socio-economic resilience of enterprises in the EU indicates a decrease in the ability to conduct productive activities from an average level in the pre-crisis and crisis periods of 2018–2021 to a low level in the post-crisis period of 2022–2023.

Keywords: socio-economic resilience, enterprise resilience, composite index, human capital indicators, resilience measurement, economic performance.

1. Introduction

Over the past ten years, there has been an increase in the frequency of crises on a national and global scale, which causes labor migration and changes in the structure of employment. Traditionally, crises lead to the closure and liquidation of even the most stable and adaptive enterprises, and personnel are forced to change their place of work and develop new skills for further employment.

In times of economic downturn and increasing uncertainty, maintaining the socio-economic sustainability of enterprises is a challenging task. On the one hand, companies are forced to accumulate resources and form reserves to cover potential losses in the face of constantly increasing operating costs. On the other hand, it is important to retain highly qualified personnel and develop human capital, which leads to an increase in labor costs.

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Human resources are considered one of the most important elements of resilience and an asset, a resource of organizations that determines their adaptive capacity (Boufounou et al., 2022). The knowledge, skills and abilities (human capital) possessed by the company's personnel become a significant factor in generating enterprise income and ensuring the productivity of activities (Kwiecień, 2022). In this regard, there is growing scientific interest in the issues of ensuring the resilience of the economic structure of enterprises and the retention and development of human resources (Lim et al., 2020).

The purpose of the research is to develop a composite index of socio-economic resilience of firms, taking into account indicators of human capital development.

2. Literature Review

2.1. The essence of human capital and the socio-economic resilience of enterprises in times of crisis

Social, economic and organizational resilience refers to the ability of a system to withstand shocks and recover from them, while sustainable development is a strategy for long-term balanced progress without resource depletion. Social resilience is defined as the ability of society and individual communities to maintain cohesion, support vulnerable groups and overcome stress or shocks; economic resilience is defined as the ability of the economic system of a region, state or company to withstand financial shocks and quickly recover; organizational resilience is defined as the ability to prepare for threats, respond to them and operate continuously during crises. At the same time, human capital is the main driver of resilience, as it ensures adaptability, innovation and rapid recovery of an organization or system during emergencies.

At the macro level, human capital is considered in economic science as a set of unique human competencies or traits, personal properties, which are expressed in specific knowledge, abilities and skills. At the micro level, human competencies are determined by the factors of income formation of the firm and each employee. Education determines the quality of human capital; therefore, investments in training have become an integral part of modern human resource management in enterprises (Kwiecień, 2022).

The resilience of enterprises is defined as their ability to recover and adapt to the risks of the external environment that arise in crisis conditions (Müller, 2024; Tsiapa & Batsiolas, 2019; Lim et al., 2020). Organizational resilience is also defined in terms of resistance, confrontation with threats. Therefore, (Li et al., 2022) interpret organizational resilience as the ability of an organization to withstand adverse unforeseen circumstances and subsequent recovery after them. A similar position is held by (Annarelli & Nonino, 2016), who interpret organizational resilience as the ability to withstand various types of shocks, disasters, and respond quickly to changes in the external environment using crisis management tools and recovery after a crisis. A new perspective on organizational resilience is offered by (Őri et al., 2024): the authors consider the concept from the perspective of a set of companies' abilities to adapt in a high-risk environment. A similar approach allows combining the concepts of human capital and enterprise resilience through the set of knowledge and skills that entrepreneurs or company managers possess for effective crisis management. In turn, effective crisis management is possible through the development of specific personnel skills that are important for ensuring resilience.

Economic sustainability at the organizational level is considered in the theory of crisis management, risk management (Müller, 2024; Toufaily & Zalan, 2023), strategic management and operational management (Annarelli & Nonino, 2016), human resources management (Kwiecień, 2022). The micro-level approach identifies economic sustainability with the set of decisions taken by enterprises to overcome the risks of demand reduction in crisis conditions and maintain the functionality of the economic structure (Şerban & Mitrică, 2024).

In 2006, Perringson proposed the concept of economic resilience in close connection with the concept of sustainable development as the ability to withstand market or environmental shocks while maintaining the ability to efficiently use resources or provide essential services. The combination of these concepts has become increasingly relevant after the crises of 2008–2009, the coronavirus crisis of 2020 and since the beginning of the Russian-Ukrainian war in 2022. Many companies began to develop strategies to reduce losses in times of crisis and switched to the application of sustainable business development practices (Kaftan et al., 2023). The development of leadership skills and talents, retention and development of personnel through training programs has become a necessity to ensure the survival and adaptation of firms to crises.

The article (Alessi et al., 2020) proposes a new concept of sustainability in terms of economic and social indicators that are important in crisis conditions. The concept encompasses relevant aspects of economic efficiency and ensuring social welfare. Thus, a more parsimonious approach to understanding economic sustainability is replaced by a new approach that takes into account important social variables.

2.2. The role of human capital in supporting the socio-economic stability of enterprises in times of crisis

One of the most important strategic resources of enterprises in times of crisis is human resources, which possess knowledge, skills, and abilities in certain functional areas of the firm's activity. The totality of the above components of human capital is the most important in the management of enterprises. In this regard, the main elements of enterprise stability should be supplemented with social resilience as the ability to maintain human resources and develop human capital in times of crisis (Table 1).

Table 1: Key elements of enterprise resilience

Element of resilience	Features
Strategic resilience	The ability of an enterprise to create strategic competitive advantages that allow it to maintain resilience in times of crisis and adapt to new risks
Operational resilience	The ability of the enterprise to continue its ongoing operational activities in times of crisis
Financial resilience	The ability of the enterprise to maintain optimal capital and cash flows in times of crisis
Economic resilience	The ability to effectively and rationally manage the company's available resources in times of crisis*
Social resilience	The ability of an enterprise to retain human resources and develop human capital in times of crisis*

Source: improved by the author based on Müller (2024).

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Note: * highlighted by the author

As noted by (Sabatino, 2016), individual elements of the resilience of an enterprise's production system to a crisis are knowledge, education and training, and the social capital of enterprises. In their work, Boufounou et al. (2022) define the ability to strengthen human resources and skills as one of the characteristics of enterprises that strive to maintain their vital activity in times of crisis. Human resources are defined as an element of the concept of organizational resilience, directly related to sustainable development and achievement of economic results of firms (Boufounou et al., 2022). In turn, organizational resilience affects the resilience of human capital (Xu et al., 2024).

The level of resilience of enterprises to crises depends on the size of the companies and their human resources. Small and medium-sized enterprises are more vulnerable to shocks due to the lower level of human resources (Őri et al., 2024). The publication (Giannakis & Bruggeman, 2017) empirically proves the impact of education and investment in education on the resilience of large and small economies in Europe. At the same time, investment in education increases the spatial homogeneity of economies in Europe in terms of their ability to respond to economic shocks.

A study of the impact of the Great Recession after 2007–2008 on labor market resilience shows that the crisis had little impact on the employment of highly educated workers (Simões et al., 2023). In contrast, labor markets with employed workers with low educational attainment were less resilient to the effects of the crisis (Simões et al., 2023).

Another study demonstrates the interrelation between intellectual capital, which includes human capital, and the resilience of Iraqi enterprises during the 2007–2008 crisis (Daou et al., 2019). The scientific article is the first to identify a direct relationship between the human capital of marine tourism enterprises in Australia and Thailand and the socio-economic and managerial resilience of enterprises (Biggs et al., 2015).

According to findings (Cueto et al., 2021), in Spain, young self-employed professionals and workers with lower levels of informal human capital were the most vulnerable in the 2020 coronavirus crisis. Startups with such professionals had the least chance of surviving the restrictions and economic downturn. The survival rate of new self-employed individuals in different regions of Spain was estimated at 53% (Cueto et al., 2021). A study of the experience of micro and small enterprises in Cyprus and Greece in overcoming the consequences of the 2008-2008 crisis points to the central role of human qualities in overcoming difficulties: skills, initiatives and the created partnership networks between firms (Sakellarios et al., 2022).

It is obvious that the contribution of human capital has separate dimensions: the operational dimension, which involves flexibility of responsibilities, rapid problem-solving based on experience and optimization of resources; the strategic dimension, which includes scenario planning, effective decision-making and innovativeness of changes; and the socio-psychological dimension, which involves the concepts of psychological resilience, mutual assistance and trust, effective communication.

3. Materials and Methods

The composite index of socio-economic resilience of enterprises is a general indicator of social and economic indicators of enterprises' activities, which reflect the level of sustainability in crisis conditions. Social indicators characterize the ability of enterprises to maintain labor resources in crisis conditions and develop human capital at the micro level. At the same time, social variables affect the productivity of companies.

For the purpose of selecting indicators of the socio-economic resilience of enterprises, the criteria of accessibility, objectivity, transparency, relevance, and measurability of data were applied. Given the significant negative impact of the coronavirus pandemic and the war in Ukraine on EU enterprises, a sample of industrial, construction, and trade enterprises of EU member states was selected to study socio-economic resilience, taking into account the criteria for selecting indicators. Data for calculating indicators were collected from the Eurostat database "Structural Business Statistics" (Eurostat, 2024, 2025). Indicators are calculated based on average values for the EU for the period 2018–2023 (Table 2).

Table 2: System of indicators for calculating the composite index of socio-economic resilience of enterprises

Type of indicator	Indicators
Social resilience	The number of employed workers per enterprise (person) indicates the economic activity of enterprises, which generates income, productivity The employment growth index at enterprises (%) reflects the ability of enterprises to retain employees in times of crisis Appeared labor productivity (thousands of euros) reflects the added value per employed worker at enterprises Labor productivity adjusted for wages (%) reflects the percentage of coverage of labor costs by the added value created at enterprises The average wage per employed worker at an enterprise (thousands of euros per year) characterizes the material motivation of work The wage index for employed workers (%) characterizes the ability to retain personnel at the expense of the main income and the provision of benefits during the crisis
Economic resilience	Value added per employee (thousand euros) as a basic indicator of resilience in crisis conditions Net turnover (revenue) per employee in an enterprise (thousand euros) reflects the ability to maintain operations in conditions of employment reduction Operating profitability (gross operating income to net income) (%) characterizes the ability to maintain the operational activities of enterprises in crisis conditions The ratio of value added to net turnover (%) reflects the role of human resources in the operational activities of enterprises Labor costs per employee (thousand euros) characterize the cost of human resources for the enterprise The ratio of labor costs to value added (%) characterizes the vulnerability of enterprises to the increase in labor costs in the crisis, the distribution of created value between labor and capital, and the dependence of business on human resources

Source: compiled by the author

Descriptive statistics of indicators of socio-economic enterprises' resilience in 27 EU member states in 2018–2023 were used for a general statistical analysis of business resilience (mean, minimum, maximum value, range, variation, dispersion). The index

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calculation method was used as the basis for developing a composite index of socio-economic resilience of enterprises. The index method is based on relative indicators of enterprise resilience and is effective for comparing changes in socio-economic resilience before, during and after the crisis. The index method allows for the generalization of social and economic variables into a single composite indicator. For the purpose of calculating the composite index of socio-economic resilience of enterprises, the input values of the indicators are normalized by the average value and the minimum and maximum values (range):

$$z_{ij} = \frac{x_{ij} - x_{ij(min)}}{x_{ij(max)} - x_{ij(min)}}.$$

The specified normalization method makes it possible to unify indicators on a scale [0; 1]; it takes into account intertemporal comparisons and reflects the resilience of companies in crisis conditions. At the same time, the extreme limits (range) of indicators of socio-economic resilience of European firms were characterized by a moderate level of volatility. At the last stage, the normalized values of the variables were combined into a composite index based on the calculation of the arithmetic mean value. In order to interpret the results of the calculated index values, a three-level measurement scale was used: 0 – 0.33 – low level of resilience, 0.34 – 0.66 – medium level of resilience, above 0.67 – high level of resilience.

For the purpose of identifying the links between the social and economic sustainability of enterprises, a correlation analysis of the normalized values of the indicators of the socio-economic resilience of enterprises in the EU-27 member states was conducted based on data from 2018–2023. The correlation coefficients were calculated based on Pearson statistics, the significance of which was tested using p-value (significance level 1% and 5%).

The construction of a composite index using normalization, equal weighting, and arithmetic mean is justified by mathematical simplicity, conceptual transparency, and minimizing the subjective impact on the data. The normalization procedure involves bringing it to proportionality, ensuring comparability, and eliminating asymmetry of direction. Assigning equal weight to all subindices or indicators is a standard approach in the absence of convincing reasons or objective data for another. At the same time, if there are no theoretical or empirical grounds to consider one indicator more important than another, the only neutral solution is to recognize them as equivalent. Equal weighting allows for transparency, minimizing subjectivity, and reducing statistical sensitivity. Mathematically, the arithmetic mean allows low results in one indicator to be fully compensated for by high results in another, assuming the additivity of properties. The method is resistant to minor data fluctuations, does not require complex transformations, and is easy to interpret.

It should be noted that changing methodological decisions almost always significantly changes the final classifications and sustainability ratings. In particular, equal weighting often hides real imbalances. If the principal component method or budget allocation is used instead of equal weights, the weight of critical environmental triggers

may increase. Objects that were kept in the top only due to one strong indicator will instantly change their sustainability class to a lower one.

Sensitivity analysis was performed by testing the weighting system (weight levels are replaced by alternative ones), testing the aggregation method (linear arithmetic mean is replaced by geometric mean, which limits compensatory), and by testing the normalization scheme, when the Min-Max method is replaced by standardization or ranking.

4. Results

The economic downturn in the EU member states led to a reduction in the level of economic activity of enterprises in 2020. The number of employees per enterprise decreased in 2020–2021, as a result of a decrease in the number of operating firms and a decrease in the level of employment. Therefore, the employment growth index for 2020 confirms a decrease in the level of employment of labor resources at enterprises within the EU. In 2021–2023, there is a significant increase in the number of employees, the recovery of economic activity of companies (Table 3). The labor market in the EU remains sensitive to the crisis, and its recovery is mainly compensatory, rather than structural in nature.

Table 3: Dynamics of indicators of social resilience of enterprises in EU member states in 2018–2023

Indicator	2018	2019	2020	2021	2022	2023	Absolute deviation 2023-2018 (+/–)
Number of employees per enterprise (persons)	5.70	5.68	5.46	5.03	4.97	4.90	–0.79
Employment growth index in enterprises (%)	1.03	1.02	0.97	1.22	1.03	1.01	–0.02
Apparent labor productivity (thousand euros)	76.20	83.90	79.50	59.84	62.65	64.50	–11.70
Wage-adjusted labor productivity (%)	162.93	142.60	139.90	153.73	152.67	148.18	–14.75
Average salary per employee in the enterprise (thousand euros per year)	23.70	24.50	24.32	25.62	27.07	28.86	5.16
Wage index for employed workers (%)	1.06	1.05	0.96	1.29	1.09	1.08	0.02

Source: calculated by the author based on (Eurostat, 2024; 2025)

The apparent labor productivity of enterprises in EU member states reduced during periods of decreased socio-economic resilience of companies by 11.70 thousand euros in 2018–2023. The economic efficiency of using labor resources decreased significantly in 2021, which is due to the decrease in employment in the previous year; the amount of value added created per employee in the current year significantly decreased. In

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post-crisis conditions, firms are characterized by a reduced level of ability to generate value added.

The observed declines in business activity can be confidently attributed to crises if a methodology for isolating crisis signals is integrated into the comprehensive index. The main challenge is to distinguish a systemic crisis from institutional noise, seasonal fluctuations, or the consequences of managerial errors.

Wage-adjusted labor productivity decreased by 14.75% in 2018–2023. The largest decline in the resilience indicator occurred in 2020, which indicates a short-term, rapid impact of the decline in business economic activity on its ability to maintain productivity. Such dynamics are due to a decrease in value added and, at the same time, an increase in labor costs in enterprises in the EU member states. Thus, value added at factor costs decreased by 5.19% in 2020, compared to the pre-crisis year of 2019. Labor costs decreased by 3.19% in 2020, compared to 2019. In 2022–2023, labor costs grew at a faster pace compared to value added (Figure 1).

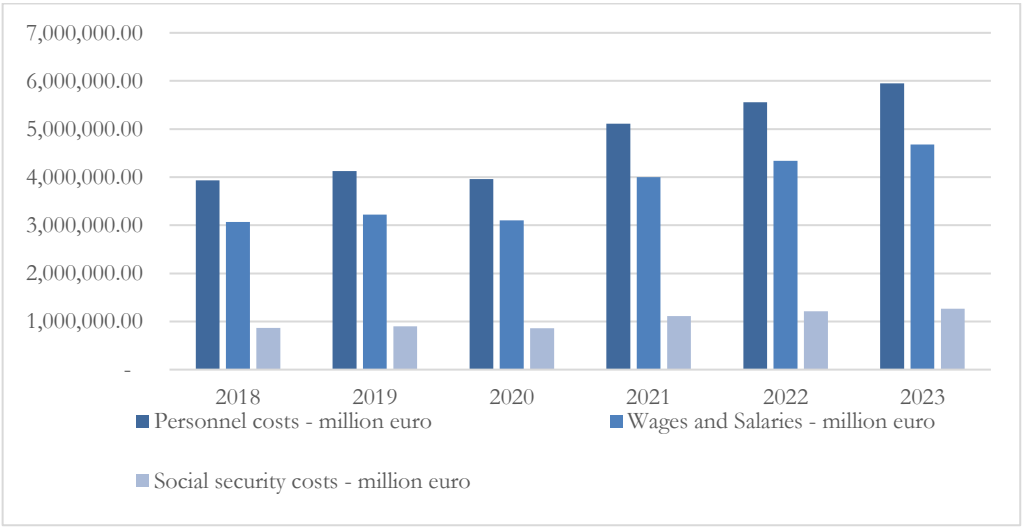

Figure 1: Dynamics of labor costs in EU member states in 2018–2023
Source: calculated by the author based on (Eurostat, 2024; 2025)

The stable positive dynamics of the average wage per employee in 2018–2023 demonstrates support for the material motivation of enterprises' labor resources, with a slight decrease only in 2020. The wage index decreased in 2020 with a subsequent recovery against the background of employment growth.

Indicators of economic resilience of companies in EU member states demonstrate a decrease in the ability to maintain sustainability in creating added value. In 2018–2023, added value per employee decreased by 22.16 thousand euros. The decrease in the level of resilience of European business is indicated by the drop in net turnover per employee to 194.10 thousand euros in 2020, compared to 2019. In 2021–2023, firms are increasing net income; that is, a restoration of business operating capacity is observed. At the same time,

in terms of operating profitability, companies in the EU are characterized by a high level of ability to maintain operating activities in crisis conditions. This trend is due to both a slight decrease in net revenue from core activities and an insignificant decrease in gross operating income of enterprises in 2020.

Table 4: Dynamics of economic resilience indicators of enterprises of EU member states in 2018–2023

Indicator	2018	2019	2020	2021	2022	2023	Absolute deviation 2023-2018 (+/–)
Value added per employee employed (thousand euros)	98.70	106.60	103.10	71.15	74.33	76.54	–22.16
Net turnover (revenue) per employee employed in the enterprise (thousand euros)	199.52	201.40	194.10	206.06	238.36	237.36	37.84
Operating profitability (%)	10.22	10.30	10.23	13.15	11.77	11.72	1.49
Value added to net turnover ratio (%)	497.93	529.19	531.10	345.36	311.50	322.43	–175.50
Labor costs per employee (thousand euros)	29.74	36.50	36.40	25.62	27.04	28.86	–0.88
Ratio of labor costs to value added (%)	60.00	60.19	60.99	42.81	43.16	44.74	–15.26

Source: calculated by the author based on (Eurostat, 2024; 2025)

Labor costs per employee increased until 2020 inclusively, with a subsequent post-crisis decline in conditions of significant employment growth. The simultaneous decrease in labor costs per employee with an increase in the average wage per employee indicates structural changes in the formation of labor costs of enterprises in the EU. Indirect payments to employees have been reduced in European firms (mainly due to a decrease in the level of social benefits and surcharges), and labor payment mechanisms have changed towards an increase in direct income payments. Enterprises are optimizing their own fiscal workload on business in post-crisis conditions against the background of a decline in labor productivity. Optimization occurs by reducing the number of personnel, reducing social benefits, which allows maintaining the appropriate level of basic pay.

The decrease in the ratio of labor costs to value added by 15.26% in 2018–2023 characterizes the vulnerability of enterprises to the increase in labor costs in the crisis. In post-crisis conditions, there was a change in the distribution of created value in favor of the formed capital of companies. The significant dependence of business on human resources before the crisis required a revision of such policies in crisis conditions. Such dependence led to a reduction in the investment capacity of enterprises. As a result, during the crisis, the diversion of financial resources to finance labor costs prevented firms from investing in assets that would support operational activities and productivity growth with lower employment. The decrease in the share of labor costs in value added after the crisis indicates an increase in the level of financial capacity of firms to support their activities. Overall, such structural changes demonstrate an increase in economic resilience and adaptive capacity in the post-crisis conditions of enterprises in the EU.

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Descriptive statistics of indicators and normalized values of variables of socio-economic resilience of enterprises in the EU are given in Annexes A and B. Descriptive statistics demonstrate significant differences between enterprises in the EU in 2018–2023 in terms of apparent labor productivity and labor productivity adjusted for wages (high variation and range). Insignificant temporal differences were found between enterprises in terms of average wages per employee employed. Economic sustainability indicators changed dynamically in 2018–2023.

Given the variation and range of indicators of socio-economic resilience of enterprises, correlation analysis was conducted on the basis of normalized values of variables (Annex C). A high direct degree of significant relationship was found between the number of employees per enterprise and apparent productivity (0.911), employment growth rates and wage growth rates (0.975). A high level of inverse relationship was found between the number of employees per enterprise and average wage per employee at the enterprise (–0.882). Social and economic sustainability variables are directly related to each other. A high degree of direct significant relationship was found between value added per employee and indicators of employment in the enterprises, labor productivity. A high direct relationship exists between net turnover per employee and average wage per employee. Operating profitability and labor productivity at enterprises, wage growth rate are closely related. At the same time, inverse relationships exist between the operating profitability of firms and the number of employees per enterprise, and value added per enterprise. A similar relationship is due to the reduction in employment and value created at firms in 2018–2023. The share of value added in the net turnover of firms is closely related to employment, productivity, total labor costs.

The calculated composite index of socio-economic resilience of enterprises in the 27 EU member states indicates an average level of their resilience in 2018–2020 (before the crisis), a slight reduction in the level of resilience during the crisis (2020), and a decrease in the level of resilience in the post-crisis period (2021–2023) to almost a low level (Figure 2).

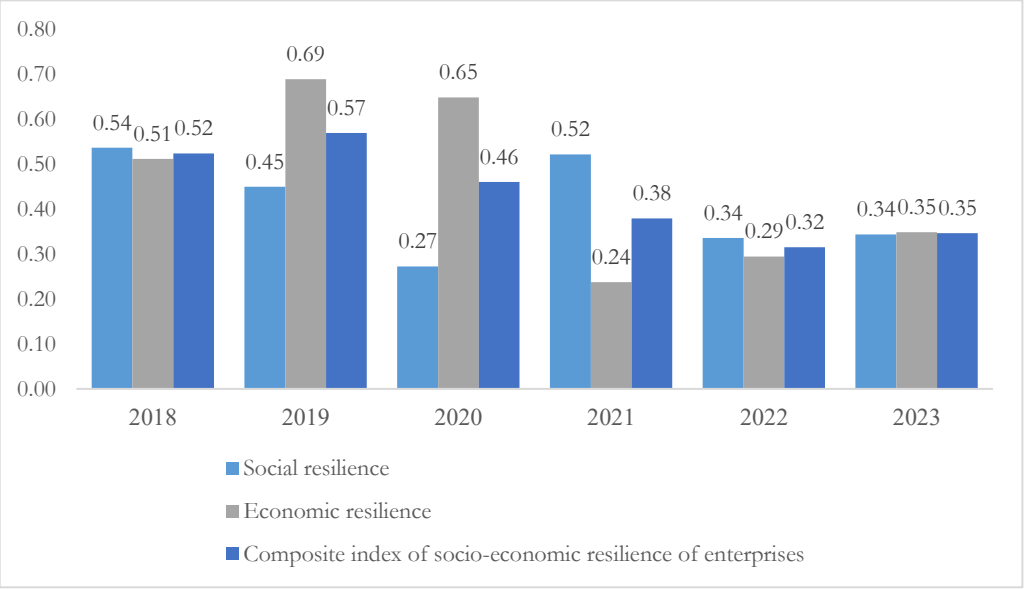

Figure 2: Dynamics of the composite index of socio-economic resilience of enterprises in the 27 EU member states in 2018–2023
Source: calculated by the author

At the same time, before the crisis, both social and economic resilience were at the mean level. During the crisis, social resilience decreased to a low level, while economic resilience remained at the mean level. In the post-crisis period, social resilience declined, especially in 2022–2023. Firms in the EU also failed to restore social resilience to an average level in 2022–2023.

The composite index is interpreted mainly at the EU aggregated level, which is a certain limitation, since national, industry and size differences of firms may not be taken into account. The data aggregation method is a determining factor in modeling sustainability, since it directly transforms the initial human capital metrics into management decisions and determines the sensitivity of the final index. Its main consequences for assessing human capital are the masking effect, when linear aggregation allows high financial results to compensate for critical staff turnover or burnout, creating the illusion of stability; sensitivity to weights and potential loss of information (the transition from primary metrics to a single index eliminates the specificity of the personnel crisis, making it impossible to provide a point-based anti-crisis response). To prevent these consequences, it is advisable to use two-level aggregation and conduct a sensitivity analysis, necessarily testing the index for resistance to changes in normalization and aggregation methods.

According to forecasts (Schulze et al., 2025), in 2025, small and medium-sized enterprises in the EU, as the basis of the Union economy, will resume their activities in terms of real value added by 1.6%, and employment growth by 0.9%. Such dynamics indicate the resilience of businesses to crisis phenomena. At the same time, smaller

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companies in Europe have been more negatively affected by the coronavirus crisis, and the economic activity of companies has changed in favor of enterprises that were characterized by a higher level of productivity before the crisis (Bruhn et al., 2023). That is, enterprises with a higher level of labor productivity have higher economic activity; they are more resistant to economic downturns.

Firms in the EU that were most affected by the crisis received significant policy support from governments (Harasztosi et al., 2022). The support had a significant impact on employment and productivity dynamics, the decline of which was contained thanks to policy measures (investment in digital technologies of enterprises, public loans and credits, debt moratoriums, wage subsidy schemes, subsidies and targeted grants) (Harasztosi et al., 2022).

According to the European Foundation for the Improvement of Living and Working Conditions database (Eurofound EU PolicyWatch, n.d.-a), 158 public support measures have been developed for SMEs in EU Member States since the beginning of the pandemic in 2020. Direct subsidies were provided by governments in Poland, Portugal, France, Ireland, Italy, Germany, Belgium, Hungary, Bulgaria, the Netherlands and other countries (Eurofound EU PolicyWatch, n.d.-b). In Poland, SMEs could receive subsidies of 70% of gross pre-tax losses in November 2020 – April 2021, provided that net turnover decreased by more than 30% (Eurofound, 2020c). In total, the Polish government allocated PLN 6.5 billion in direct subsidies to businesses. The Netherlands provided fixed cost subsidies to agricultural and horticultural companies and fixed cost subsidies to SMEs between January 2020 and November 2021 (Eurofound, 2021). The Austrian government created a nationwide SME relief fund in response to business closures and a drop in revenues of more than 25%. Regional state support was provided in the form of non-repayable grants (de minimis grants). The funding was based on the fixed costs of small businesses over three months of 2020 and covered 25% of the fixed costs (Eurofound, 2020d). In Belgium, temporary direct support was provided to small firms in the form of grants of €4,000 in 2020. In addition, the Belgian government offered other support measures: loans at lower interest rates and government guarantees (Eurofound, 2020b). In Spain, small firms with more than 20 employees received direct subsidies of up to 100% of the negative cash flow (Eurofound, 2020a). This explains the slight decrease in net turnover per employee in EU Member States in 2020 compared to 2019.

5. Conclusions

In 2018–2023, the level of socio-economic resilience of enterprises in the EU countries decreased due to the closure of enterprises, reduction of employment in industry, construction, and the service sector due to restrictions on business activity in 2020. The spread of coronavirus in the EU countries led to a decrease in the level of social resilience of firms and their ability to retain staff. Enterprises were forced to reconsider their human resource retention strategies in the direction of reducing social benefits while maintaining the main remuneration in the structure of labor costs. The decrease in employment in 2020 led to a decrease in labor productivity during the crisis and post-crisis period of business activity in Europe. As a result of the decline in social resilience in 2021–2023, there was a

decrease in the level of economic resilience of enterprises in terms of value added per employee and value added in net income of European firms.

Studies assessing the role of human capital in the resilience structure confirm, extend and partially question certain classic empirical data on European enterprises. New models of resilience indices prove the basic theses of European econometrics: that a high level of key personnel retention during a crisis is directly correlated with the speed of enterprise recovery, that a key role is assigned to specific skills, and there is also a "buffer" effect, when high qualifications of management and line personnel minimize transaction costs in the first months of the shock. Previous European studies were often based on the crises of 2008 or 2011. The development of indices in this study (taking into account the experience of COVID-19, the energy crisis and geopolitical shocks in Europe) significantly expands the understanding of human capital, noting digital adaptability, inclusiveness, cognitive capital. At the same time, some classic postulates of European management in conditions of permanent crisis are not confirmed. In particular, it is about refuting the cost paradigm (the classic optimization approach destroys sustainability in the long term, while companies that increased staff support during the crisis outperformed their competitors at the plateau stage). The positioning of formal education as a key indicator of capital quality is also refuted - today it is a secondary factor compared to upskilling.

As a result of the overall decline in the socio-economic resilience of enterprises, structural changes occurred in the formation of companies' labor costs towards a decrease in indirect payments to employees. Enterprises applied strategies to optimize labor costs to increase the level of investment capacity and capital accumulation to support activities after the crisis. In general, the calculated composite index of socio-economic resilience of enterprises in the EU indicates a decrease in the capacity to conduct productive activities from an average level in the pre-crisis and crisis periods of 2018–2021 to a low level in the post-crisis period of 2022–2023. The scientific contribution of the study is to substantiate and create an integral toolkit for assessing the ability of a business to adapt to crisis conditions through prioritizing the characteristics of labor potential. At the same time, a rethinking of resilience, conceptualization of relationships, and transformation of the role of capital were noted. Future research should be devoted to testing the index at different levels, as well as studying the resilience of the index during different crisis periods and recovery periods.

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Annex A

Descriptive statistics on indicators of socio-economic resilience of enterprises in the EU-27 member states according to data from 2018–2023

Indicator	Mean value	Standard error	Standard deviation	Variation	Scope	Minimum value	Maximum value
Social resilience							
Number of employees per enterprise (persons)	5.29	0.15	0.36	0.13	0.79	4.90	5.70
Employment growth index in enterprises (%)	1.05	0.04	0.09	0.01	0.25	0.97	1.22
Apparent labor productivity (thousand euros)	71.10	4.09	10.02	100.43	24.06	59.84	83.90
Wage-adjusted labor productivity (%)	150.00	3.41	8.34	69.64	23.03	139.90	162.93
Average salary per employee in the enterprise (thousand euros per year)	25.68	0.80	1.96	3.85	5.16	23.70	28.86
Wage index for employed workers (%)	1.09	0.04	0.11	0.01	0.33	0.96	1.29
Economic resilience							
Value added per employee employed (thousand euros)	88.40	6.56	16.06	257.92	35.45	71.15	106.60
Net turnover (revenue) per employee employed in the enterprise (thousand euros)	212.80	8.08	19.79	391.58	44.26	194.10	238.36
Operating profitability (%)	11.23	0.49	1.19	1.42	2.93	10.22	13.15
Value added to net turnover ratio (%)	422.92	43.65	106.91	11430.19	219.60	311.50	531.10
Labor costs per employee (thousand euros)	30.69	1.91	4.68	21.93	10.88	25.62	36.50
Ratio of labor costs to value added (%)	51.98	3.77	9.24	85.40	18.18	42.81	60.99

Annex B

Normalized (z-scores) values of indicators of socio-economic resilience of enterprises in the EU-27 member states according to data from 2018–2023*

Indicator	2018	2019	2020	2021	2022	2023
Social resilience						
Number of employees per enterprise (persons)	1.00	0.97	0.70	0.16	0.09	0.00
Employment growth index in enterprises (%)	0.25	0.18	0.00	1.00	0.23	0.16
Apparent labor productivity (thousand euros)	0.68	1.00	0.82	0.00	0.12	0.19
Wage-adjusted labor productivity (%)	1.00	0.12	0.00	0.60	0.55	0.36
Average salary per employee in the enterprise (thousand euros per year)	0.00	0.15	0.12	0.37	0.65	1.00
Wage index for employed workers (%)	0.30	0.27	0.00	1.00	0.38	0.35
Average value of social resilience indicators	0.54	0.45	0.27	0.52	0.34	0.34
Economic resilience						
Value added per employee employed (thousand euros)	0.78	1.00	0.90	0.00	0.09	0.15
Net turnover (revenue) per employee employed in the enterprise (thousand euros)	0.12	0.16	0.00	0.27	1.00	0.98
Operating profitability (%)	0.00	0.03	0.00	1.00	0.53	0.51
Value added to net turnover ratio (%)	0.85	0.99	1.00	0.15	0.00	0.05
Labor costs per employee (thousand euros)	0.38	1.00	0.99	0.00	0.13	0.30
Ratio of labor costs to value added (%)	0.95	0.96	1.00	0.00	0.02	0.11
Average value of economic resilience indicators	0.52	0.57	0.46	0.38	0.32	0.35

*based on the scope given in Annex A

Annex C

Correlation analysis of normalized values of indicators of socio-economic resilience of enterprises in the EU-27 member states according to data for 2018–2023*

Correlations

		Number of employees per enterprise (persons)	Employment growth index in enterprises (%)	Apparent labor productivity (thousand euros)	Wage-adjusted labor productivity (%)	Average salary per employee in the enterprise (thousand euros per year)	Wage index for employed workers (%)	Value added per employee employed (thousand euros)	Net turnover (revenue) per employee employed in the enterprise (thousand euros)	Operating profitability (%)	Value added to net turnover ratio (%)	Labor costs per employee (thousand euros)	Ratio of labor costs to value added (%)
Number of employees per enterprise (persons)	Pearson Correlation	1	-0.347	.911*	-0.027	-.882*	-0.482	.933**	-0.800	-.830*	.947**	0.705	.948**
	Sig. (2-tailed)		0.500	0.012	0.959	0.020	0.333	0.007	0.056	0.041	0.004	0.117	0.004
Employment growth index in enterprises (%)	Pearson Correlation	-0.347	1	-0.602	0.399	0.019	.975**	-0.582	-0.068	0.809	-0.430	-0.650	-0.543
	Sig. (2-tailed)	0.500		0.206	0.433	0.972	0.001	0.225	0.898	0.051	0.395	0.162	0.265

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Apparent labor productivity (thousand euros)	Pearson Correlation	.911*	-0.602	1	-0.397	-0.699	-0.711	.995**	-0.679	.919**	.958**	.927**	.966**
	Sig. (2-tailed)	0.012	0.206		0.435	0.122	0.113	0.000	0.138	0.010	0.003	0.008	0.002
Wage-adjusted labor productivity (%)	Pearson Correlation	-0.027	0.399	-0.397	1	-0.066	0.429	-0.344	0.121	0.236	-0.294	-0.707	-0.240
	Sig. (2-tailed)	0.959	0.433	0.435		0.901	0.396	0.505	0.819	0.653	0.571	0.116	0.646
Average salary per employee in the enterprise (thousand euros per year)	Pearson Correlation	-.882*	0.019	-0.699	-0.066	1	0.211	-0.750	.924**	0.568	-.850*	-0.509	-0.801
	Sig. (2-tailed)	0.020	0.972	0.122	0.901		0.689	0.086	0.008	0.239	0.032	0.303	0.056
Wage index for employed workers (%)	Pearson Correlation	-0.482	.975**	-0.711	0.429	0.211	1	-0.706	0.138	.883*	-0.588	-0.749	-0.683
	Sig. (2-tailed)	0.333	0.001	0.113	0.396	0.689		0.117	0.794	0.020	0.220	0.086	0.135
Value added per employee employed (thousand euros)	Pearson Correlation	.933**	-0.582	.995**	-0.344	-0.750	-0.706	1	-0.726	-.925**	.978**	.905*	.987**
	Sig. (2-tailed)	0.007	0.225	0.000	0.505	0.086	0.117		0.102	0.008	0.001	0.013	0.000
Net turnover (revenue) per employee employed in the enterprise (thousand euros)	Pearson Correlation	-0.800	-0.068	-0.679	0.121	.924**	0.138	-0.726	1	0.471	-.853*	-0.571	-0.776
	Sig. (2-tailed)	0.056	0.898	0.138	0.819	0.008	0.794	0.102		0.346	0.031	0.237	0.069
Operating profitability (%)	Pearson Correlation	-.830*	0.809	-.919**	0.236	0.568	.883*	-.925**	0.471	1	-.849*	-.816*	-.919**
	Sig. (2-tailed)	0.041	0.051	0.010	0.653	0.239	0.020	0.008	0.346		0.033	0.047	0.009
Value added to net turnover ratio (%)	Pearson Correlation	.947**	-0.430	.958**	-0.294	-.850*	-0.588	.978**	-.853*	-.849*	1	.858*	.986**
	Sig. (2-tailed)	0.004	0.395	0.003	0.571	0.032	0.220	0.001	0.031	0.033		0.029	0.000
Labor costs per employee (thousand euros)	Pearson Correlation	0.705	-0.650	.927**	-0.707	-0.509	-0.749	.905*	-0.571	-.816*	.858*	1	.848*
	Sig. (2-tailed)	0.117	0.162	0.008	0.116	0.303	0.086	0.013	0.237	0.047	0.029		0.033
Ratio of labor costs to value added (%)	Pearson Correlation	.948**	-0.543	.966**	-0.240	-0.801	-0.683	.987**	-0.776	-.919**	.986**	.848*	1
	Sig. (2-tailed)	0.004	0.265	0.002	0.646	0.056	0.135	0.000	0.069	0.009	0.000	0.033	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).