APPLICATION OF HIERARCHICAL AGGLOMERATIVE CLUSTERING WITH THE TOPSIS METHOD FOR EVALUATING THE BUSINESS ENVIRONMENT IN EUROPEAN COUNTRIES DURING THE POST-PANDEMIC PERIOD

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Abstract. The economic growth of any country relies significantly on its business environment and entrepreneurship, particularly after overcoming a crisis such as the COVID-19 pandemic. This research paper employs macroeconomic indicators to compare the business environment across European Union (EU) countries, integrating cluster analysis with the TOPSIS method. The results revealed distinct clusters in the European business landscape, highlighting Germany as having the most favourable environment due to regulatory reductions and innovation promotion. France and Italy represent another cluster with advanced industrial status, while Hungary stands out with competitiveness shortcomings, suggesting the overall business climate may not be conducive for enterprises.

Keywords: business environment, European Union countries, COVID-19 pandemic, macroeconomic indicators, TOPSIS, cluster analysis.

JEL Classification: C38, F63, O11.

1. Introduction

Regular monitoring of the business environment helps businesses recognize new market opportunities and potential risks. Changing economic conditions, consumer behaviour, and regulatory environments can influence market dynamics (Dutta & Khurana, 2023). As highlighted by Fernandes et al. (2023), businesses must comprehend the competitive environment to position themselves effectively. Monitoring the tactics of competitors, market share, and innovations enables companies to adjust and distinguish their offerings in the marketplace. Additionally, monitoring indicators like GDP growth, inflation rates, and employment trends offers businesses a macroeconomic perspective. Understanding economic conditions is pivotal for companies to make informed decisions regarding investment, expansion, and resource allocation. The EU experienced a significant economic downturn due to the pandemic, leading to recessions in numerous member states. Economic activity decreased because of travel restrictions, lockdowns, and disruptions in several industries. The COVID-19 pandemic had an extensive impact on the business environment in the EU, which included both short-term challenges and long-term consequences. The ability of businesses to adapt, their resilience, and the effectiveness of policy responses played pivotal roles in determining recovery trajectories across various sectors and countries within the EU (Chen et al., 2020; Gandjour, 2022; Panazan et al., 2023).

Thus, the main aim of this paper is to evaluate the business climates across the EU nations, a political and economic union comprising 27 member nations primarily situated in Europe, by focusing on macroeconomic indicators, analysing the factors affecting business activities, and, subsequently, applying appropriate statistical techniques to validate the results. It is imperative to evaluate specific macroeconomic indicators within EU countries, as they provide a comprehensive perspective on the economic conditions within the nations forming the common market and facilitate a comparison of the significance of different countries within the same

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community. The research paper is focused on examining the business climate across a 6-year timeframe, with the pre-COVID years spanning 2017–2019 and the COVID-19 pandemic years covering 2020–2022. This evaluation involves the analysis of fundamental macroeconomic indicators, including gross domestic product (GDP), general government debt (GGD), direct foreign investment (FDI), inflation (I), unemployment (U), exports (EX), and imports (IM), utilizing the multi-criteria decision-making technique.

According to Tuysuz and Kahraman (2023), multi-criteria decision-making is a complex yet indispensable process. According to Sira et al. (2020), the technique for order performance by similarity to the ideal solution (TOPSIS) is one of the most used techniques for multiple objective decision-making, which is a crucial instrument in the present uncertain business environment and a useful method for ranking and choosing among a set of externally defined alternatives. Therefore, the TOPSIS method was used to evaluate the business climate in countries within the EU, giving priority to attributes that are important for the prosperous growth of prospective business operations. The results facilitated the identification of homogeneous clusters representing business conditions in EU countries. The study provides valuable insights by categorizing countries based on similarities in their business environments, thereby contributing to the enhancement of European market competitiveness and facilitating effective focus on international markets. Monitoring the business environment of EU countries is imperative for adapting to changes, recognizing opportunities, managing risks, and making well-informed business decisions. This practice enhances the overall resilience and competitiveness of businesses operating within the European Union.

The study has valuable insights by categorizing countries based on similarities in their business environments, providing a beneficial framework for enhancing competitiveness in the European market. The contribution of this paper lies in furnishing essential data to entrepreneurs and governments regarding the present condition of the business environment across EU countries after the COVID-19 pandemic. These insights would facilitate the development of policies and strategies that support economic recovery, recognize the competitive strengths and vulnerabilities of respective countries, and foster global collaboration in trade and innovation endeavors.

The paper is divided into several sections. The Theoretical Background provides a synopsis of recent and pertinent studies affirming the influence of the coronavirus pandemic on the business climate and the advancement of national competitiveness. The Data and Methodology section outlines the countries and factors under analysis, clarifying the methodological procedures used. The Results and Discussion section introduces the research outcomes, which are discussed within the framework of other pertinent studies published worldwide.

2. Theoretical background

The operational dynamics of individual businesses in the market are primarily determined by the business environment, which is summarized as a collection of influences that contribute to the establishment and growth of business entities as well as the sustainable development of national economies (Trang & Nam, 2020). Consequently, the generality of corporate decision-making methods and the overall quality of the business climate hold significant importance. Additionally, Kim (2022) underscored the fundamental role played by national entrepreneurship systems, which are influenced by opportunities at the individual level and regulated by institutional elements unique to each country. This conclusion was further clarified by Inacio Junior et al. (2021), emphasizing that national entrepreneurship systems should be considered a critical priority, facilitating effective resource allocation by entrepreneurs in national economies.

The examination of variations in economic growth across countries, exploring the interdependence between institutions and entrepreneurship within an ecosystem, has been investigated (Masca, 2017; Bilan et al., 2019; Hajduova et al., 2021; Szymczak et al., 2023). Additionally, the foremost predictor of expectations for economic growth is the initial size of the firm (Trang & Nam, 2020). A smaller government, financial stability, institutional quality, and start-up abilities are among the important determinants of productive entrepreneurship, according to Dutta and Khurana (2023). Kim (2022) and Fernandes et al. (2023) highlighted the necessity for labour market reforms and financial market deregulation to support the growth of high-performance ventures. The authors clarified the relationship between entrepreneurship and economic growth through the Global Entrepreneurship Index, which describes the distinctive characteristics of entrepreneurship in various countries (Inacio Junior et al., 2021).

Each country maintains its own unique internal policy, often referred to as the macro environment, wherein businesses lack the ability to create the conditions within the business environment (Valaskova & Nagy, 2023). The government functions as the crucial economic regulator, and all market-focused financial and administrative organizations are contingent upon its decisions (Belas et al., 2020). The industry-specific context represents a dominant environment wherein businesses focusing on competitive dynamics have the capacity to adjust their relations with suppliers and customers (Holl & Rama, 2023). Concurrently, the worldwide context, characterized by contemporary technologies, technological accessibility, and information and communication infrastructure, also enhances the opportunities for business development and production (Valaskova et al., 2022).

These studies may overlook the intricate connections and causalities between these macroeconomic indicators, even though they frequently examine correlations between indicators such as GDP, inflation, and

unemployment rates. Additionally, focusing only on traditional metrics might neglect emerging trends or fail to capture the whole complexity of modern business environments, including the impact of digitalization and climate change. Furthermore, differences in study methodology and data quality might induce biases and uncertainties, challenging the generalizability of findings. Thus, even if these studies provide some fundamental understanding, an in-depth examination of the macroeconomic influence on the business environment requires a more complete approach that considers broader contextual factors and methodological rigor.

The current global business environment is heavily influenced by globalization and constantly changing trends, as well as negative aspects, including the recent coronavirus pandemic (e.g., Meinen et al., 2021; Popescu et al., 2023; Valaskova & Nagy, 2023). Belas et al. (2020) conducted a study that verified that pinpointing problematic aspects of doing business within a national economy improves the development of appropriate structures for efficient structural policies or the enhancement of performance assessment methods and procedures. According to Švagždienė et al., 2020), global challenges, managerial competencies, and knowledge creation enhance the current business environment. To investigate the multiplier effects of COVID-19 on tourism and evaluate its influence on macroeconomic indicators, including GDP, total employment, and trade balance, Mariolis et al. (2021) utilize a multi-sectorial model. Conversely, Gandjour (2022) estimates the effects of a shutdown on life years gained and lives saved for Germany using the life-tables model and a variety of possibilities, establishing correlations with GDP. Another study on the COVID-19 pandemic by Meinen et al. (2021) reveals that, in European countries, the economic impact is not solely driven by the spread of the virus. The findings suggest that a region's trade relations serve as a crucial indirect channel through which disruptions related to COVID-19 influence regional economic activity.

The business environment in EU countries has witnessed substantial changes due to the profound effects of the COVID-19 pandemic. Panazan et al. (2023) sought to determine the changes caused by the pandemic in the business relocation circumstances within the EU. They examined the trends of global company relocations to European countries amid the uncertainties of this macroeconomic environment. When comparing the impact of the COVID-19 pandemic in Europe and the United States, Chen et al. (2020) concluded that regions and countries experiencing a more widespread pandemic experienced more severe economic setbacks. The coronavirus outbreak, as a worldwide pandemic, caused a slowdown in business activities and isolated nations. The global epidemic has far-reaching consequences for countries that are established as well as emerging, including a decrease in economic activity.

The outbreak of COVID-19 pandemic has resulted in an unpredictable economic performance, marked by heightened market volatility, unpredictability, and previously unexpected difficulties that have impacted the worldwide economy as well as enterprises operating in the market. Such enterprises, which frequently have difficulties with profitability and liquidity, have become particularly susceptible to external shocks. Simultaneously, it is crucial to consider the differences among the EU countries concerning their current competitiveness levels and the perspective for competitive development.

3. Data and methodology

The research paper examines the business environment in EU countries employing suitable mathematical and statistical methods. The TOPSIS technique was utilized to compare the business climate across EU countries. Several significant macroeconomic factors, including gross domestic product, general government debt, foreign direct investment, inflation, unemployment, export, and import, were chosen as input variables. The average values were computed after collecting data for all EU countries from 2017 to 2022 and dividing it into (1) the period before the COVID-19 pandemic until 2019, and (2) the period following the outbreak of the pandemic. During the examined period, all countries had positive and negative effects that impacted the entire political and economic environment, necessitating the use of these two periods when evaluating business performance and competitiveness.

The TOPSIS method is predicated on the principle of choosing a variant that is both as far away from the least suitable solution and as near to the ideal solution as is conceivable. The least suitable solution comprises the worst possible combination of criteria among all the evaluated variants. The criteria may involve aspects of maximization or minimization, and minimization criteria need to be converted to maximization (such as GGD, I, U, and IM in our case). Maximization criteria provide the basis of the final representation. The following steps were used to implement the TOPSIS method. To evaluate the criteria (macroeconomic variables) in terms of their relative relevance and assign them weights, Saaty's matrix was used (Table 1). The computed consistency ratio (0.02854) indicated a reasonable level of consistency.

A matrix for evaluation, encompassing all examined nations and macroeconomic factors, was developed, and the points where each alternative intersected the criteria were indicated as x_{ij}. The computed weights were subsequently applied in the TOPSIS technique for each examined period. By converting all criteria to maximization, normalized $R = r_{ij}$ and weighted normalized $W = w_{ij}$ decision matrices were computed, developing the foundation for estimating the ideal $H = (H_1, H_2, \ldots, H_k)$ and basal $D = (D_1, D_2, \ldots, D_k)$ alternatives, where:

$$H_j = \max_i w_{ij} \quad j = 1, 2, 3, \ldots, k;$$

$$D_j = \min_i w_{ij} \quad j = 1, 2, 3, \ldots, k. \tag{1}$$

Table 1. Weights of individual criteria

Indicator	w_i
GDP	0.326
GGD	0.242
FDI	0.127
I	0.103
U	0.089
EX	0.068
IM	0.043

Subsequently, it was determined how far the variants were from the ideal and basal alternatives:

$$d_i^+ = \left(\sum_{j=1}^{k} \left(w_{ij} - H_j \right)^2 \right)^{1/2} \quad i = 1,2,3,\ldots,p;$$

$$d_i^- = \left(\sum_{j=1}^{k} \left(w_{ij} - D_j \right)^2 \right)^{1/2} \quad i = 1,2,3,\ldots,p. \quad (2)$$

The final step involved computing a parameter $c_i(0; 1)$, which represents the relative distance of the variants from the basal alternative, with higher values indicating a closer proximity to the ideal solution:

$$c_i = \frac{d_i^-}{d_i^- + d_i^+}. \quad (3)$$

The outcomes derived from the TOPSIS method facilitate the comparison of conditions among countries during each analysed period. Thus, it becomes possible to identify the most favourable business environment.

Having the c_i values, a cluster analysis was used. The main task of this analysis is to identify homogeneous subgroups (clusters) of business conditions in EU countries. Typically, countries within a cluster share similarities in terms of a specific level of enterprise performance and competitiveness. Conversely, countries in different clusters indicate different levels of development in the business environment. The principle of clustering involves calculating the distances between objects. The squared Euclidean distance and Ward's method were used in this research paper. This distance type is employed when progressively greater weight should be assigned to further objects:

$$d_{ij} = \sqrt{ \sum_{k=1}^{K} \left(x_{ik} - x_{jk} \right)^2 }, \quad (4)$$

where x_{ik} is the value of k-th variable of the i-th object and x_{jk} is the value of k-th variable of the j-th object. The Ward's hierarchical agglomerative clustering method relies on an analysis of variance, specifically the minimal increase in the sum of squared deviations from the average by adding a new object to the cluster, while this process results in the creation of clusters with similar shapes and sizes. The clustered EU countries are subsequently depicted in the dendrogram, revealing patterns

of homogeneity in the development of the business environment within the countries.

4. Results and discussion

The main aim of the paper was to compute the c_i indicator for both the pre-pandemic and pandemic periods, adhering to the methodological procedures described, which included employing specific macroeconomic indicators to evaluate the quality and attractiveness of the business climate in the EU nations. Results have been compiled in Table 2 based on the relative distance of each variant from the basal alternative (c_i) during the pre-pandemic period (2017–2019).

Table 2. Ranking of the EU countries in the pre-pandemic period (2017–2019)

Rank	Country	c_i
1.	Germany	0.82806
2.	France	0.69335
3.	Italy	0.60111
4.	Spain	0.50247
5.	Netherlands	0.46381
6.	Sweden	0.43641
7.	Poland	0.42053
8.	Belgium	0.41231
9.	Denmark	0.40804
10.	Ireland	0.40752
11.	Austria	0.40734
12.	Czech Republic	0.40557
13.	Finland	0.39694
14.	Luxembourg	0.39235
15.	Portugal	0.39163
16.	Romania	0.39052
17.	Greece	0.38726
18.	Slovak Republic	0.38485
19.	Malta	0.38402
20.	Cyprus	0.38330
21.	Slovenia	0.38267
22.	Croatia	0.38207
23.	Bulgaria	0.38132
24.	Lithuania	0.37986
25.	Latvia	0.37862
26.	Estonia	0.37817
27.	Hungary	0.18173

During the pre-pandemic period, the economies of both Germany and France attained their optimal proportions. Subsequently, Italy, Spain, the Netherlands, and Sweden follow in the ranking. The Visegrad Group countries are evaluated as average in terms of the business environment, with the exception of Hungary, which occupies the least favourable position in the ranking. The Baltic countries, along with Bulgaria, Croatia, Slovenia,

Cyprus, and Malta, are positioned below average values and are ranked in the second half.

During the post-pandemic period (2020–2022), the same procedure was used. A comprehensive arrangement of all variants was achieved by computing the relative indicators, which generated and organized variants in descending order based on the steadily diminishing values of the c_i indicator (Table 3).

Table 3. Ranking of the EU countries in the post-pandemic period (2020–2022)

Rank	Country	c_i
1.	Germany	0.82862
2.	France	0.69274
3.	Italy	0.59148
4.	Spain	0.50237
5.	Netherlands	0.46320
6.	Sweden	0.43674
7.	Poland	0.41607
8.	Belgium	0.41349
9.	Austria	0.40752
10.	Denmark	0.40728
11.	Ireland	0.40526
12.	Czech Republic	0.40394
13.	Finland	0.39602
14.	Portugal	0.39345
15.	Luxembourg	0.39316
16.	Romania	0.39013
17.	Greece	0.38868
18.	Malta	0.38634
19.	Slovenia	0.38443
20.	Slovak Republic	0.38430
21.	Cyprus	0.38252
22.	Croatia	0.38175
23.	Bulgaria	0.38167
24.	Estonia	0.37949
25.	Latvia	0.37925
26.	Lithuania	0.37911
27.	Hungary	0.18008

Table 3 reveals comparable findings to those obtained prior to the pandemic, but there have been notable changes. Denmark, Ireland, Luxembourg, and Cyprus shifted one place lower compared to the pre-pandemic period, while Slovakia and Lithuania experienced a decline by two positions, suggesting a modest deterioration in the business environment in these EU countries. Conversely, countries like Malta and Portugal improved their positions in the business environment ranking, moving up by one place. Austria, Slovenia, and Estonia managed to advance by two places in the ranking following the outbreak of the COVID-19 pandemic. Generally, the pandemic situation in 2020 did not have a significant impact on the scores. Despite this, a marginal decline is discernible in the average-ranked nations according to the c_i values.

The results of examined nations are a consequence of the macroeconomic indicators development within their economies, which exhibited diverse developments in each country over the analysed period. Utilizing the multi-criteria TOPSIS technique for analysis, the positioning of monitored EU nations was assessed. Germany emerges as the country boasting the most favourable business environment according to the TOPSIS method, which could be attributed to the continuous removal of restrictions posed by regulations and the encouragement of innovations aimed at enhancing the competitiveness within EU nations. Additionally, the national market is distinguished by robust engineering, high productivity, an intensively trained labour force, an effective transportation infrastructure, and a central location within Europe (Valaskova et al., 2022; Szymczak et al., 2023). France, the second country recognized for having a highly favourable business climate, is a developed and industrialized country with a highly educated labour force, an advanced financial market, the largest capital market, outstanding infrastructure, and well-established telecommunication and technology sectors. Because of these characteristics, it is an attractive location for commercial activities (Kojic et al., 2022).

Among the leading countries that maintained their positions in assessing the business environment during the post-pandemic period are Italy, Spain, Netherlands, Sweden, Poland, and Belgium. To ensure the prosperity and competitiveness of an economy, a heightened focus on knowledge, involving its creation, transfer, and preservation, is imperative. As indicated by Sira et al. (2020), importance to the elements of a knowledge-based economy positively impacts a business competitiveness, thereby bolstering its overall sustainability. The authors utilized the TOPSIS method for a multi-criteria assessment of countries, complemented by a regression model, to examine differences in selected indicators related to knowledge economies and competitiveness across EU countries. Sweden was identified by their research as a leading country in terms of competitiveness, sustainability, and knowledge economy. Furthermore, Sweden was identified by Masca (2017) as having the most favourable business environment in their research results. Conversely, in both observed periods, not only Hungary but also the Baltic countries, along with Bulgaria and Croatia, could be considered the least favourably rated countries concerning the business environment. Hajduova et al. (2021) conducted a comprehensive assessment of the business climate using multicriteria method, analysing data from 2018 to 2020. The authors employed the weighted sum approach (WSA) with seven selected indices and the technique for order preference by similarity to the ideal solution (TOPSIS) methods and decided that the effectiveness of business climates in Visegrad Group countries, Baltic states, Cyprus, and Slovenia is below the EU average, which is consistent with our findings. Bilan

et al. (2019) also investigated the key indicators influencing the macroeconomic stability of EU countries using economic and mathematical approaches, including TOPSIS. They specifically examined the five latest EU members (Latvia, Lithuania, Croatia, Romania, and Poland) and Ukraine, identifying essential social determinants crucial for shaping the development strategy.

The obtained results are consistent with various global competitiveness rankings assessing competitive performance after the COVID-19 pandemic (Popescu et al., 2023; Bieszk-Stolorz & Dmytrow, 2022; Valaskova & Nagy, 2023). Panazan (2023) also reflected similar findings when examining the pandemic-influenced business environment. The research demonstrated a change in business relocation preferences from the east to the west, aligning with the broader trend in dynamics of relocation prompted by the pandemic. Based on their results, certain European countries, including the Baltic states, Cyprus, and Romania, noticed a decline in attractiveness for businesses considering relocation, diverging from the pre-pandemic period. However, countries like Germany, France, Spain, and Italy that have more robust economies and lower risks seem to be gaining appeal for firms contemplating facility relocation.

Based on the c_i values, the homogenous clusters of business conditions within EU countries were determined, and the dendrogram is presented in Figure 1.
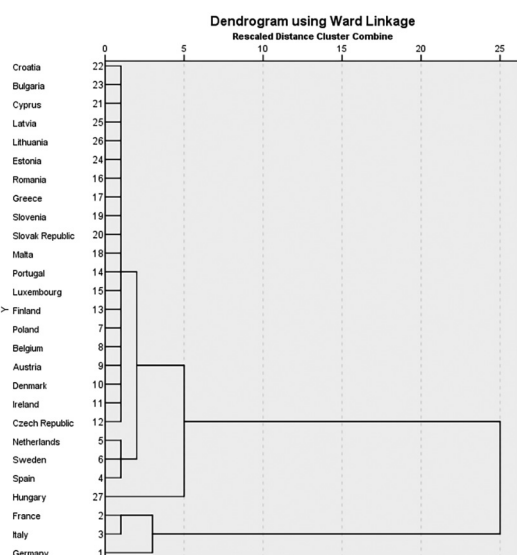

Figure 1. Dendrogram of EU countries clustering based on the c_i values

As the countries were divided into five clusters, the results of the cluster analysis (Table 4) confirmed the notable presence of EU countries displaying comparable patterns in the development of the business climate.

Summarizing the findings, it can be stated that Cluster 1 includes Germany, which aligns with the paper conducted by Faria et al. (2021) and Gavurova et al. (2021), who, in their exploration of clustering EU countries based on macroeconomic indicators, highlighted Germany as a distinct cluster. According to the authors, the

Table 4. Developed clusters of monitored EU countries

Cluster	Number of countries	EU countries
C1	1	Germany
C2	2	France, Italy
C3	3	Netherlands, Spain, Sweden
C4	20	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Greece, Ireland, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovak Republic, Slovenia
C5	1	Hungary

reason for this separation is the relatively lower tax rates in Germany. Cluster 2 comprises France and Italy, while Cluster 3 includes the Netherlands, Spain, and Sweden. These clusters represent countries considered leaders in the EU, given their substantial economic size and influence, which significantly contributes to the overall economic performance of the EU. According to the research conducted by Cicea et al. (2019), Germany, France, and the Netherlands are recognized as highly developed countries. The authors focused on assessing the impacts of various determinants on the performance of small and medium-sized enterprises at a macroeconomic level. Gligor and Ausloos (2008) utilized cluster analysis to conduct a comparative examination of 15 EU countries, exploring the differences in several fundamental macroeconomic indicators. Within their study, the authors identified Germany, Italy, Sweden, and Spain as forming a single cluster, a pattern that may align with the outcomes of the present research (similarly to Zivadinovic et al., 2009; Marceta & Bojnec, 2020). These nations, all members of the EU, are recognized for fostering a pro-business environment. Boikova et al. (2021) adopted a comprehensive perspective encompassing competitiveness and economic growth, aiming to unveil the factors determining and contributing to the development of European economies while also identifying clusters within the EU countries. According to their findings, the authors designate Belgium, Denmark, Germany, France, the Netherlands, Austria, Finland, and Sweden as adequately macroeconomically stable EU countries. Most of these countries are also prominently featured in the top three clusters of our study, signifying economically advanced countries with a pro-business atmosphere. Shaulska et al. (2021) similarly classified Germany, Spain, France, and Italy into a unified cluster, attributing their advanced level of digitalization in employment. The cluster analysis performed in this study revealed that the largest homogeneous group is predominantly Cluster 4, comprising 20 countries, mainly from Central and Eastern Europe, along with some Southern European countries. These results align with the findings of Boikova et al. (2021). Hungary can be placed in Cluster 5, and Svacinova (2020) also affirmed the presence of macroeconomic disparities among countries.

The study provides insights into regional trends and similarities by identifying distinct clusters within the European landscape, which enables targeted policies and initiatives to address particular challenges or build on common strengths. Additionally, the reliability and credibility of the evaluation are increased by the use of significant analytical methods like TOPSIS and cluster analysis, which foster confidence not only among stakeholders but also among cross-border collaborations and partnerships. The study supports strategic decision-making processes like investment allocation or market entrance strategies by giving policymakers and business leaders a structured framework to assess and compare the business environment in other nations. Overall, the practical implications of the paper involve improving competitiveness among businesses, supporting economic growth, and fostering deeper integration and collaboration within the EU.

However, data availability and accuracy may be limited, particularly when obtaining real-time or comprehensive data on appropriate macroeconomic indicators across EU countries. Additionally, there may be differences in indicator selection since some metrics may be preferred over others depending on subjective opinion or availability, thus missing crucial elements impacting the business environment because assuming linear relationships between selected macroeconomic indicators and business outcomes or ignoring qualitative characteristics may restrict the accuracy of the obtained results. Moreover, the paper could neglect to account for contextual subtleties or external factors that might affect the relationships between macroeconomic indicators and the business landscape, resulting in simplicity or misunderstanding of results. By addressing these limitations, future research has the potential to advance our understanding and provide more robust frameworks for assessing the impact of macroeconomic indicators on the business environment across EU countries, as future studies could focus on incorporating contextual factors and external influences into the analysis to provide a more holistic understanding of the complex dynamics influencing the business environment.

5. Conclusions

Many authors have already published papers on how businesses have responded to the pandemic, emphasizing the need to investigate how the world has evolved as a result of the long-term COVID-19 pandemic consequences and identify specific actions that business leaders can take to thrive in this new landscape. One of the most widespread strategies that can be employed is continuously monitoring and analysing the business environment, macroeconomics, and government policies, which will provide new perspectives for companies, allowing them to formulate tailored plans based on their advantages and the current situation.

In conclusion, the research paper endeavoured to shed light on the dynamics of the business climate in European nations during the post-pandemic period. By integrating the cluster analysis with the TOPSIS method, a comprehensive evaluation of the diverse macroeconomic indicators influencing the competitiveness of these nations was performed. The results revealed distinct clusters within the European landscape, emphasizing similarities and differences in business conditions. Germany was identified as a standout country with the most favourable business environment, attributed to consistent reductions in regulatory burdens and a proactive approach to promoting innovation. France and Italy form another notable cluster, showcasing their advanced and industrialized status, while Spain, Sweden, and the Netherlands constitute a separate grouping. As part of evaluating the economic development dynamics within the EU countries concerning the sustainability and competitiveness of enterprises, the business environment revealed that Hungary exhibits specific competitiveness shortcomings. It was concluded that the overall business climate is not entirely appropriate for enterprises operating in the market. The integration of the TOPSIS method and cluster analysis has allowed to discern subtle shifts in the business competitiveness of EU countries post-pandemic. Notably, some nations experienced a slight deterioration in their business environments, while others exhibited resilience and improvement.

These findings underscore the nuanced impact of the post-pandemic landscape on the business competitiveness of EU countries. The integration of quantitative methods, such as TOPSIS and cluster analysis, provides a robust framework for policymakers, businesses, and researchers to understand the intricate interplay of macroeconomic factors and make informed decisions in a rapidly evolving economic environment. Navigating the complexities of a post-pandemic period and understanding the competitive dynamics shaping the European business landscape are enriched by the insights gleaned from this research.

Contribution

Both authors contributed equally to this manuscript. All authors have read and agreed to the published version of the manuscript.

Disclosure statement

There are no financial conflicts of interest to disclose.

References

Belas, J., Gavurova, B., Cepel, M., & Kubak, M. (2020). Evaluation of economic potential of business environment development by comparing sector differences: Perspective of SMEs in the Czech Republic and Slovakia. *Oeconomia Copernicana*, *11*(1), 135–159.
https://doi.org/10.24136/oc.2020.006

Bieszk-Stolorz, B., & Dmytrow, K. (2022). Assessment of the similarity of the situation in the EU labour markets and their changes in the face of the COVID-19 pandemic. *Sustainability*, *14*(6), Article 3646.
https://doi.org/10.3390/su14063646

Bilan, Y. V., Vasylieva, T. A., Liulov, O. V., & Pimonenko, T. V. (2019). EU vector of Ukraine development: Linking between macroeconomic stability and social progress. *International Journal of Business and Society*, *20*(2), 433–450.

Boikova, T., Zeverte-Rivza, S., Rivza, P., & Rivza, B. (2021). The determinants and effects of competitiveness: The role of digitalization in the European economies. *Sustainability*, *13*(21), Article 11689. https://doi.org/10.3390/su132111689

Chen, S., Igan, D. O., Pierri, N., & Presbitero, A. F. (2020). Tracking the economic impact of COVID-19 and mitigation policies in Europe and the United States. *IMF Working Paper*, *20*(125), 1–25. https://doi.org/10.5089/9781513549644.001

Cicea, C., Popa, I., Marinescu, C., & Cătălina Ştefan, S. (2019). Determinants of SMEs' performance: Evidence from European countries. *Economic Research-Ekonomska Istraživanja*, *32*(1), 1602–1620.
https://doi.org/10.1080/1331677X.2019.1636699

Dutta, D. K., & Khurana, I. (2023). Productive entrepreneurship within the entrepreneurial ecosystem: Insights from social exchange theory. *Applied Psychology: An International Review*. https://doi.org/10.1111/apps.12509

Faria, J. R., Cuestas, J. C., Gil-Alana, L., & Mourelle, E. (2021). Self-employment by gender in the EU: Convergence and clusters. *Empirica*, *48*(3), 717–741.
https://doi.org/10.1007/s10663-020-09494-2

Fernandes, C. I., Veiga, P. M., & Ramadani, V. (2023). Entrepreneurship as a transition to the circular economy. *Environment, Development and Sustainability*.
https://doi.org/10.1007/s10668-023-03513-5

Gandjour, A. (2022). The clinical and economic value of a successful shutdown during the SARS-CoV-2 pandemic in Germany. *Quarterly Review of Economics and Finance*, *84*, 502–509. https://doi.org/10.1016/j.qref.2020.10.007

Gavurova, B., Privara, A., Janikova, J., & Kovac, V. (2021). Quantification of tourism sector parameters related to competitiveness of countries according to macroeconomic indicators. *Journal of Competitiveness*, *13*(3), 56–72.
https://doi.org/10.7441/joc.2021.03.04

Gligor, M., & Ausloos, M. (2008). Convergence and cluster structures in EU area according to fluctuations in macroeconomic indices. *Journal of Economic Integration*, *23*(2), 297–330. https://doi.org/10.11130/jei.2008.23.2.297

Hajduova, Z., Hurajova, J. C., Smorada, M., & Srenkel, L. (2021). Competitiveness of the selected countries of the EU with a focus on the quality of the business environment. *Journal of Competitiveness*, *13*(4), 43–59.
https://doi.org/10.7441/joc.2021.04.03

Holl, A., & Rama, R. (2023). Spatial patterns and drivers of SME digitalisation. *Journal of the Knowledge Economy*, 1–25.
https://doi.org/10.1007/s13132-023-01257-1

Inacio Junior, E., Dionisio, E. A., Fischer, B. B., Li, Y., & Meissner, D. (2021). The global entrepreneurship index as a benchmarking tool? Criticisms from an efficiency perspective. *Journal of Intellectual Capital*, *22*(1), 190–212.
https://doi.org/10.1108/JIC-09-2019-0218

Kim, S. (2022). A global entrepreneurship efficiency benchmarking and comparison study based on national systems of entrepreneurship and early-stage business: A data envelopment analysis approach. *SAGE Open*, *12*(3), 1–17.
https://doi.org/10.1177/21582440221123252

Kojic, M., Schluter, S., Mitic, P., & Hanic, A. (2022). Economy-environment nexus in developed European countries: Evidence from multifractal and wavelet analysis. *Chaos, Solitons & Fractals*, *160*, Article 112189.
https://doi.org/10.1016/j.chaos.2022.112189

Marceta, M., & Bojnec, S. (2020). Drivers of global competitiveness in the European Union countries in 2014 and 2017. *Organizacija*, *53*(1), 37–52.
https://doi.org/10.2478/orga-2020-0003

Mariolis, T., Rodousakis, N., & Soklis, G. (2021). The COVID-19 multiplier effects of tourism on the Greek economy. *Tourism Economics*, *27*(8), 1848–1855.
https://doi.org/10.1177/1354816620946547

Masca, M. (2017). Economic performance evaluation of European Union countries by TOPSIS method. *North Economic Review*, *1*(1), 83–94.

Meinen, P., Serafini, R., & Papagalli, O. (2021). Regional Economic impact of COVID-19: The role of sectoral structure and trade linkages. *Social Science Research Network*.
https://doi.org/10.2139/ssrn.3797148

Panazan, O., Gheorghe, C., & Calefariu, G. (2023). Relocation trends determined by increasing risks in Eastern Europe: An ANP-TOPSIS approach. *Human Systems Management*, *42*(3), 337–350. https://doi.org/10.3233/HSM-220062

Popescu, M. E., Cristescu, A., & Paun, R. M. (2023). The COVID-19 pandemic and main economic convergence indicators in the EU. *Economic Research-Ekonomska Istraživanja*, *36*(2), Article 2142807.
https://doi.org/10.1080/1331677X.2022.2142807

Shaulska, L., Karpenko, A., Doronina, O., Naumova, M., & Biletskyi, O. (2021). Drivers of macroeconomic growth in a creative economy: Innovation policy and human capital. *Ad Alta: Journal of Interdisciplinary Research*, *11*(1), 178–186.

Sira, E., Vavrek, R., Kravcakova V. I., & Kotulic, R. (2020). Knowledge economy indicators and their impact on the sustainable competitiveness of the EU countries. *Sustainability*, *12*(10), Article 4172. https://doi.org/10.3390/su12104172

Svacinova, K. (2020). Analysis of Industry 4.0 readiness in Hungary: Estimation of I4.0 readiness index compared to EU countries. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics & Administration*, *28*(2), Article 1094. https://doi.org/10.46585/sp28021094

Szymczak, S., Parteka, A., & Wolszczak-Derlacz, J. (2023). Joint foreign ownership and global value chains effects on productivity: A comparison of firms from Poland and Germany. *International Journal of Emerging Markets*.
https://doi.org/10.1108/IJOEM-09-2022-1357

Švagždienė, B., Perkumienė, D., Grigienė, J., & Bilan, S. (2020). Characteristics of service quality evaluation in rural tourism sector: Case of the Baltic states (Lithuania, Latvia, Poland). *Transformations in Business & Economics*, *19*(2A), 495–510.

Trang, P. T. H., & Nam, V. H. (2020). Distance to the frontier and innovation: The role of local business environment. *Malaysian Journal of Economic Studies*, *57*(1), 21–37. https://doi.org/10.22452/MJES.vol57no1.2

Tuysuz, N., & Kahraman, C. (2023). An integrated picture fuzzy Z-AHP & TOPSIS methodology: Application to solar panel selection. *Applied Soft Computing*, *149*, Article 110951. https://doi.org/10.1016/j.asoc.2023.110951

Valaskova, K., & Nagy, M. (2023). Macro-economic development of the EU countries in the context of performance and competitiveness of SMEs. *Business, Management and Economics Engineering*, *21*(1), 124–139. https://doi.org/10.3846/bmee.2023.18958

Valaskova, K., Gajdosikova, D., & Pavic, T. K. (2022). How important is the business environment for the performance of enterprises? Case study of selected European countries. *Central European Business Review*, *11*(4), 85–110. https://doi.org/10.18267/j.cebr.300

Zivadinovic, N. K., Dumicic, K., & Casni, A. C. (2009). Cluster and factor analysis of structural economic indicators for selected European countries. *WSEAS Transactions on Business and Economics*, *6*(7), 331–341.