

Béla Kádár

Navigating the COVID-19 Crisis
- Entrepreneurial Finance in the EU27: State
Interventions, Zombie Firms, and
Sectoral Performance

Departments Institute of Finance

Supervisor:
Erika Jáki, Ph.D., habil

©Béla Kádár

CORVINUS UNIVERSITY OF BUDAPEST

Doctoral School of Business and Management

Béla Kádár

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DOCTORAL DISSERTATION

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Budapest

2025

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1 RESEARCH CONTEXT AND FRAMEWORK

My dissertation follows a paper-based dissertation format, meaning it consists of multiple studies that are introduced in the following chapters and synthesized in Chapter 6. My doctoral research examines the financial impact of the COVID-19 crisis on businesses, with the publication status of these articles outlined below and their order within the dissertation is illustrated in Figure 4 of Section 1.4.

1. Kádár, B., & Jáki, E. (2024). COVID-19 and SMEs: An umbrella review of systematic literature (2020–2024) and future directions for entrepreneurship: Introduction to the “The Entrepreneurial Landscape in the Post-COVID Era: Insights, Challenges, and Future Perspectives” special issue. *Society and Economy*, 46(4), 323-341. DOI: 10.1556/204.2024.00017.

Furthermore, this paper is referred to as **Article 1**.

2. Kádár, B., & Hegedűs, S. (2024). A magyar gazdaság ágazatainak pénzügyi alkalmazkodása a koronavírus-járvány idején. *Külgazdaság*, 68(11-12), 33-65. DOI: 10.47630/KULG.2024.68.11-12.33.

Furthermore, this paper is referred to as **Article 4**.

3. Jáki, E., Kádár, B., & Michalkó, G. (2024). Az immunitás nyomában: a hazai turisztikai vállalatok szakágazati és területi sajátosságai a polikrízis időszakában. *Területi Statisztika*, 64(6). DOI:10.15196/TS640605

Furthermore, this paper is referred to as **Article 5**.

The following ongoing articles: This article has been submitted to *Studies in Economics and Finance*, a journal with a Q2 Scimago ranking, and currently, we are in the third round of the review process. Of the three reviewers, two have accepted the revised version, while the third has requested minor revisions:

4. Kádár, B., & Jáki, E. (2024). Assessing the Evolution of Zombie Firm Dynamics in the EU During COVID-19: A Novel Identification Method and Comparative Analysis. Furthermore, this manuscript is referred to as **Article 3**.

The following article was submitted to the *Regional Statistics* (Q1) on 17 March 2025. We have already completed the first round of review and are confident of a positive assessment.

5. Jáki, E., Kádár, B., & Pollák, Z.: Multidimensional analysis of COVID-19 preparedness, impact, and economic support measures regarding EU27. Furthermore, this manuscript is referred to as **Article 2**.

This dissertation is structured as follows: Chapter 1 introduces the topic of the dissertation. This Chapter contains all the required content, in particular a structured theoretical and conceptual framework, integrating the articles in the dissertation into a coherent system. The justification and relevance of the research questions are supported by my professional experience at K&H Bank and the already published umbrella systematic literature review, the relevant parts of which are presented in the introduction. Furthermore, the introduction highlights the synergies between the theoretical and methodological approaches used in the articles on which the dissertation is based. At the same time demonstrates that there are significant differences in content between the articles, both in terms of the theoretical problems they address and the empirical methods they employ. It starts with a general overview of how the pandemic affected businesses which follows a funnel approach and gradually narrowing the focus to financial effects (Chapter 1.3). I examined and presented the impact of COVID-19 on businesses, with Chapter 1.3.1 reviewing survey-based studies on SMEs' crisis experiences, Chapter 1.3.2 providing a systematic umbrella review identifying key research trends and gaps, and Chapter 1.3.3 summarizing findings from studies based on firm-level financial data regarding the financial impacts of the crisis. Following that, the research objectives are outlined in Chapter 1.4. However, a more detailed and critical assessment of the domestic and international literature is presented in the literature review sections of each article (Chapter 2-5).

Chapters 2 to 5 present Articles 2 to 5 without any content modification. However, it should be noted that Article 4 and Article 5 were originally written in Hungarian. Therefore, they have been translated specifically for this dissertation. The final chapter, Chapter 6 *Summary and further research questions*, concludes the findings of the included studies and provides a synthesis of their results and discusses further research questions for future research.

1.1 Professional background and personal motivations

Between 2017 and 2023, I worked in the Corporate Lending and Underwriting Department of K&H Bank, where I dealt with financial statement analysis and loan proposals on a daily basis. A central part of my job was to conduct credit risk assessment, and analyze the financial situation of companies in relation to loan applications. This gave me deep experience in assessing the financial stability and performance of companies in different industries and economic situations.

The emergence of the coronavirus in early 2020 has become a global pandemic, with the immediate introduction of epidemiological measures in March 2020 leading to general economic uncertainty across the world. Within just a few days, countries implemented unprecedented restrictions, such as the declaration of a state of emergency, border closures, movement restrictions, the closing of schools and kindergartens, the cancellation of public events. People worked from home as much as they could and bought up durable food in panic for fear of shortages. The severity of the crisis was highlighted by Hungarian Prime Minister Viktor Orbán in a radio interview on March 13, 2020, where he cautioned that “the situation is much more serious than people generally think”. He warned that many had not yet realized that "the economy is coming to a halt, as is happening to us now," and that Hungary must face "very serious consequences" (Prime Minister’s Office, 2020).

In this situation, the COVID-19 crisis significantly changed commercial banks’ credit policies and guidelines, which led financial institutions to reevaluate their credit risk appetite and conduct a screening of affected sectors (MNB, 2020a; MNB, 2020b). The lockdowns, fear of COVID-19, and loss of confidence resulted in drastic changes in business operations and consumer behavior, severely impacting corporate revenues and financial stability, which led to the collapse of the **performance of many sectors and firms’ financial standing** from one day to the next (Asztalos et al., 2020). However, companies' available financial reports (i.e., interim financial data) did not immediately reflect this in the first months of the crisis. This situation was very challenging from a professional view, as assessing a company's true risk profile often had to be done without concrete interim financial data.

During my work, I recognized through loan proposals that a significant portion of the clients received some form of **financial support measures or intervention** (e.g.,

participated in a subsidized loan program, did not opt out of the general moratorium, or received wage subsidies, etc.) I also noted that these measures were used not only by companies that were severely affected by the crisis but also by those that had already been in weak financial condition before the pandemic. At the same time, many firms that were not significantly impacted by the crisis still took advantage of them. This realization later had a major impact on the direction of my research.

During this period, I first came across the **concept of zombie firms**¹ and how the crisis, along with government support measures, could facilitate their survival. (ECB-Banking Supervision, 2020; Valentiny, 2021). Furthermore, some publications have drawn my attention to the fact that research on zombie firms is gaining increasing relevance in academic literature. Research on zombie companies is receiving increasing attention in academic publications, some of which highlight how government subsidies have provided short-term relief, keeping potentially financially weak companies alive, thereby distorting market competition. (Laeven et al, 2020; Banerjee & Hofmann, 2022; Álvarez et al., 2023).

Finally, during my work, I gained insight into multiple industries and concluded that the **crisis impacted different sectors in varying ways**. The identification of the most affected industries quickly became a priority, and banks started to closely monitor companies operating in these sectors. This included tourism and hospitality, event management, and entertainment, which were among the hardest hit sectors, facing complete shutdowns and massive revenue losses. Retail businesses also faced challenges as many stores were forced to close for months, while manufacturing companies struggled with severe supply chain disruptions. The Hungarian National Bank also classified the different industries based on their exposure to the COVID-19 crisis using expert-judgement already at the beginning of the crisis. (MNB, 2020b)

This practical experience directly inspired my research a few years later. Furthermore, while reviewing the existing literature, I noticed a lack of empirical studies examining the impact of COVID-19 on the financial performance of companies across sectors. Given my strong quantitative orientation, I aimed to address this issue through corporates'

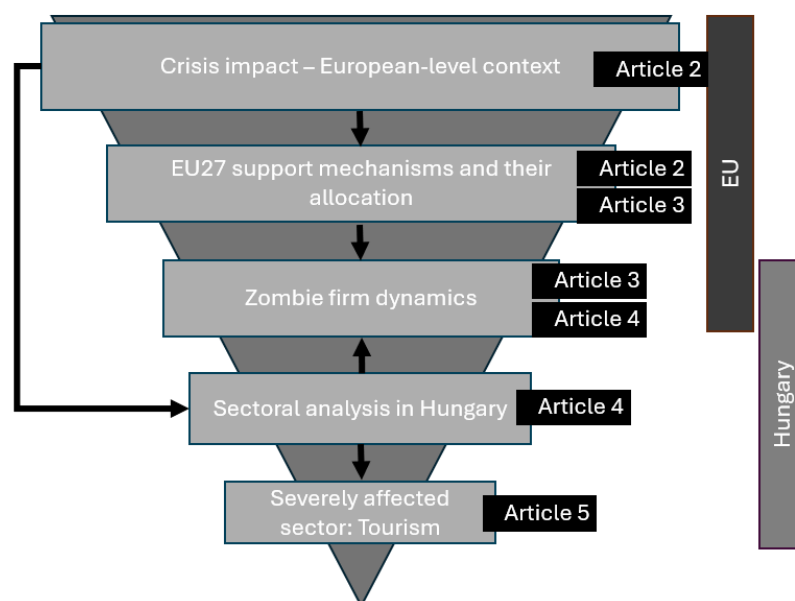
¹ The existing literature does not provide an universally accepted definition of zombie firms, but generally these firms are financially distressed with significant leverage, which have no potential to repay their debt. However, they are often kept alive by their financing banks through additional loans or by prolonging existing ones. These firms are commonly referred to as „zombie firms”. The concept is discussed in more detail in Article 3 and Article 4

financial data analysis. During my doctoral studies, I had access to the ORBIS financial database, which offers extensive corporate information. This database gave me the opportunity to evaluate the main financial indicators, including revenue, profitability, debt levels and interest payment obligations. By analyzing these data, my aim is to gain a deeper understanding of how the crisis financially affected businesses.

1.2 Logical structure and research focus progression of the dissertation

The structure of the dissertation follows a funnel logic, moving from a broad European-level perspective to a more focused sectoral analysis. It begins with an examination of the COVID-19 crisis and the EU27 support mechanisms (Articles 2 and 3). These measures, while essential for stabilizing the economy, also raise an important question: could they have unintentionally prolonged the survival of financially weak firms? This idea serves as a bridge to the investigation of zombie firm dynamics across the EU (Articles 3 and 4). The analysis then narrows further to the Hungarian context. A sectoral study (Article 4) highlights which industries were most vulnerable and how zombification patterns emerged locally, which also illustrates how the differentiated effects of the crisis were reflected at the sectoral level in Hungary. Finally, the dissertation provides a comprehensive assessment of one of the hardest-hit sectors - tourism (Article 5) - to provide a detailed picture of the crisis' financial impact at the industry level.

1. Figure: Research focus progression of the dissertation



Source: own work

1.3 Challenges imposed by the COVID-19 crisis

The COVID-19 pandemic has posed unexpected and complex challenges to social and economic systems worldwide. The rapid spread of the epidemic and its severe consequences have caused considerable uncertainty not only in the health sector, but also in all aspects of economic and social life (Donthu & Gustafsson, 2020). The crisis hit economies and societies suddenly, causing major disruptions in supply and demand. In many countries, this led to economic downturns and increased uncertainty globally. Miklian, J., & Hoelscher (2021, p.180) defined an exogenous shock as “*an unpredictable and/or unexpected event not initiated by a given market, community or country that carries a significant negative impact upon that market, community or country.*” In addition, Walby (2022) defines a crisis as a short-term event with long-term consequences that are disproportionately large compared to the original cause. These views fit well with how the COVID-19 crisis developed.

There is an extensive literature on the research of the concept of crisis in economics from the last decades. Scholars have approached it from various perspectives, including organizational and leadership crises (Pearson & Clair, 1998; Riggio & Newstead, 2023), disruptions in supply chains (Durugbo, 2023), and a range of financial dimensions (Mishkin, 1992; Sufi & Taylor, 2022). Across these different definitions, there is a common understanding that a crisis represents an event that threatens the fundamental functioning of a system or organization and leads to severe and significant consequences.

Mishkin (1992) highlights that financial crises are often triggered by factors such as rising interest rates, stock market declines, heightened uncertainty, bank panics, and unexpected price level drops. During the COVID-19 crisis, increased uncertainty and sharp stock market declines were particularly evident, directly impacting firms’ financial positions and access to credit. In the theoretical literature on financial crises, the contributions of Minsky (1982, 2008) and Aliber et al. (2015) are highly significant. Their work highlights the endogenous instability of financial systems and the dynamics of *boom–bust* cycles (periods of rapid asset price increases followed by sudden contractions). According to these models, financial crises are not solely the result of external shocks. Rather, they can also emerge from internal processes within the system itself - driven by positive feedback in financial markets, increased risk-taking activities, and irrational and emotional factors influencing the behaviour of market participants (Wullweber, 2020).

In this context, Wullweber (2020) describes how, prior to the pandemic, a prolonged period of low interest rates, rising asset prices, and increasing financial leverage had contributed to a fragile financial environment that became highly vulnerable to pandemic.

Posgay et al. (2020) note that the COVID-19 crisis created an unprecedented socio-economic situation. With no clear end to the pandemic in sight, uncertainty grew among both consumers and businesses. As a result, both demand and supply were disrupted at the same time. Similar conclusions were drawn in other studies as well: the COVID-19 crisis cannot be seen as a pure demand shock. Rather, it was an unusual combination of both demand and supply shocks. On the demand side, the decline was driven by physical restrictions and increased consumer caution, while on the supply side, production shutdowns, supply chain disruptions, and reduced labor availability played a major role (Bekaert et al., 2020; Czczeli et al., 2020).

Taken together, these perspectives underline that crises can disrupt both the broader economy and the financial stability of individual firms. Building on this literature - and in particular on contributions that emphasize the financial dimensions of crises (Mishkin, 1992; Minsky, 1982, 2008; Aliber et al., 2015; Wullweber, 2020) - this dissertation adopts a definition of crisis that focuses on firms' financial health. Specifically, a crisis is understood as a situation in which a firm or sector experiences a significant loss of revenue, declining profitability, and a resulting deterioration in capital position, liquidity, and debt-servicing capacity. These factors fundamentally affect firms' resilience and long-term survival during crises, regardless of whether the shock originates from the demand or the supply side.

I continued the literature review by examining how the COVID-19 crisis affected businesses. First **in Chapter 1.3.1, five questionnaire-based studies** (Siuta-Tokarska, 2021; Juergensen et al., 2020; Lu et al., 2021; MNB, 2020a; EC, 2021) **were reviewed** to answer the question: How has the COVID-19 pandemic impacted SMEs and entrepreneurs in different areas, and what are the main effect categories identified in survey-based research? In the second part **in Chapter 1.3.2, we analysed 26 systematic literature reviews (SLRs) to identify key themes and research trends related to the impact of COVID-19 on SMEs.** By comparing the findings from survey-based studies and SLRs, we aim to highlight the most frequently studied impact areas and identify topics that have received less attention. These subchapters are an integral part of **Article**

1 and have been directly incorporated from the article word for word, without any modifications. The following section provides a literature review on the COVID-19 crisis and its impact on firms cited from Kádár and Jáki (2024, pp. 324-331).

“The COVID-19 pandemic began in Wuhan, China, in November 2019, rapidly escalated into a global crisis with profound economic and social impacts. It brought severe and unexpected disruptions to economies worldwide, placing immense pressure on businesses and posing significant challenges to manage and mitigate its effects (Su et al., 2022; Krishnan et al., 2022). This crisis has dramatically altered the operational and financial landscape for firms, creating a complex new environment (Krishnan et al., 2022; Miklian and Hoelscher, 2021; Sharma et al., 2022). In particular, small and medium-sized enterprises (SMEs) - which represent nearly 90% of businesses and serve as a critical engine of economic growth and employment globally - have been acutely affected (Castro and Moreira, 2024; Sharma et al., 2022). As seen in the 2008-2009 global financial crisis, the pandemic once again underscored SMEs' susceptibility to external shocks, intensifying the need for resilience-building strategies to ensure their continuity and growth.

SMEs faced numerous challenges, including supply and demand disruptions, limited access to finance, business contraction, and operational restrictions, all of which underscored their fragility in the face of exogenous shocks (Mishra and Singh, 2023; Miklian and Hoelscher, 2021, Erdiaw-Kwasie et al., 2023). However, Belitski et al. (2022), reveal that while the COVID-19 pandemic poses unprecedented challenges for SMEs, it also creates unique opportunities for growth, adaptation, and the development of dynamic resilience strategies.

*Kuckertz and Brändle (2022) observed that entrepreneurship research on the COVID-19 crisis was framed through three main perspectives: uncertainty, resilience and opportunity. Later studies added additional perspectives, such as sustainability and supply chain management emphasizing how organizations adapt to crises. Sustainable development involves balancing economic, environmental and social goals to create long-term value (Su et al., 2022). Ardolino et al. (2024) drew attention that the COVID-19 pandemic disrupted global **supply chains** to an unprecedented extent which underlined the urgent need for resilience strategies for sustainable operations. Supply chain resilience is highly dependent on teamwork, organisational culture, competencies, effective information systems and access to finance (Mishra and Singh, 2023). Effective*

resilience requires both proactive and reactive preparedness during different phases of a crisis, and builds on the core characteristics of preparedness, responsiveness, adaptability and learning (Krishnan et al., 2022; Akula & Singh, 2021).

COVID-19 has accelerated digitalization across multiple fronts, with increased reliance on social media, digital platforms, and data processing technologies bringing significant innovations (Elkhwesky et al., 2024). The COVID-19 pandemic highlighted the need for more resilient and sustainable industrial models, prompting the European Union to introduce Industry 5.0 in 2021 (Madhavan et al., 2022). This new paradigm represents a shift from a purely technological focus to a “techno-social” approach, emphasizing resilience, social impact, and sustainability alongside technological advancement. Senin et al. (2024) and Omar & Sulaiman. (2023) discuss how Industry 4.0 and 5.0 technologies can support the digitalization of SMEs, and underscore the importance of understanding the factors that drive technology adoption among SMEs.

The COVID-19 pandemic particularly underscored the value of digital financing as a lifeline for SMEs but the transition to these solutions remains challenging for many SMEs (Ardolino et al. 2024, Pellegrino and Abe, 2022; Omar & Sulaiman, 2023). However, the rapid adoption of technology, as Lim (2022) notes, has reached unprecedented levels. According to Hossain et al. (2022), businesses that maximized their use of digital platforms - through technology, digital marketing, and innovation - achieved notable success and profitability. Sharma et al. (2022) further highlight that digitalization is not only transforming work and life but is also strategically reshaping the global economy.

Epidemics and pandemics leave lasting impacts on the economy and society, altering more than just immediate business landscapes (Belitski et al., 2022, Tokarz et al., 2021). The COVID-19 pandemic has become a defining event that has not only prompted survival strategies but has also introduced a new era, widely recognized as the “new normal” (Lim, 2022). This "new normal" reflects a period of sustained shifts in the ways businesses, especially SMEs, operate, adapt, and strategize in a post-pandemic environment. As noted by Hossain et al. (2022) a dynamic, resilient strategy model is needed for SMEs to effectively navigate future challenges.

Various crises - ranging from the global financial crisis and natural disasters to geopolitical threats and, most recently, the COVID-19 pandemic - have significantly impacted organizations, driving the need for resilience in operations and supply chains

(Krishnan et al., 2022). In the fourth year after the outbreak of COVID, it is necessary to examine the impact of COVID-19 on entrepreneurs and SMEs, based on the entrepreneurs' perceptions, and to compare it with the research results and identify possible research gaps. Given the ongoing uncertainties in the global economy, it is crucial to understand how SMEs adapted to the post-pandemic "new normal."

1.3.1 Questionary survey-based insights on COVID-19's impact on SMEs

The COVID-19 pandemic placed significant financial and operational pressure on SMEs. A survey by the National Bank of Hungary (MNB, 2020a) conducted during the initial wave revealed that nearly half of respondents faced revenue declines exceeding 30%, anticipated further substantial losses, and reported severe challenges due to major supply chain disruptions and limited substitution options. Many respondents also cited liquidity issues, particularly in meeting tax and wage obligations. While 55% of firms aimed to retain their workforce, most considered pre-crisis staffing levels sustainable for only two months. Similar findings emerged from an EC (2021) survey conducted in late 2020 across nine EU Member States, which reported that 21% of European SMEs faced temporary closures, over 60% saw significant sales declines (rising to 80% in Spain and Italy), and many encountered liquidity shortages that threatened their survival.

In addition to these reports by the MNB (2020a) and the EC (2021), several survey-based studies also explored the pandemic's impact on SMEs. Siuta-Tokarska (2021) examined Polish SMEs, Lu et al. (2021) focused on Chinese SMEs, and Juergensen et al. (2020) studied SMEs across Europe. From these studies, summarized in Table 1, we identified five key areas of impact:

1. **Operational Disruptions:** COVID-19 containment measures, including national lockdowns, required companies to adapt rapidly to regulatory changes. These restrictions led to local production disruptions, factory closures, and material shortages (Tang et al., 2021; Boone et al., 2020). Operational restrictions also presented labor challenges, with demand for flexible and safe work arrangements driving many companies to adopt hybrid or remote work models, which, while potentially enhancing employee satisfaction, complicated team coordination (Bolisani, 2020).
2. **Demand-Side Changes:** The pandemic drastically altered consumer habits, leading to a surge in e-commerce while sectors like entertainment, tourism, and hospitality

saw severe declines (Sheth, 2020; Uğur and Akbiyik, 2020). Companies had to adapt swiftly, often by enhancing their digital presence or introducing new products and services.

3. **Supply Chain Disruptions:** Global supply chain issues, including component shortages and shipping delays, significantly affected sectors such as automotive, electronics, and healthcare (Xu et al., 2020). In response, companies adopted strategies like favoring local suppliers and rethinking inventory management to better prepare for future disruptions.
4. **Financial Difficulties:** Economic instability heightened financial stress, making borrowing and investment riskier for many firms. SMEs struggled to adapt to these conditions, often requiring external financial support and focusing on cash preservation over expansion (Tawiah and O'Connor Keefe, 2024).
5. **Digitalization:** The pandemic accelerated digital technology adoption, compelling companies to shift to online sales and remote work. This shift required developing digital solutions and platforms to sustain productivity and efficiency (Amankwah-Amoah et al., 2021).

These wide-ranging impacts reshaped business fundamentals, from workforce management to investment strategies and financial planning. The challenges and lessons of the COVID-19 crisis have driven long-term changes within firms, necessitating new solutions to enhance resilience for future crises.

1. Table: Main categories of COVID-19's impact and consequences on SMEs

Category	Subcategories	Impact on SMEs	Source
Operational disruptions	Operational restrictions	Restrictions during the pandemic severely impacted SMEs, especially with closures of shopping centers and restaurants.	Siuta-Tokarska (2021), Juergensen et al. (2020), Lu et al. (2021),,
	Digital infrastructure deficits	SMEs were forced to make digital upgrades, such as introducing online sales channels and enabling remote work.	Juergensen et al. (2020)
	Labour challenges	Productivity was impacted by remote work, health measures, new safety regulations, employee absences due to quarantine or illness, and challenges in providing adequate protective measures for workers.	Siuta-Tokarska (2021) EC(2021)

Category	Subcategories	Impact on SMEs	Source
Demand side changes	Demand volatility	Demand declined due to lockdowns and reduced consumer confidence, particularly affecting companies focused on the consumer market.	Siuta-Tokarska (2021) Juergensen et al. (2020) Lu et al. (2021), MNB (2020a); EC(2021)
	Changes in Consumer behaviour	Lockdowns and social distancing measures led to changes in consumer habits that directly impacted SMEs.	Siuta-Tokarska (2021) Juergensen et al. (2020)
Supply chain disruptions	Logistical challenges and raw material shortages	Shipping disruptions and labor shortages delayed product shipments, with manufacturing facing raw material shortages.	Juergensen et al. (2020) Lu et al. (2021), MNB (2020a) EC(2021)
Financial difficulties	Liquidity shortage	Many SMEs faced short-term financial problems, with some only able to survive for three months	Siuta-Tokarska (2021) Juergensen et al. (2020) MNB (2020a)
	Cash-flow volatility	Reduced income and delays in payments created cash flow issues, especially for SMEs	Lu et al. (2021)
	Need for external support	SMEs often required external support and government assistance.	Juergensen et al. (2020), MNB (2020a), EC(2021)
	Decline in investments	The COVID-19 pandemic caused a sharp decline in SME investments as funds were redirected to immediate survival needs.	MNB (2020a)
Digitalization	Acceleration of digital transformation	The COVID-19 crisis pushed SMEs to accelerate digital transformation, making remote work and online sales channels crucial for staying operational.	Juergensen et al. (2020), EC(2021)

Source: Own editing – based on the selected questionnaire survey literatures

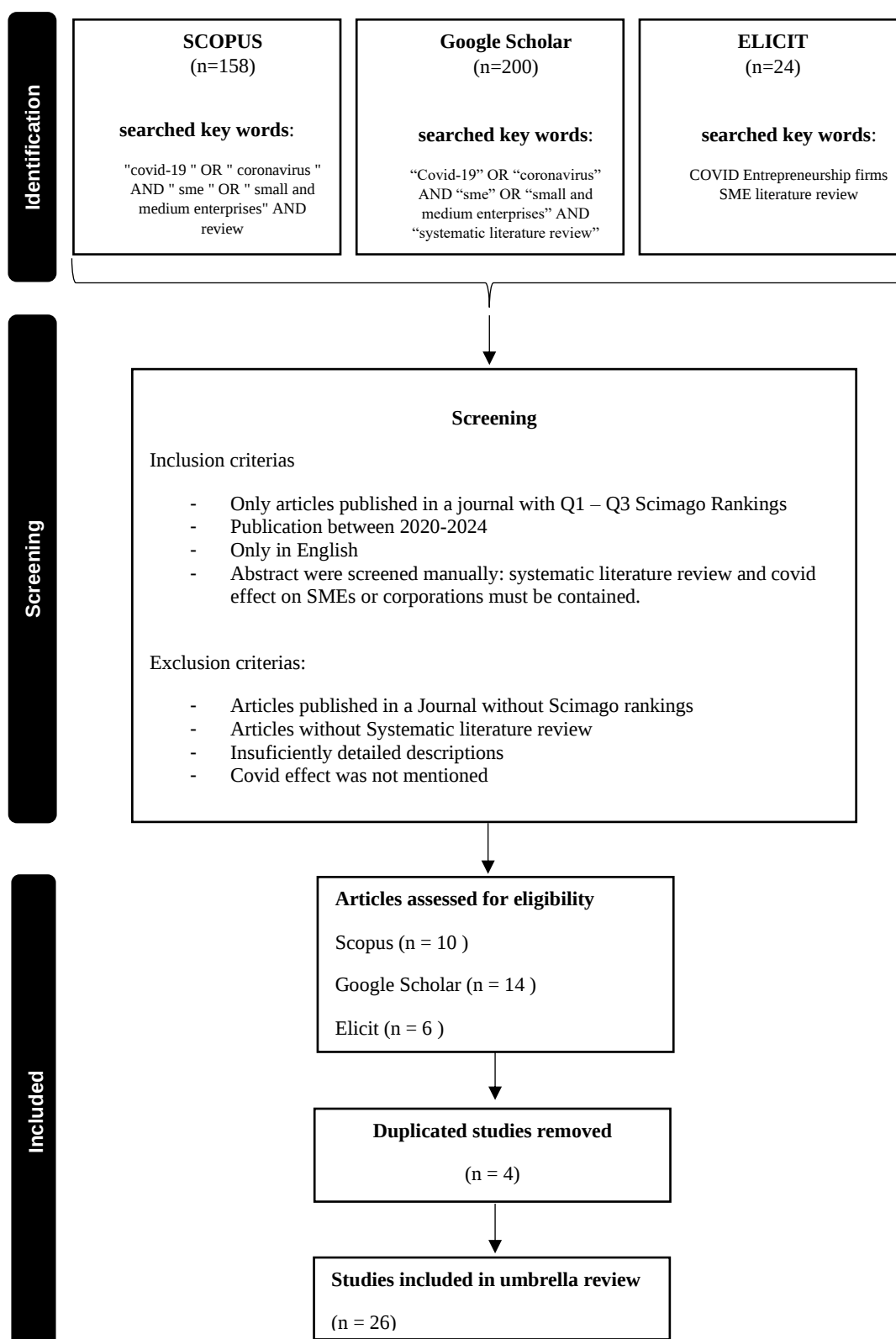
1.3.2 Umbrella review

Umbrella reviews employ systematic methods to collate multiple systematic reviews and meta-analyses, providing a comprehensive summary of findings on a specific research question (Faulkner et al., 2022). Key steps in umbrella reviews include defining the scope, establishing search and exclusion criteria, and conducting the analysis (Biondi-Zoccai, 2016). This relatively new research method is often referred to as “umbrella reviews,” “overview of reviews,” or “review of reviews.” With the growing volume of published studies, there is an increasing need for such syntheses to guide policy, practice, and future research.

Our comprehensive review follows a structured three-phase approach, as illustrated in the PRISMA flowchart (see Figure 2): Identification, Screening, and Inclusion. In the Identification stage, we conducted a thorough search of academic databases using three search engines: Scopus, Google Scholar, and Elicit. Scopus, known for its extensive peer-reviewed content (Baas et al., 2020), provided a robust foundation of established publications. Google Scholar, with its broad indexing and relevance-based ranking, highlighted both widely cited and recent articles. Additionally, Elicit, an AI research assistant, helped refine searches and identify studies closely aligned with our criteria, enhancing both precision and scope. We searched for terms like “Literature review,” “Systematic literature review,” “SME,” and either “COVID-19” or “Pandemic” within titles, abstracts, and keywords. During the Screening stage, we reviewed articles based on titles and abstracts, removing irrelevant studies not focused on COVID-19's impact on SMEs or those not employing SLR methods. Only articles from Q1 to Q3 journals in the Scimago ranking were considered. In the Eligibility stage, we reviewed the full texts of the selected articles, removed duplicates, and finalized 26 relevant systematic literature reviews.

For the final step, we developed a conceptual map. Keywords from the selected SLRs were manually extracted from abstracts, reviewed, and standardized by (a) converting plural terms to singular and (b) unifying keywords where various terms referred to similar concepts (e.g., COVID-19 and Coronavirus). The concept map was based on these standardized keywords and the article titles.

2. Figure: PRISMA flowchart



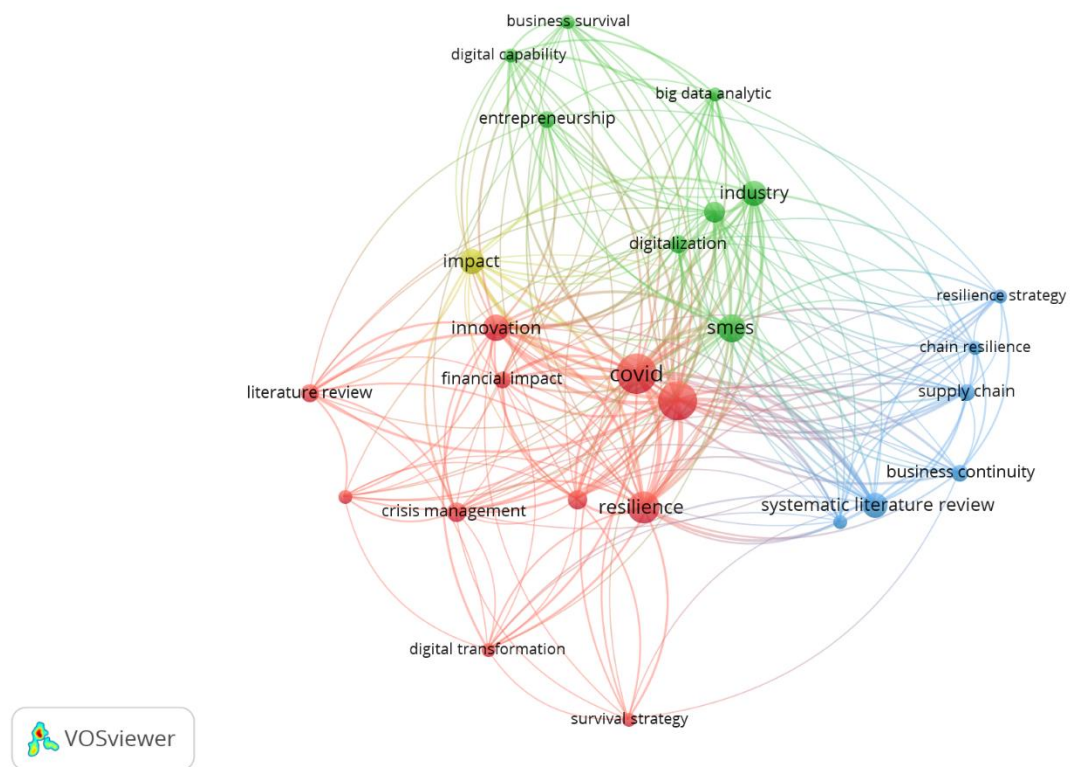
Source: own work

Of the twenty-six articles included in the analysis, 14 were published in Q1-ranked journals, 9 in Q2, and 3 in Q3 according to the Scimago Journal Ranking. As of November 2024, the average number of citations per article was 108. The three most highly cited publications were Belitski et al. (2022) with 589 citations, Spieske and Birkel (2021) with 388 citations, and Khlystova et al. (2022) with 354 citations, indicating a promising outlook for research on this topic and a robust presence of high-quality publications.

We focused on SLRs published between 2020 and September 2024; however, no relevant journals from 2020 met our screening criteria. Of the 26 studies, 4 were published in 2021, 12 in 2022, 4 in 2023, and 6 in 2024, with 2022 standing out as an exceptional year in terms of publication volume. There was no significant concentration of articles within specific journals, as they were broadly distributed, with only two instances of articles appearing in the same journal.

The network analysis reveals several key clusters and interconnections among concepts related to the impacts of COVID-19 on SMEs (see Figure 3). The green "digitalization" cluster highlights the critical role of technological adoption and innovation in mitigating the pandemic's negative effects. This suggests that SMEs able to quickly adapt to digital technologies and e-commerce were better positioned to withstand the crisis. The red "crisis management" cluster emphasizes the importance of resilience in facing unexpected disruptions and is closely tied to crisis management and business survival strategies. The blue "supply chain" cluster underscores the fragility of global supply chains and the need for increased resilience. While the "financial impact" is grouped within the "crisis management" cluster, its distinct characteristics warrant separate attention, as highlighted by four papers that discuss it specifically. This "financial impact" cluster addresses the severe economic challenges faced by SMEs during the pandemic, including liquidity shortages, revenue declines, and increased debt levels."

3. Figure: Concept map based on the title of the selected SLRs and keywords identified by authors from abstracts



Source: Own editing with using of VOSviewer

1.3.3 The financial effect of COVID-19 on entrepreneurs

After reviewing the survey-based findings in Section 1.3.1, which identified four key aspects of financial difficulties - namely liquidity shortages, cash-flow volatility, a drop in investments, and the need for external support - the next step is to explore how these challenges were reflected in firms' actual financial statements. While the surveys provided important insights into SMEs' perceived difficulties during the COVID-19 crisis, I aimed to complement this perspective by examining publications based on firm-level financial data. This section therefore reviews empirical studies that used corporate financial databases to examine the real financial effects of the pandemic across various countries and industries (see Table 2).

2. Table: Empirical studies on the financial impact of COVID-19 on companies

<i>Impact category</i>	<i>Source</i>	<i>Database / Scope of analysis</i>
Revenue	<i>Bloom et al., 2021;</i>	Survey data on 2,500 US small businesses
	<i>Lalinsky & Pál, 2021</i>	Bisnode database Slovakian non-listed firms
Profitability	<i>Deghi et al., 2021;</i>	S&P Capital IQ: listed companies G7 countries
	<i>Lassoued & Khanchel, 2021</i>	Thomson Reuters database – listed firms in 14 European countries.
Cash-flow	<i>Deghi et al., 2021</i>	S&P Capital IQ: listed companies G7 countries
Liquidity / Cash holding	<i>Banerjee et al., 2020;</i>	S&P Capital IQ: 40,000 listed and large unlisted firms across 26 countries
	<i>De Vito & Gómez (2020)</i>	COMPUSTAT: 14,245 listed companies
	<i>Chung et al., 2023</i>	FnGuide: listed companies in Korea
Equity shortfall	<i>Carletti et al. (2020)</i>	ORBIS database: 83,621 Italian firms
Financing	<i>Li et al, 2020;</i>	Federal Reserve's FR 2644 data set in US
	<i>Acharya, V. V., & Steffen, S. (2020).</i>	S&P's Loan Commentary and Data (large public corporations)
Investments	<i>Jiang et al (2021)</i>	CSMAR database: Chinese listed companies
Dividend	<i>Krieger et al., 2021;</i>	COMPUSTAT and CRSP: 1,400 listed companies
	<i>Ali, 2021</i>	Thomson Reuters Eikon: 8,889 listed companies
Zombification	<i>Schivardi et al., 2020</i>	Italian Firm Register (Cerved):
	<i>Helmersson et al. (2021),</i>	ORBIS database: 13 million firm-year observations for euro area
	<i>Hoshi et al. (2023),</i>	Credit report compiled by Tokyo Shoko Research and firm survey: 4093 Japanese firms

Source: Own editing – based on the selected literatures

Overall, the literature review and our research show that as of November 2024, the impact of COVID-19 on businesses, based on financial data, is still not well explored. This highlights the need for further studies in this area, both at the sectoral and country level. During the first wave of the pandemic, financial research on corporate sector had limited access to accounting data, relying primarily on quarterly reports of publicly traded firms and stock market movements (Shen et al., 2020; Al-Awadhi et al., 2020). Shen et al. (2020) identified eight industries as particularly high-impact sectors: tourism, film and television entertainment, hospitality, retail, transportation, real estate, construction, and manufacturing with significant export exposure. These industries, characterized by high labor intensity, social interaction, and cross-border trade, were severely affected by lockdown measures, as demand for their products and services plummeted in response to mobility restrictions and economic uncertainty.

Subsequent research expanded the analysis of financial impacts and examined different aspects. The crisis led to sharp declines in revenue (Bloom et al., 2021; Lalinsky & Pál, 2021), and deterioration in profitability, firms' cash flow generation capacity (Deghi et al., 2021). In the short term, the Covid crisis pressured corporate liquidity by significantly disrupting cash flows, as many firms had to face substantial deficits and struggled to adjust expenses in line with declining revenues (Banerjee et al., 2020; Deghi et al., 2021). In contrast, certain firms increased their cash holdings due to the precautionary motive (Chung et al., 2023). Jiang et al. (2021) highlighted that firms with greater cash flexibility were better able to sustain investment during the COVID-19 crisis, and underscore the importance of financial reserves in times of shock. In contrast, Carletti et al. (2020) emphasized that the COVID-19 crisis not only stretched firms' liquidity but also significantly eroded their equity, based on a large sample of Italian firms, highlighting structural vulnerabilities across size, leverage, and industry.

As a consequence of economic uncertainty, many firms adjusted their dividend policies to preserve their liquidity and capital, particularly due to their high levels of indebtedness (Krieger et al., 2021; Ali, 2021). Lassoued & Khanchel (2021) found that publicly traded firms actively „managed to minimize” reported losses in 2020 to restore investor confidence. The crisis also triggered extreme volatility in stock markets, leading to sharp declines in major indices worldwide (Baker et al., 2020; Didier et al., 2021). Given these financial pressures, governments introduced various policy interventions to stabilize corporate operations and liquidity positions (Demmou et al., 2021).

One crucial way companies survived the crisis was through „hibernation”, as described by Didier et al. (2021). This crisis management approach involves temporarily reducing operating costs by minimizing or shutting down operations while they maintain the relationships with key stakeholders and preserve human and physical capital for reopening. Another important strategy was securing liquidity by drawing down on committed credit lines. Studies by Li et al. (2020) and Acharya & Steffen (2020) show that, in the face of declining revenues and rising uncertainty, many firms rushed to convert available credit into cash - a phenomenon referred to as a "dash for cash" - to ensure operational continuity and financial flexibility. This massive liquidity demand was especially strong among lower-rated firms, as highlighted by Acharya & Steffen (2020). This strategy enables firms to minimize debt accumulation during periods of economic distress, preventing an excessive debt burden that could lead to a prolonged debt overhang and the emergence of zombie firms (Didier et al., 2021).

Finally, a set of papers examined whether COVID-19-related support measures kept unviable firms alive and, as a consequence, increased the risk of zombification (Schivardi et al., 2020; Helmersson et al., 2021; Hoshi et al., 2023).

However, a common limitation of these studies was that they mainly analyzed publicly traded companies, so they did not provide meaningful insights into the impact on small and medium-sized enterprises (SMEs). Furthermore, these analyses mostly relied on data from the year of 2020 and therefore did not assess the long-term effects of the crisis. In addition, many of the studies focused on single countries or regions (e.g. the US, Japan, or Italy), and as a result their findings do not apply well across the EU. It is also notable, no firm-level financial analysis has been conducted for Hungary.

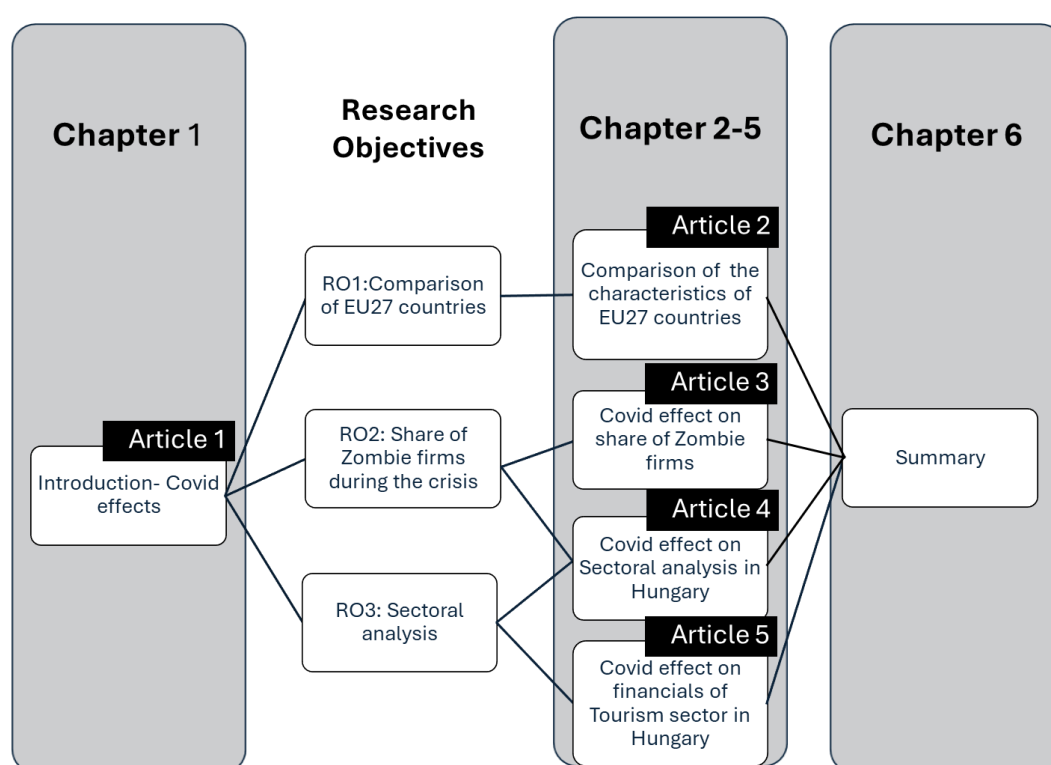
1.4 Research objectives and research questions

This chapter presents three main research objectives and links them to the corresponding articles. As explained earlier in Section 1.1, the first article justifies the subsequent research based on international literature, so its relevant parts are presented in the introduction while the other four articles represent separate research. Although the four studies focus on different research questions, theories and methods, they are still connected theoretically and practically, and together they provide a coherent conceptual framework for the dissertation.

The diagram below presents the structure of the dissertation, linking the research objectives with the corresponding articles. It visually illustrates how each article contributes to addressing the key research objectives, organizing them within the chapters. The detailed research findings are discussed in Chapters II, III, IV and V. From a theoretical and methodological point of view, the articles build on each other to some extent, helping to give a better understanding of the topic (see Figure 4). Each study adds to the overall research, following a logical order.

The following subsection begins by introducing the relevant research context and background, which then leads to the formulation of the specific research objective and its associated research questions. This is followed by an overview of the data sources and methodological approaches applied.

4. Figure: Structural mapping of the dissertation: linkage of research objectives and articles



Source: own work

1.4.1 Research Objective 1: Comparison of European countries' crisis management strategies in the EU27 countries

At the beginning of the COVID-19 crisis, the EU27 countries responded to the economic shock of the epidemic with significant but very different lockdown restrictions (EC, 2022b; Goniewicz et al., 2020; Alemanno, 2020). To mitigate the economic impact of the crisis, many countries introduced different measures such as loan moratoria, public guarantees, subsidized loans, direct grants, tax deferrals, wage support and reliefs etc., but the extent, targeting and effectiveness of these varied from country to country (Alcidi & Corti, 2021; Dornean & Oanea, 2022).

In my professional experience as a corporate credit risk analyst, I observed that Hungarian companies actively utilized various lending support measures such as the moratorium, the state-subsidised loan schemes and public guarantee programs in Hungary (Kádár & Jáki, 2024; Drabancz & Marosi, 2021). However, it raises the question of whether these subsidies are really helping the economic recovery in the long term or only temporarily ease the problems.

Hence, I am interested in how far Hungary stands out among the EU27 countries with its crisis management strategy, and to what extent the nature and form of its support measures differ from those of other countries. Since Hungary is a member of the European Union and the COVID-19 crisis was managed within a common support framework, it is worthwhile to first compare its crisis management strategy in the context of the EU27. It should also be examined whether a nation's level of preparedness - such as the strength of its healthcare system and institutional capacity - has influenced the strictness of containment measures, and thereby the success of its economic response measures.

In line with these considerations, the first research objective of this dissertation (**Research Objective 1**) focuses on examining and comparing the crisis management strategies employed across the EU27 countries.

In **Article 2 (Chapter 2)** the purpose of our research is to categorize EU27 countries based on their preparedness, economic impact and policy responses and explore these differences through cluster analysis. Ultimately, our aim is to show how different patterns can be observed among the strategies of the EU27 countries and where Hungary fits into this. Since firm-level data on received subsidies were not available, the analysis of the

distribution of support measures was conducted at the aggregated national level across countries.

To achieve Research Objective 1, the study in Article 2 explores the following research questions:

- *A2.RQ1: How can the EU27 countries be grouped based on their preparedness for the challenges of COVID-19, as well as their responses to protection measures and the resulting health and economic impacts?*
- *A2.RQ2: How do the levels (as a percentage of GDP) and forms of European Commission-backed state aid measures differ across the identified clusters of EU27 countries?*

The data used in this study comes from publicly available records from Our World in Data platform and we organized into four main dimensions. (1) Preparedness: measured by HDI (Human Development Index) and hospital bed availability; (2) Protective measures: assessed using the Oxford COVID-19 Stringency Index and vaccination coverage; (3) Health impact: evaluated through excess mortality and reproduction rate; and (4) Economic impact: reflected by GDP change between 2019 and 2020, illustrating the economic disruption caused by the pandemic. We also examined publicly available data to examine the European Commission's The State Aid Temporary Framework (EC, 2022b) in order to identify patterns of economic support measures. This study is novel as used a multidimensional framework to assess COVID-19's impact, which investigates both the early phase of the crisis and its later stages (January 2020–April 2022).

In Article 2 we used information and indicators from the **‘Our World in Data’** (OWID) database, which is an open access data platform operated by the Global Change Data Lab, a UK registered non-profit organisation, in collaboration with researchers at the University of Oxford (Our World in Data, 2025). OWID databases are widely used by researchers, journalists and policy makers, particularly for the analysis of the COVID-19 epidemic. The data is also used by WHO on its official dashboard and by leading media platforms such as the New York Times and the BBC (Mathieu et al., 2020). The OWID database also includes the Stringency Index of **Oxford COVID-19 Government Response Tracker** (OxCGRT) compiles data on policies from over 180 countries, covering restrictions, health measures, and economic support. It includes a composite metric based on nine key indicators, such as school and workplace closures, movement

restrictions, stay-at-home orders, public information campaigns, and travel controls. This dataset helps researchers evaluate the impact of non-pharmaceutical interventions on the pandemic. (Hale et al., 2021)

Additionally, we used data published by the European Commission (EC, 2022b) examining the financial support measures implemented by EC under the **State Aid COVID-19 Temporary Framework** over the period 2020–2021. The dataset includes the nominal values of 15 different types of support, categorized by country and type. Our analysis concentrates on the four most significant categories: direct grants, subsidized loans, loan guarantees, and wage subsidies.

In order to identify patterns in EU27 countries groupings, we applied hierarchical clustering with Ward linkage to form comparable groups. A key methodological tool of my dissertation is cluster analysis, which techniques allow for the identification of homogeneous groups based on financial and economic variables, for example in cross-country and sectoral comparisons. Cluster analysis identifies groups of similar observations, maximizing within-group similarity while minimizing differences between clusters (Szüle, 2016). Building on the approach of Kovács (2014) and Szüle (2016), Article 2 and Article 3 initially employed Ward's method combined with the Squared Euclidean distance measure to form well-separated and homogeneous clusters of similar size. Ward's hierarchical clustering has also been frequently applied in recent EU27-focused COVID-19 studies employing similar grouping approaches (Roman et al., 2022; Czegezli et al., 2020; Fedajev et al., 2022). To refine the clustering and determine the optimal number of groups, we applied the Elbow Method and performed K-Means clustering in SPSS.

The novelty of the study is the comprehensive examination of the full two-year time period (2020-2021) of the COVID-19 crisis across all EU27 countries. In contrast, previous research typically focused only on specific phases of the pandemic and, consequently, provided only a partial understanding of its broader impacts.

1.4.2 Research Objective 2: The share of zombie companies during the time of Covid-crisis

Zombie firms are companies that continue to operate despite poor financial performance and weak long-term prospects. They survive mainly because of external support or easy access to credit. Typically, these firms show low productivity and persistently generate

insufficient cash flow to cover their interest payments, while relying heavily on debt (Banerjee and Hofmann, 2018; Acharya et al., 2022). The growing presence of zombie firms is a cause for concern, as they can retain resources that could otherwise be used by healthier, more productive businesses, which in turn can slow down overall economic growth and recovery (McGowan et al., 2018; Banerjee & Hofmann, 2022; Albuquerque & Iyer, 2024).

As the COVID-19 disease spread throughout Europe and globally, European Member States implemented relief measures to facilitate new lending and offer some liquidity to borrowers to ease the immediate economic impact. This includes actions such as moratoria on loan repayments, public guarantee schemes, supported loan programs, along with fiscal measures (EC, 2022b). Policy measures aimed at supporting businesses and the economy during the coronavirus pandemic may have unintentionally helped not only financially stable companies but also zombie companies. Helmersson et al. (2021) provided empirical evidence that despite the eligibility criteria of public support schemes, up to 90% of firms identified as zombies may have been eligible for such support programmes in the euro area. Consequently, concerns have arisen that the euro area economy could face increased zombification, potentially impeding the post-pandemic recovery (EBA 2020b; Pelosi et al., 2021; Laeven et al., 2020; Acharya et al., 2021; Bighelli et al., 2022).

According to the literature review, existing research has approached the topic from a theoretical view, with limited empirical analysis or focused on short-term effects. To the best of current knowledge, studies have not examined the evolution of zombie firm prevalence over an extended period, such as a three-year horizon (2020, 2021, and 2022).

Based on this background, Research Objective 2 aims to examine how the share of zombie firms changed during the Covid-crisis. A key question is whether the negative effects of the crisis and the introduced support measures contributed to the survival and increased presence of these firms.

As part of Research Objective 2, this study examines the following key questions:

- *A3.RQ1: Was the increase in the number of zombie firms in the manufacturing sector greater in countries with significant credit easing measures during the COVID-19 pandemic?*

- *A3.RQ2: How do the annual survival rates of firms identified as zombies over a two-year timeframe change from 2016 to 2022?*

In my dissertation, **Article 3** aims to fill this gap by thoroughly analyzing zombie firm trends across the EU27 over multiple years, which focused on the manufacturing sector within selected EU27 countries. The research aimed to examine how government interventions impacted Zombies' survival rates and whether these measures unintentionally kept financially weak firms in operation that might have otherwise exited the market.

In order to explore this tendency, in the first step we analyzed the extent of credit-facilitating measures and interventions introduced during the pandemic. This included state aid expenditures for guarantees and subsidized loans as a percentage of GDP, as well as the length and scope of payment moratoria. For the empirical analysis, we have used the following two variables from the European Systemic Risk Board data on credit moratoria in the EU27 countries: Moratorium Months describes the length of deferral period for loan repayments granted to non-financial corporates. Scope of Eligibility evaluates the type of moratoria as it was implemented with sector-specific or criteria-based implementation, and universal applicability without restrictions (ESRB, 2022).

Building on this examination, we selected two extreme clusters: one consisting of countries that provided the least financial support and another made up of those with the most extensive assistance. To identify these groups, we employed a three-step clustering approach based on the extent and type of government support measures. Following that, our focus was on how the proportion of zombie firms changed within these groups from 2016 to 2022. For this reason, we provided descriptive statistics and a cohort matrix approach.

In the following step we identified zombie firms using four distinct methodologies (McGowan, 2017; Schivardi, 2017; Storz, 2017; and own approach) and examined how their prevalence evolved over time. We use firm-level data from the ORBIS database managed by Moody's to identify zombie firms, more details about the database and its structure are provided in Appendix Section 1.6. It is important to emphasize that there is no universally accepted definition of zombie firms. As demonstrated in Article 3, previous research has applied various indicators and different combinations of them to classify these companies. Generally, we can conclude, our study adopted a broader classification

of zombie firms. In this framework, a company was considered a zombie if it had significant debt and its earnings generation was not sufficient to cover interest obligations. To be noted, some studies define zombie firms in a more restrictive manner, not only requiring financial distress but also assuming that the company continues to receive additional funding from a bank or financial institution. However, access to credit registry data would be required for this classification, which was not available to our research due to the strict GDPR regulations.

As part of the analysis, we calculated annual zombie firm ratios at the country level for the period 2016–2022 and examined their survival paths using a cohort matrix approach, following the methodology of Carreira et al. (2022).

In **Article 4**, I extend this analysis to the sectoral level, using financial data from Hungarian firms to assess the proportion of zombie companies and track trends during the COVID-19 crisis. The objective is to understand how the pandemic affected the presence of zombie firms across various sectors in Hungary using McGowan's (2018) methodology.

- *A4.RQ2: How did the proportion of zombie firms and undertakings in difficulty² change over this period in Hungary?*

To the best of my knowledge, this study is the first to provide a sectoral-level analysis of zombie firm prevalence in the Hungarian context, offering new insights into how sector-specific characteristics may influence zombification trends.

1.4.3 Research Objective 3: Sectoral analysis of corporate financial performance during the COVID-19 crisis

The COVID-19 pandemic and the measures introduced to mitigate its effects had a profound impact on the Hungarian economy. However, this impact was not equal across industries, some sectors were hit harder than others. The crisis significantly reshaped the corporate financial performance in many sectors (Shen et al., 2020; MNB, 2020b; MNB, 2021a; El-Meouch et al., 2024). During my work I observed in different credit applications, that the crisis had a marked influence on corporates' financial performance and debt service capacity across specific sectors. The credit assessments and screening process revealed that certain sectors, such as tourism, hospitality, and event management,

² The concept of 'undertaking in difficulty' is a competition law term that determines ineligibility for European Union and national state aid based on changes in equity. The concept is discussed in more detail in Article 4

were particularly affected by financial distress during the restrictions implemented in response to the COVID-19 pandemic (MNB, 2020b).

Although numerous studies have explored the financial impact of the pandemic as detailed in Chapter 1.3, the existing literature has primarily focused on macroeconomic data and financial market volatility, while more general firm-level financial analysis have received relatively less attention (Khan, 2022). Later, El-Meouch et al. (2024) also noted that early publications from 2020 were mostly sector-specific and concentrated on the resilience of businesses operating in the most heavily affected industries, such as tourism. Moreover, as detailed in previous sections, much of the existing research has concentrated on publicly listed corporations, and the financial circumstances of smaller enterprises were often overlooked, which also faced challenges during the crisis.

Based on the literature review it can also be concluded that, only a few studies in Hungary - such as those by KSH (2021) and El-Meouch et al. (2024) - have assessed sectoral vulnerability, and even these analyses were conducted at the broad national economic sector level (codes A–U). In contrast, it would be worth examining these impacts more deeply by analyzing data at the two-digit NACE level, which allows us to show important sub-sector differences.

Building on the macro- and firm-level perspectives discussed so far - namely, the limited availability of detailed, firm-level financial analyses across economic sectors in Hungary - **Research Objective 3 aims to provide a sectoral examination of corporate financial performance during the COVID-19 crisis.**

To achieve Research Objective 3 the study in **Article 4** explores the following research questions:

- *A4.RQ1: How did the sectoral financial performance of Hungarian small and medium-sized enterprises (SMEs) change during the COVID-19 pandemic.*

In **Article 4**, I seek to bridge this gap by providing an in-depth analysis of sectoral financial performance during the COVID-19 crisis in Hungary, relying on wide range of financial data. During this research, specific financial indicators are analyzed, such as the change in revenue, EBIT margin, or the rate of undertaking in difficulty, which ultimately examines the change in equity capital. The financial data for these indicators are available

from the ORBIS database and they help identify which sectors recovered quickly or which remained vulnerable for a longer period.

One of the main motivations behind Article 4 is to gain a better understanding of how different industries in Hungary coped with the financial pressures caused by the pandemic. This study fills a gap in the literature by offering a more detailed sectoral analysis with TEÁOR level 2 classification (sub-sector level), which represents an original contribution to the existing literature.

In this research, we used the ORBIS database as our primary data source, relying on financial data from over 68,000 Hungarian small, medium, and large enterprises for the period 2019–2022. The financial analysis focused on sectoral revenue developments, EBIT indicators, and changes in the proportion of undertakings in difficulty and zombie firms. To identify the sectors most affected by the crisis, we conducted a cluster analysis. We applied the TwoStep clustering algorithm, which is particularly advantageous as it can automatically determine the optimal number of clusters and efficiently handle large datasets. The methodological suitability and strengths of the TwoStep clustering method in handling mixed-type data and large datasets have been well-documented in the literature (Bacher et al., 2004).

In Article 4, we concluded that one of the most vulnerable industries during the COVID-19 crisis was the tourism sector due to the implemented lockdown measures. Building on these findings, and consistent with the aim of Research Objective 3 to provide a sectoral analysis of corporate financial performance, the research in **Article 5** conducts an in-depth investigation of two key tourism sectors - accommodation services (TEÁOR 55) and food and beverage services (TEÁOR 56) - along with their sub-sectors. In line with this objective, the following research questions are examined:

- *A5.RQ1: How did the revenue and operating profit (earnings before interest and taxes - EBIT) of the domestic tourism industry change in the period 2020-2022 compared to 2019?*
- *A5.RQ2: What level of fixed asset investments characterized the various subsectors of Hungarian tourism between 2016 and 2022?*
- *A5.RQ3: Can a pattern be identified in the companies that ceased operations between 2020 and 2023, based on geographical location and administrative settlement category in the two tourism sectors in Hungary?*

First, the analysis focuses on financial performance within the accommodation and food service sub-sectors. To achieve this, we analyzed both aggregated and median values of EBIT and revenue within the sub-sectors. Additionally, we assessed the intensity of fixed asset investments to understand how businesses managed capital expenditures during the crisis. For each year, the median of the EBIT margin and the median of the annual change in turnover at sector level was tested using a Wilcoxon test to verify whether there is a significant difference between the medians of two consecutive years. The use of Wilcoxon signed-rank tests to compare financial performance measures is well-established in the literature and has been effectively applied to corporate financial data in terms of firm-level financial performance (Aas & Pedersen, 2011), such as EBITDA and operating income, to detect shifts in profitability and operational efficiency over time (Bouwens et al., 2019).

To assess the impact of the polycrisis³ on firm's financial performance, we rely on data from the ORBIS database, covering all Hungarian tourism companies with financial reports available between 2016 and 2022. This broad dataset allows us to explore how these enterprises adapted to economic disruptions over time. The ORBIS database, widely used in international tourism research (Succurro & Boffa, 2018; Tobón Perilla et al., 2022; Paule-Vianez et al., 2024), provides the basis for our sectoral financial analysis.

Beyond financial indicators, our analysis explores the resilience of tourism-related firms, measured by the proportion of businesses that ceased operations across different geographic and administrative categories. To determine the significance of these differences, we applied a Z-statistic test.

The originality of this study is demonstrated through several aspects. First, it examined a large number of firms, offering a broad industry-wide perspective, which fills a gap in both domestic and international literature. Second, it highlights the territorial and administrative dimensions of business resilience. We aimed to integrate tourism and financial aspects from the perspective of the COVID-19 crisis, and our study contributes to a deeper understanding of the sector's economic dynamics.

³ The term polycrisis describes a situation where several crises - such as the COVID-19 pandemic, the energy crisis, and high inflation - occur at the same time and amplify each other, creating serious challenges for many sectors, including tourism.

1.5 Overview of the article involved in the dissertation

This dissertation combines firm-level financial analysis with cross-country and sectoral perspectives to better understand the economic impact of the COVID-19 crisis. Several articles (Articles 3, 4 and 5) use financial data from the ORBIS database, covering thousands of companies across different countries and sectors. For example, Article 3 focuses on manufacturing firms in selected EU countries, while Articles 4 and 5 examine sectoral trends in Hungary, including the tourism industry.

The dissertation is based on a qualitative and a number of quantitative methods to support the analysis. Article 1 employs an umbrella review methodology, Article 2 and 3 apply hierarchical clustering (Ward's method), Article 4 uses TwoStep clustering for sectoral classification, while Articles 3 and 5 incorporate statistical methods such as the cohort matrix approach, Z-tests and Wilcoxon signed-rank tests to assess financial dynamics and firm survival.

The five articles build on one another in a logical and cumulative structure: from a systematic literature synthesis (Article 1), through EU27-level comparisons (Article 2), to firm-level zombification analysis (Articles 3 and 4), ending with a detailed tourism sector case study (Article 5). This structure allowed me to explore the economic effects of the COVID-19 crisis from multiple perspectives and levels, which I believe contributes to a more comprehensive understanding of the topic. A summary of the five articles and their key methodological features is provided in Table 3 on the following page.

3. Table: overview of the article involved in the dissertation

	Article 1	Article 2	Article 3	Article 4	Article 5
Title	An umbrella review of systematic literature (2020–2024) and future directions for entrepreneurship	Spread and economical severity of the COVID-19 epidemic - Regional Comparisons for EU27 with Cluster analysis findings	Assessing the Evolution of Zombie Firm Dynamics in the EU During COVID-19: A Novel Identification Method and Comparative Analysis	Financial adaptation of sectors in the Hungarian economy during the coronavirus pandemic	On the trail of immunity: sectoral and regional features based on accounting reports of Hungarian tourism companies in the period of polycrisis
Status of the article	Published in Society and Economy	Manuscript before submission	Submitted to Studies in Economics and Finance	Published in Külgazdaság	Published in Területi Statisztika
Research method	Systematic literature review	Quantitative Research			
	Umbrella review	Hierarchical clustering (Ward's method)	Hierarchical clustering (Ward's method); Z-test; Cohort matrix approach	Two-Step cluster analysis	Analysis of aggregated data and median values; Z-test
Methodological references / justification	Faulkner et al., 2022	Kovács, 2014; Szüle, 2016; Czecezi et al., 2020; Roman et al., 2022; Fedajev et al., 2022	McGowan et al., 2017; Schivardi et al., 2017; Storz et al., 2017; Carreira et al., 2022	Bacher et al., 2004; Tseng and Wu, 2007	Aas & Pedersen, 2011; Bouwens et al., 2019
Main topic	Covid-19's impact on SMEs	Comparison of the characteristics of EU27 countries	Covid effect on share of Zombie firms	Covid effect on Sectoral analysis in Hungary	Covid effect on financials of Tourism sector in Hungary
Data collection	Publication between 2020-2024	Data for the period 01.2020 – 04.2022	Financial data from 2015 to 2022	Financial data from 2019 to 2022	Financial data for tourism sector from 2019 to 2022
Database	Scimago, Elicit, Google Scholar	Database of European Commission; Our World in Data Platform	ORBIS		
			ESRB, EBA	-	-
Sample size	26 studies	EU27 Country data	Financial data of 110,000–130,000 companies per year from five countries	68,000 companies in 74 different sectors	27,000 companies in tourism.

	Article 1	Article 2	Article 3	Article 4	Article 5
Research question(s) and hypotheses	RQ1: How has the COVID-19 pandemic impacted SMEs and entrepreneurs across different dimensions, and what are the primary effect categories identified in the survey-based literature and umbrella literature review?	RQ1: How can the EU27 countries be grouped based on their preparedness for the challenges of COVID-19, as well as their responses to protection measures and the resulting health and economic impacts? RQ2: How do the levels (as a percentage of GDP) and forms of European Commission-backed state aid measures differ across the identified clusters of EU27 countries?	RQ1: Was the increase in the number of zombie firms in the manufacturing sector greater in countries with significant credit easing measures during the COVID-19 pandemic? RQ2: How do the annual survival rates of firms identified as zombies over a two-year timeframe change from 2016 to 2022?	RQ1: How did the sectoral financial performance of Hungarian small and medium-sized enterprises (SMEs) change during the COVID-19 pandemic. RQ2: How did the proportion of zombie firms and undertakings in difficulty change over this period?	RQ1: How did the revenue and operating profit (earnings before interest and taxes - EBIT) of the domestic tourism industry change in the period 2020-2022 compared to 2019? RQ2: What level of fixed asset investments characterized the various subsectors of Hungarian tourism between 2016 and 2022? RQ3: Can a pattern be identified in the companies that ceased operations between 2020 and 2023, based on geographical location and administrative settlement category in the two tourism sectors in Hungary?

Source: own work based on the involved articles

1.6 Appendix to the Research context and framework - Financial database - ORBIS database

The research presented in Chapters 3-5 have quantitative nature and primarily based on corporates's financials and macroeconomical data. The company-level data necessary for our analyses are taken from the ORBIS database, which is managed by Moody's and available online. The database contains information on companies of approximately 489 million public and private enterprises worldwide, including Europe in a large number of countries (Moody's, 2024). This database was chosen because it is the largest database which provides financial data of European companies (Kalemli-Ozcan et al. (2015), and because it has been available to students through the Corvinus University Library's website since 2022.

The ORBIS database provides comprehensive firm-level data, including key items from balance sheets and income statements, as well as other publicly disclosed supplementary information from company registers, such as date of establishment or ownership structure, etc.).

Income statement and balance sheet data are derived from national business registers, which are governed by country-specific legal and administrative reporting requirements. Although reporting rules may differ due to the accounting specificities of each country, a major advantage of ORBIS is that provides harmonized financial data in a standard 'global' format to ensure worldwide company comparisons. (Kalemli-Ozcan et al. (2015)

The ORBIS database serves as the basis for several international publications in different topics, such as firm-level productivity, business dynamics or persistence of zombie firms (Bajgar et al, 2020), as well as in international tourism research (Succurro & Boffa, 2018; Tobón Perilla et al., 2022; Paule-Vianez et al., 2024). In addition to the Zombie firms study, there are several international publications on the other topics we have examined, which are also based on the ORBIS database, and these are mentioned separately in the methodology section of each article.

During the data download process, I have only included data from the non-consolidated accounts, as the database may contain some of the companies included in the scope of consolidation, so the same performance would be multiplied when examining the aggregated data. On the other hand, when examining the consolidated data, the scope of

consolidation may also include a company whose main activity does not belong to the sector I have examined, which could also introduce a bias. However, this condition does not exclude companies that have both types of accounts.

Bajgar et al. (2020) drew attention to the fact that the coverage and representativeness of ORBIS in OECD countries vary significantly over time and across countries. They emphasized that ORBIS disproportionately represents larger, older, and more productive firms while underrepresenting smaller, younger, and less productive ones. In terms of representativeness, we have estimated the downloaded firm data in each article, with Zombie firms having a coverage in the manufacturing industry ranging from 22-59% in each country, in Article 5 we estimate a coverage of 90% for the downloaded company data from the tourism related sector, and in Article 4, due to the lack of data on the number of domestic companies with at least 5 employees, an exact percentage cannot be given, but I estimate that the nearly 68,000 SMEs and large companies' financial data surveyed may provide a similarly high

2 MULTIDIMENSIONAL ANALYSIS OF COVID-19 PREPAREDNESS, IMPACT, AND ECONOMIC SUPPORT MEASURES REGARDING EU27

ABSTRACT

In this study we classify the EU27 countries based on their COVID-19 national preparedness (Human Development Index, hospital bed availability), health effects (excess mortality, reproduction rate), economic consequences of the crisis (GDP changes), and protective measures (Stringency Index, vaccination rates) during the covid-crisis and applies hierarchical clustering with Ward linkage to form comparable groups. Six clusters have emerged, four of them reflect geographical patterns or institutionalized groups, such as the Baltic States, the Mediterranean countries and the Visegrad Group 4 (V4), while Bulgaria forms a separate cluster. Central Europe was divided into Western and Eastern clusters. Additionally, it examines the European Commission's State Aid Temporary Framework program using public data and reveals notable patterns in terms of economic support measures. This study is novel as it used a multidimensional framework to assess COVID-19's impact, which investigates both the early phase of the crisis and its later stages (January 2020–April 2022). One limitation is the use of averaged data, which smooths short-term fluctuations and wave-specific insights. Another limitation is the focus on EC-funded aid, but it excludes national aid schemes. Our findings provide insight for policymakers and researchers on regional differences in pandemic response, economic impacts, and EU financial aid distribution.

2.1 Introduction

COVID-19 reached European countries in the spring of 2020 resulting in significant challenges to EU countries and revealing differences in preparedness, response coordination, and socio-economic resilience. However, many nations had high health security capabilities, and their pandemic responses varied considerably, ranging from strict lockdowns and comprehensive financial aid packages to more relaxed measures with limited government intervention. These differences highlight the complex interplay between economic structures, healthcare systems, and policy decisions in shaping pandemic outcomes. As previous studies have focused only on specific phases of the pandemic, they have limited the understanding of its broader impacts, which emphasizes

the need to examine the full two-year period (2020-2021) of the COVID-19 crisis across all EU27 countries.

Our dataset was sourced from public records, structured around four key dimensions. 1) Preparedness was measured using the Human Development Index (HDI) and hospital bed availability. 2) Protective measures were assessed by the Oxford COVID-19 Stringency Index (Hale et al., 2021), capturing government interventions such as lockdowns and movement restrictions and the vaccination coverage measures by the % of the population vaccinated at least once. 3) Health impact was evaluated through excess mortality and the reproduction rate, reflecting the direct and indirect consequences of the pandemic. Finally, 4) economic impact was quantified through GDP change between 2019 and 2020, highlighting the financial disruption caused by the pandemic in the first year.

The primary goal of the research is to uncover similarities and differences between the EU27 countries based on selected variables COVID such as pandemic response measures, economic performance, and the resilience of healthcare systems that reflect the multifaceted impacts of the COVID-19 pandemic. By grouping countries into clusters, we aim to highlight patterns that may reveal underlying structural characteristics and response strategies across the European Union. To explore these patterns further, we address the following research questions:

RQ1: How can the EU27 countries be grouped based on their preparedness for the challenges of COVID-19, as well as their responses to protection measures and the resulting health and economic impacts?

Financial support policies are important in promoting businesses and compensating them due to the restrictions implemented. Countries introduced temporary state aid measures backed by the European Commission in different degrees and forms (EC, 2022a).

RQ2: How do the levels (as a percentage of GDP) and forms of European Commission-backed state aid measures differ across the identified clusters of EU27 countries?

This research presents a novel, multidimensional approach to assessing the impact of the COVID-19 pandemic covering the period from January 2020 to April 2022, while prior research with cluster analysis focused on the initial crisis phase on early 2020 (Aristodemou et al., 2021, Dzurova & Květoň, 2021; Roman et al., 2022). The findings offer valuable insights for policy makers, economists and public health officials as they

highlight regional differences in pandemic preparedness, health impacts and economic outcomes across the EU27. The study can help us learn from the EU's crisis response, the allocation of financial support, experiences and consequences for the EU27, supporting future decision-making on crisis management and targeted interventions.

The remainder of the study is structured as follows: Section 2 discusses the literature; Section 3 presents the research question database and methodology; Section 4 presents the results and discussion; and Section 5 provides the conclusions.

2.2 Literature review

COVID-19 was first reported in November 2019 in Wuhan. On 30th of January 2020, the World Health Organization (WHO) declared COVID-19 a public health emergency of international concern, following on 11th of March 2020, COVID-19 was characterized as a pandemic (Kavaliunas et al., 2020; Cho, 2020). The COVID-19 pandemic first broke out in China and then in Italy, which was particularly hard hit by the first wave of the outbreak, and only China recorded more cases (Remuzzi & Remuzzi, 2020; Chen et al.; 2020). Despite high health security capabilities, most European countries struggled to respond quickly and effectively (Forman & Mossialos, 2021). While the European Commission has implemented common measures for member states and several strategies to address the emerging COVID-19 crisis (Goniewicz et al., 2020; Forman & Mossialos, 2021) the pandemic has still posed significant challenges for EU countries, revealing gaps in preparedness and coordination (Alemanno, 2020).

As a first step of protection, governments have tried to reduce the spread of the virus through general lockdowns to limit the health impact of the COVID-19 pandemic (Green & Loualiche 2021; Belitski et al.; 2022). National responses varied widely based on administrative systems and health system capacities. France's centralized approach contrasted sharply with Germany's decentralized model, while countries like Belgium and Italy adopted intermediate strategies (Bouckaert et al., 2020). Stricter restriction measures were often imposed in nations with weaker healthcare systems, such as Greece and Croatia, reflecting the inverse relationship between health system preparedness and the severity of restrictions (Aristodemou et al., 2021). Sweden's COVID-19 response differed from many European countries by relying primarily on voluntary measures and individual responsibility (Kavaliunas et al., 2020) and implementing the least restrictive measures such as public event cancellations, home confinement, workplace closures, and travel

restrictions (Aristodemou et al., 2021). While this approach resulted in higher mortality compared to neighboring Nordic countries, it was lower than in several other European nations (Kavaliunas et al., 2020). This diversity in policy approaches, described as "coronationalism", hindered broader European cooperation and coordination. Their institutional settings and administrative systems influenced differences in crisis management strategies among countries (Bouckaert et al., 2020). However, the pandemic also highlighted structural challenges in the EU. Countries with high government effectiveness and trust, such as Sweden and Germany, were slower to adopt restrictive measures, relying more on voluntary compliance. In contrast, Eastern European nations acted swiftly but struggled to sustain measures during subsequent waves, often misinterpreting early successes (Toshkov et al., 2022). The socio-economic impacts were uneven, with countries like Lithuania and Spain facing severe unemployment and fiscal pressures, while Hungary and Austria experienced relatively milder economic consequences (Aristodemou et al., 2021).

The COVID-19 pandemic caused significant excess mortality in European countries in 2020-2021, with significant regional variations. Studies have shown that mortality rates were influenced by factors such as healthcare capacity, restriction policies and vaccination coverage (Ziakas et al., 2022; Sobczak & Pawliczak, 2022). Socioeconomic factors also played a role, with lower life expectancy and income levels correlating with higher excess mortality in 2021 (Lopez-Gigosos et al., 2023). Overall, the health impact of the pandemic varied across countries, even within the European Union. The lack of an effective vaccine through the end of 2020 resulted in countries' struggle with restriction measures and healthcare administrative interventions as the only tools to mitigate multiple COVID-19 waves (Ziakas et al., 2022). The first vaccines were available from the end of 2020. Measures such as centralized vaccine procurement, the establishment of a European health emergencies response agency and coordinated economic support marked a shift toward more integrated solutions (Goniewicz et al., 2020; Paccès & Weimer, 2020). The European Commission has played a leading role in regional vaccine supply (Deters & Zardo, 2023). Citi & de la Porte (2022) found that higher vaccination rates are associated with lower COVID-19 mortality in EU countries. Ziakas et al. (2022) in the EU looked at cumulative mortality in relation to the pandemic and found that the proportion of fully vaccinated directly influenced relative mortality.

The mandatory social distancing and government-imposed lockdowns have resulted in economic shocks for many economic actors (Kuckertz et al., 2020) and economic activity has declined at an unprecedented rate (Coibion et al.; 2020a; Ravindran & Shah, 2020). The governments provided immediate support to maintain adequate liquidity for companies and to ease the immediate negative impact of the sudden freeze in economic activity. As a quick response, the national authorities introduced moratoria on loan repayments for borrowers in financial difficulty, as well as different public guarantee schemes to support the banks' lending activity (European Central Bank, 2020). In response to the COVID-19 pandemic's economic effect, also the European Union introduced the COVID Temporary Framework for State aid, allowing Member States to provide targeted and flexible support to businesses in the forms of guarantees, loans and direct grants. Between mid-March 2020 and the end of 2021, Member States committed budgets totaling approximately EUR 3.01 trillion in State aid measures, of which around EUR 940 billion - 3.4% of the EU's GDP on an annual basis - was actually used (Cannas et al., 2022). This framework was adapted six times to address the evolving challenges of the pandemic, enabling unprecedented levels of aid while offering a range of options to strengthen the economies of the European Union effectively.

Several studies have used cluster analysis to examine variations in COVID-19 impacts and policy responses across European countries or regions. Bucci et al. (2022) identified regional disparities in pandemic outcomes, showing that some areas recovered after early waves, while others experienced later surges. Dzurova & Květoň (2021) found that stricter early interventions correlated with lower mortality but later faced challenges, as seen in Czechia. Aristodemou et al. (2021) linked health system resilience to government responses, showing that less-prepared countries, like Hungary and Croatia, imposed stricter measures with significant socio-economic costs. Furthermore, their findings highlighted that stricter measures were associated with more substantial socio-economic consequences, emphasizing the trade-offs governments faced in balancing public health and economic stability. Roman et al. (2022) assessed tourism disruptions, highlighting severe declines in tourism-dependent economies. Czezele et al. (2020) explored fiscal and labor market vulnerabilities, finding that job-preserving policies mitigated unemployment despite industrial slowdowns. Despite differing focuses, these studies underscore the utility of clustering methods in identifying pandemic patterns and informing crisis management strategies.

2.3 Database and methodology

The analysis relies on the publicly available daily epidemiological situation and healthcare capacity data sourced from the Our World in Data platform downloaded on March 6, 2023 (Mathieu et al., 2020) and on the GDP-related information obtained from the Eurostat database available up to March 4, 2023 (Eurostat, 2023). We consider data for the period from January 2020 to April 2022. First, the examined country-level data exhibit high variability, particularly across different pandemic waves, making a two-year timeframe essential for capturing more stable trends and mitigating the impact of short-term fluctuations. Second, by early 2022, the health crisis in Europe had significantly eased, supported by a relatively high vaccination rate and the progressive relaxation of restrictive measures. In line with this, the European Commission announced in May 2022 that the State aid COVID Temporary Framework would not be extended beyond June 30, 2022, reflecting a shift in crisis management policies. Additionally, from February 2022 onwards, the outbreak of the Russian-Ukrainian conflict marked the beginning of a broader period of polycrisis, introducing economic and geopolitical uncertainties that extended beyond the direct impacts of COVID-19 (Rokicki et al., 2023).

2.3.1 Variables

The variables were carefully chosen to capture the multidimensional nature of the COVID-19 crisis and enable meaningful comparisons across countries. In the first round, we investigated several variables to represent the four aspects under study. As cluster analysis requires minimal correlation between variables, we narrow the range of variables along the four aspects to avoid intercorrelation. Lastly, seven variables with sufficiently low intercorrelation were chosen, offering a comprehensive assessment of the COVID-19 pandemic across four distinct dimensions, providing a holistic perspective (see Table 4).

Countries' preparedness was measured using two variables: *Human Development Index* (HDI) and *number of hospital beds per 1,000 people (number of hospital beds)*. The HDI is a composite measure of life expectancy, education, and income levels; we took the 2019 data. HDI values reflect broader socioeconomic conditions that influence a country's ability to respond to crises. The *number of hospital beds* was used as a proxy for healthcare system preparedness. For this analysis, we relied on 2019 data, which offer a pre-pandemic baseline for evaluating each country's capacity to manage healthcare demands during a crisis. Similar indicators were used by Aristodemou et al. (2021) in

their Health System Preparedness Index, while Simakhova et al. (2022) also examined HDI and healthcare financing to assess healthcare preparedness across Europe.

To consider the **protective measures** against the spread of the virus, we used two factors. The first line of protective measures was the implementation of lockdowns, quantified by the stringency index. The second was vaccination, which became available in Europe at the beginning of 2021, in the second year of the pandemic. This was assessed as the percentage of the population vaccinated. The *Oxford COVID-19 Stringency Index* is a composite metric derived from nine government response indicators, including school and workplace closures, restrictions on gatherings and internal movements, stay-at-home orders, public information campaigns, and international travel controls. Each indicator contributes to a daily score ranging from 0 (no restrictions) to 100 (strictest response). For this study, the average stringency score for each country was calculated from January 2020 to April 30, 2022. This metric reflects the overall intensity of government measures to restrict the virus's spread during the pandemic. The *vaccination rates* were calculated as the proportion of the population that received at least one vaccine dose by April 30, 2022. A related approach was taken by Aristodemou et al. (2021) in their Government Response Confinement Index, which measured lockdown severity across six dimensions, while Dzurova & Květoň (2021) examined restrictions like border closures and emergency declarations to assess policy responses in Europe.

The health impact was assessed using two variables. First, *excess mortality* was included, which represents the number of excess deaths per one million inhabitants. It was calculated by comparing the actual number of deaths during a specific period with the expected number of deaths for the same period if the COVID-19 pandemic had not occurred. We used data up to April 30, 2022. Overall, this metrics help in understanding mortality impacts, including indirect effects such as healthcare system overload and countries can be compared on this basis. A comparable approach was taken by Simakhova et al. (2022), who analyzed COVID-19-related deaths per million people as a key indicator of health impact. Similarly, Dzurova & Květoň (2021) examined case fatality rates and crude death rates to assess the severity of the pandemic across European countries. Second, the *reproduction rate* was considered, which is the median number of new infections caused by a single infected individual. If the rate exceeds 1, the infection can spread within the population. If it falls below 1, the number of cases in the population will gradually decline to zero. For the reproduction rate, we calculated the range of the

reproduction rate during the period as this metric effectively reflects the extremes of the virus's spread and the critical points of the epidemic's dynamics. The value of the metric is calculated as the distance between the maximum and minimum values.

The **economic impact** of the pandemic was captured using *changes in GDP* between 2019 and 2020. This variable reflects the economic disruption caused by the lockdowns imposed to mitigate the spread of the pandemic. Aristodemou et al. (2021) included GDP changes in their Socio-Economic Impact Index alongside unemployment and fiscal stimulus, while Roman et al. (2022) linked GDP declines to tourism losses, highlighting industry-specific impacts.

4. Table: Factors for clustering the EU27 countries along the impact of the COVID-19

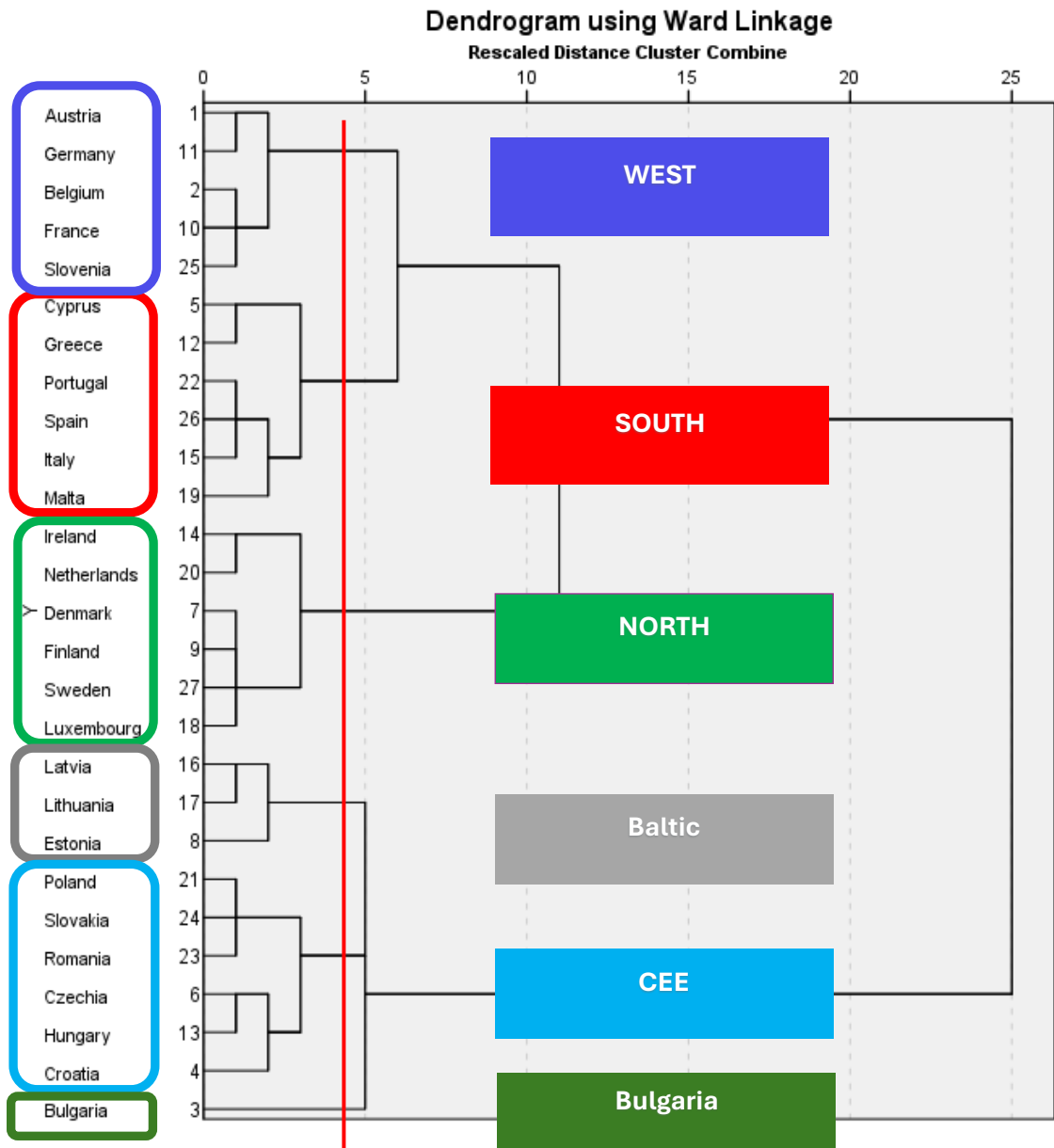
Factors	Meaning?	Category	Source
Stringency Index	Composite measure based on nine response indicators regarding closure. Score ranging from 0% to 100%. average stringency score from January 2020 to April 2022	Protective measure	Our World in Data - Oxford database (Hale et al, 2021).
Vaccination rate	Total number of people who received at least one vaccine dose until April 2022, divided by the total population of the country	Protective measure	Our World in Data (World Health Organization, 2023)
Excess Mortality	The difference between the reported number of deaths from January 2020 to April 2022 and an estimate of the expected deaths for that period had the COVID-19 pandemic not occurred.	Health Impact	Our World in Data (The Economist & Solstad, 2021).
Reproduction rate	The reproduction rate represents the average number of new infections caused by a single infected individual. Daily data from January 2020 to April 2022, calculated the max-min values.	Health Impact	Our World in Data (Arroyo-Marioli et al., 2023)
Available Hospital bed	Hospital beds include inpatient beds available in public, private, general, and specialized hospitals (bed per thousand in 2019)	Preparedness	Our World in Data (World Bank Group, (2023)
HDI	Measuring human development helps us understand how people's lives and livelihoods vary across the world and how they have changed over time. Score ranging from 0 to 1	Preparedness	Our World in Data (United Nations Development Programme, 2020)
GDP Change	GDP change in the first year of COVID-19 crisis: change between 2019-2020	Economic Impact	Eurostat (2023)

Source: own work

2.3.2 Cluster analysis

These seven variables capture the stringency of government responses, health impacts, and socioeconomic conditions shaping countries' pandemic experiences (see Table 4). This multidimensional approach ensures the clustering reflects the complex interplay of factors and highlights the heterogeneity among countries during the crisis. In cluster analysis, variations in the measurement scale or magnitude of variables can introduce implicit weighting, potentially distorting the calculated distances between observations. To ensure equal weight for all variables, we standardized them using Z-scores (mean = 0, standard deviation = 1). For hierarchical cluster analysis, we used agglomerative methods, which begin by treating each observation as its own cluster and progressively merging clusters based on distance or similarity. We aimed to identify a few relatively large, well-separated, and homogeneous clusters of approximately equal size. Therefore, we used the Squared Euclidean distance measure in combination with Ward's method. Ward's method minimizes the variance within clusters by merging those that result in the smallest increase in total variance, producing highly homogeneous groups (Simon et al., 2024). The dendrogram (see Figure 5) illustrates the agglomeration schedule and the relative distances between clusters, scaled to a maximum distance level of 25 units. Beyond its role in clustering, the dendrogram provides insights into the optimal number of clusters. By cutting the linkage just below the relative distance level of 5 (red vertical line in Figure 5), we identify six homogeneous and relatively large clusters, with Bulgaria forming a single-element outlier cluster. Further reducing the cut-off point to a relative distance level below 4 would introduce an additional small cluster comprising Cyprus and Greece. However, this would excessively fragment the groups, making the clustering less meaningful and reducing the interpretability of the results. Therefore, the chosen cut-off point ensures a balance between cluster size and homogeneity.

5. Figure Dendrogram using Ward Linkage

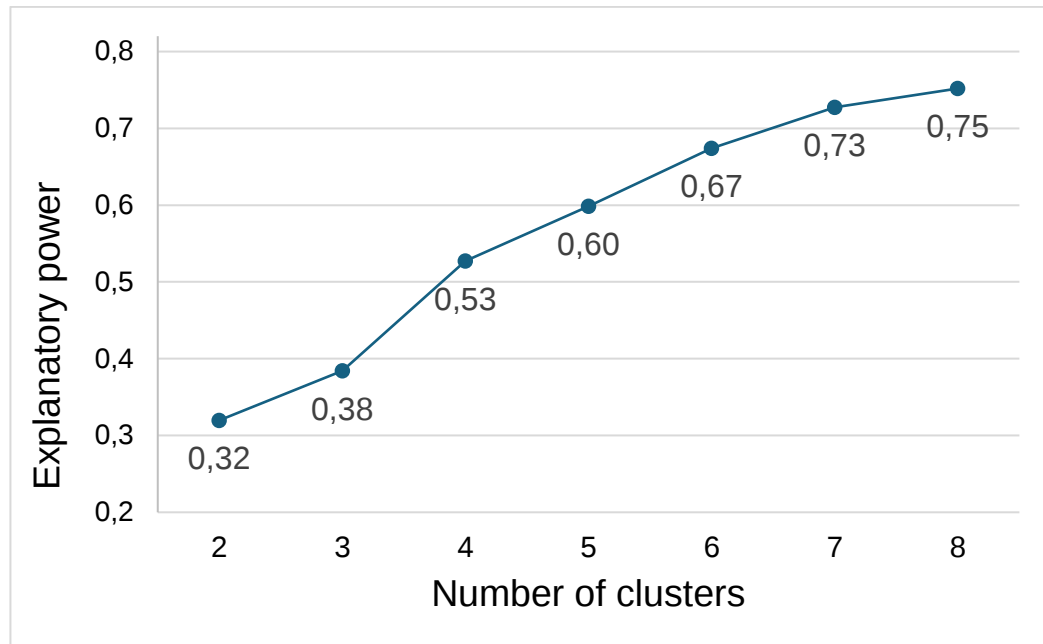


Source: own work, conducted with SPSS software

The optimal number of clusters was also determined using the Elbow Method, following Thorndike (1953). K-Means Cluster Analyses were run in SPSS for cluster numbers from $k=1$ to $k=8$ using standardized variables (Z-scores). For each cluster configuration, cluster membership variables were analyzed using One-Way ANOVA. The ratio of the between-groups sum of squares to the total sum of squares indicates the explanatory power, which is plotted against the number of clusters in Figure 6. The breakpoint (elbow) in the graph indicates the point beyond which adding more clusters does not significantly increase

explanatory power. As shown in Figure 6, the elbow occurs between 6 and 7 clusters. Adding a sixth cluster increases explanatory power by 8 percentage points, while the increase from 6 to 7 clusters is only 5 percentage points, and from 7 to 8 clusters, just 2 percentage points. Given the need to avoid creating small, less meaningful clusters (e.g., Cyprus and Greece), the optimal number of clusters is 6, as confirmed by the K-Means analysis.

6. Figure The Cluster Elbow Method



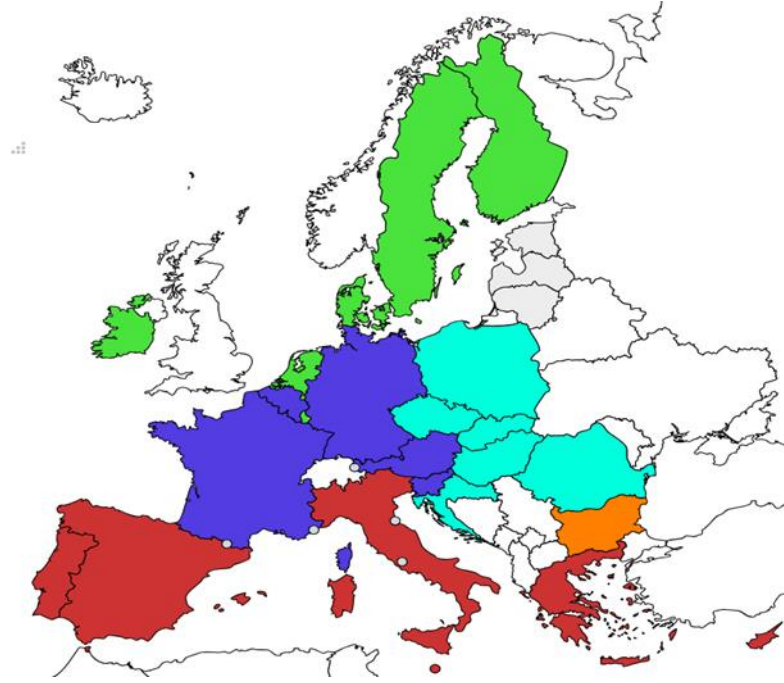
Source: own work

The 6 clusters look as follows and correspond mostly to 6 geographic European regions (see Figure 7):

- Dark blue - West-European Cluster (West): Austria, Germany, Belgium, France and Slovenia;
- Red - Southern countries Cluster (South) equal to Mediterranean: Cyprus, Greece, Portugal, Spain, Italy and Malta;
- Green - The typical North countries Cluster (North): Ireland, Netherlands, Denmark, Finland, Sweden and Luxembourg; containing three countries from the Nordic.
- Grey - Baltic States (Baltic): Latvia, Lithuania and Estonia; which are often referred to collectively using the political term “Baltic states”.

- Light blue - Europe's middle Cluster (CEE): the Visegrad Group 4 (V4) countries (Poland, Slovakia, Czechia, Hungary), Romania and Croatia;
- Orange - Quasi outlier: Bulgaria

7. Figure: EU27 geographical grouping using hierarchical clustering



Source: own work

As the final step in the cluster analysis, we examined the ANOVA table for the six clusters to assess the role of each variable in cluster formation. The p-values in the last column of Table 5 are close to 0, indicating that all standardized variables significantly contribute to cluster formation at commonly used significance levels (1% and 5%). The F-values help rank the variables by their importance in forming the clusters. Notably, the number of available hospital beds and the Human Development Index (HDI) emerged as the strongest determinants of cluster formation, while the Stringency Index had the least influence.

5. Table: ANOVA table in case of k=6 clusters – SPSS

ANOVA						
	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Zscore(Stringency Index)	2.820	5	0.567	21	4.975	0.004
Zscore(GDP change from 2019 to 2020)	3.558	5	0.391	21	9.105	<.001
Zscore(excess_mortality)	3.704	5	0.356	21	10.396	<.001
Zscore(Reproduction rate)	3.098	5	0.500	21	6.191	0.001
Zscore(Vaccinated)	3.303	5	0.452	21	7.312	<.001
Zscore(Hospital beds)	4.043	5	0.276	21	14.67	<.001
Zscore(HDI)	4.002	5	0.285	21	14.036	<.001

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Source: own work, conducted with SPSS software

Based on the data published by the European Commission (EC, 2022b), we analyzed the EU support measures utilized by individual countries covering two years (2020-2021). The downloaded data present the nominal value of support measures, categorized by type and country, including 15 different types of support measures; however, our analysis focuses on the four most significant categories: direct grants (TF 3.1 and Treaty), subsidized loans (TF 3.3), guarantees on loans (TF 3.2 and Treaty), and wage subsidies (TF 3.10). These four types account for 95% of the total support utilized. Therefore, the remaining support types were grouped under the category "Other/Non-classified". The analysis considers the distribution of aid both in nominal and relative terms, as a proportion of each country's GDP (2019), assessing the types of state aid measures employed, first at the national level and then by aggregating the data to identify patterns within the defined clusters.

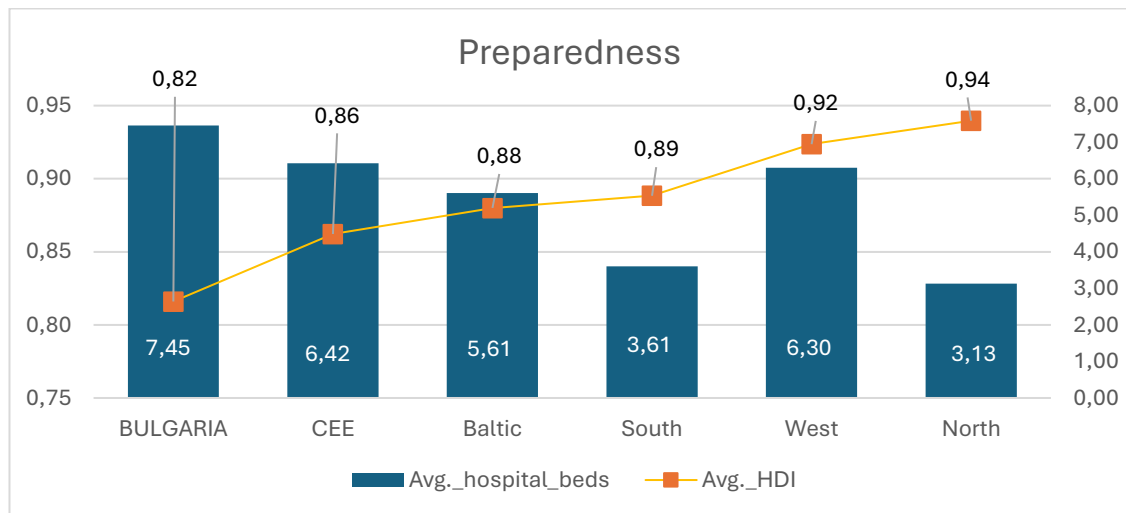
2.4 Results

In the Appendix 4 we presented the mean, minimum, maximum values, and the standard deviation of the variables analyzed by country and cluster. In the following, we introduce the characteristics of each cluster along the variables.

2.4.1 Characteristics of clusters along the variables

The clusters were initially analyzed based on their preparedness for COVID-19, using HDI and the number of hospital beds as key indicators. Figure 8 presents the clusters in ascending order of HDI growth. Bulgaria, with the lowest HDI, interestingly has the highest number of hospital beds. The CEE, Baltic, and West exhibit medium HDI levels. Notable, as HDI increases, the number of hospital beds generally decreases. West deviates from the general trend of increasing HDI and decreasing hospital beds, as they exhibit middle HDI high values for hospital beds, similar to the CEE. North has the highest HDI, with the lowest number of hospital beds. In conclusion, in terms of HDI, North, West, and South countries are the most advanced, while Bulgaria, CEE, and West are the most advanced regarding hospital beds.

8. Figure: Preparedness for the pandemic

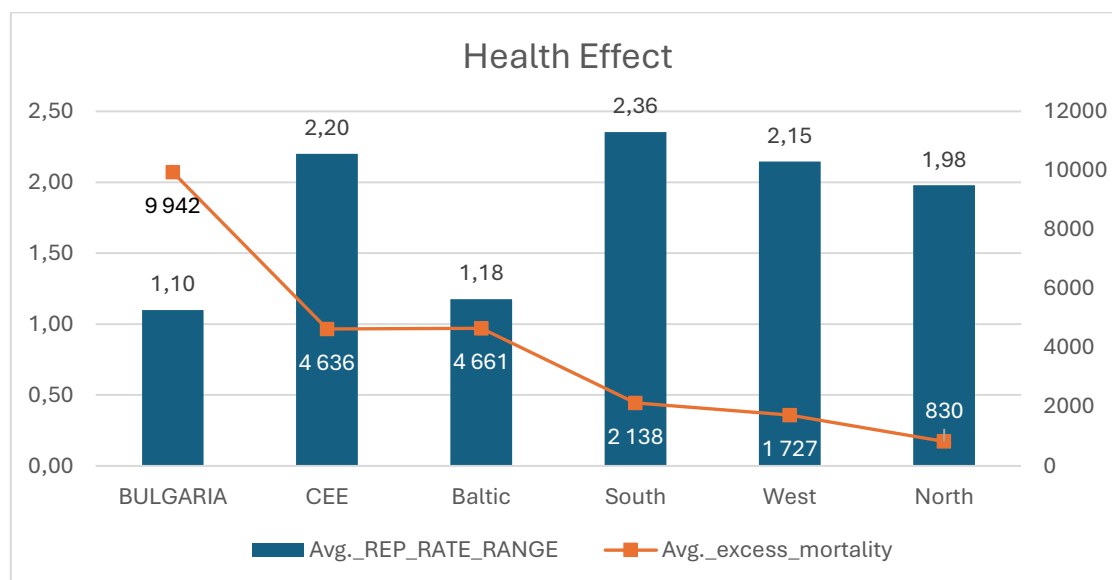


Source: own work

After examining preparedness, we now turn to the health effects of COVID-19. Excess mortality serves as the primary indicator of health impact, for which the reproduction rate was also considered. Excess mortality emerged as the third most significant clustering factor, with an F-value of 10.3, while the reproduction rate ranked sixth among the seven variables, with an F-value of 6.2. Figure 8 displays the clusters in ascending order of HDI

growth, revealing a clear trend: excess mortality decreases as HDI increases. Bulgaria recorded the highest excess mortality, despite having one of the lowest reproduction rates. In contrast, the North cluster, with high vaccination coverage, experienced the lowest excess mortality.

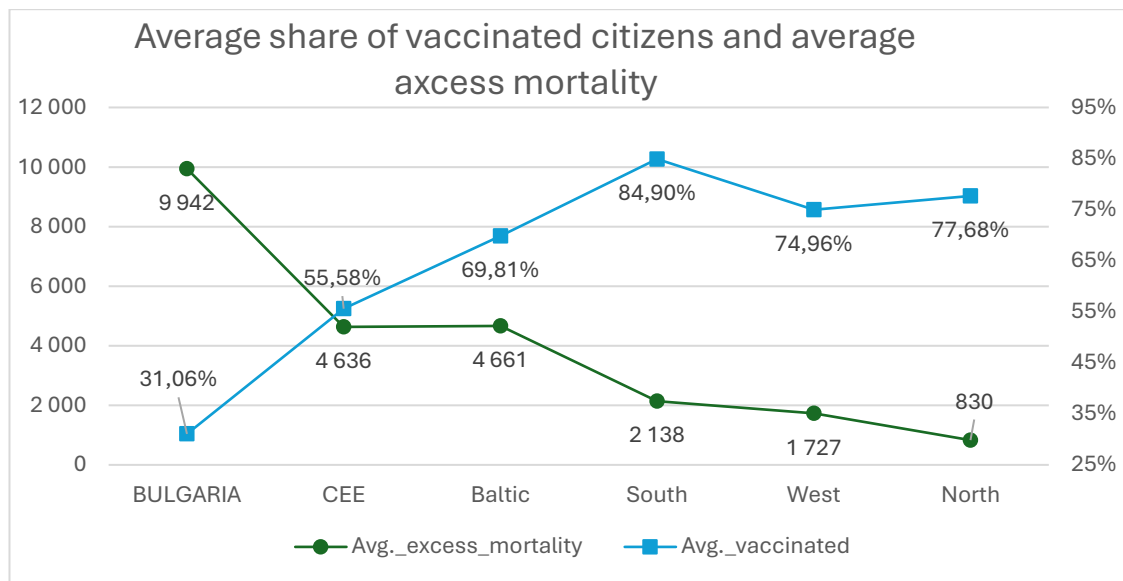
9. Figure: Health effect of the pandemic



Source: own work

Protective measures were assessed using two key variables: the stringency index and the proportion of the population vaccinated. Continuing with the health impact, the Figure 10 illustrates the number of deaths alongside vaccination rates, with the clusters ordered by HDI. As HDI increases, so does the vaccination rate, with the highest vaccination coverage observed in the South cluster. The graph reveals an inverse relationship between vaccination rates and mortality rates. Bulgaria, with the lowest vaccination rates, also experienced the highest death rates, while the opposite trend was observed in the North cluster.

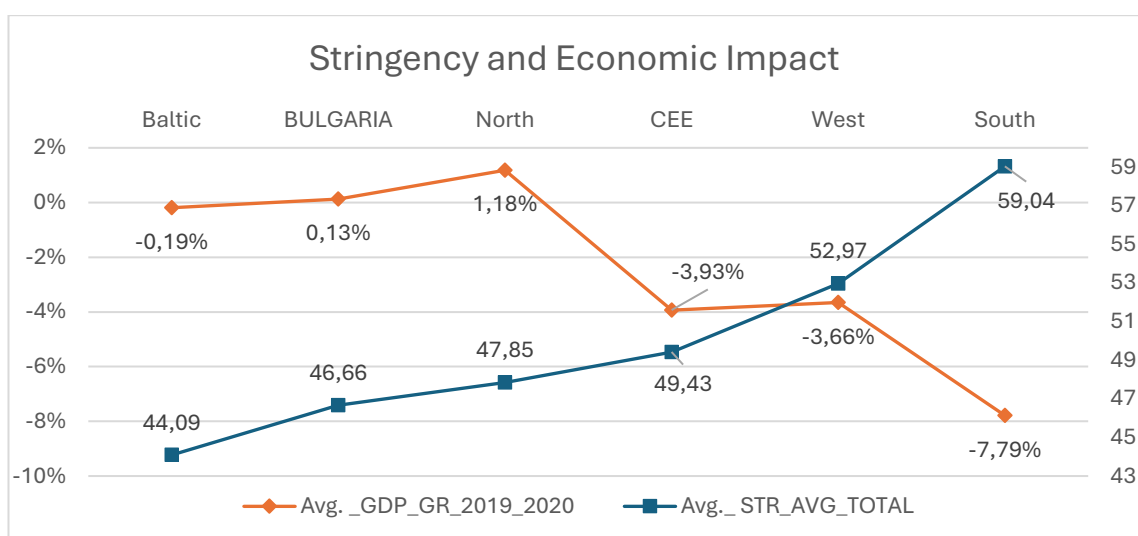
10. Figure: Average share of vaccinated citizens and average excess mortality



Source: own work

The first protective measures against the spread of COVID-19 were the implementation of lockdowns by the government; however, these measures had a significant negative impact on the economy, as reflected in GDP changes between 2019 and 2020. Bulgaria, the Baltic, and the North implemented less stringent measures to control the spread of the virus. As shown in the Figure 11, the most stringent measures were typically introduced by the South, which experienced the sharpest GDP decline, approaching 8%. The South cluster enforced these measures early on, as they were among the first EU27 countries to face severe health consequences from the pandemic. While effective in mitigating health risks, these lockdowns led to the most significant economic downturns in the EU27. In contrast, the lowest stringency levels were observed in the Baltic and Bulgaria, which experienced more moderate economic downturns. Notably, Northern countries adopted moderately stringent measures and achieved slight economic growth, distinguishing themselves from other EU27 clusters.

11. Figure: Protective measures – Stringency index and Economic Impact



Source: own work

2.4.2 European Commission's State Aid

In this section, we analyze the implementation of measures under the European Commission's State Aid COVID-19 Temporary Framework (EC, 2022b), focusing on the extent of financial support utilized by EU27 countries. The analysis considers the distribution of aid, both in nominal and relative terms, as a proportion of each country's GDP. Furthermore, we assess the types of state aid measures employed, first at the national level and then by aggregating the data to identify patterns within the defined clusters. The EU support measures are shown in relative terms (as a percentage of GDP) in Figure 12 and Table 6.

Figure 12 shows the deployment of State aid measures' budget implemented by Member States which vary widely across the countries. In relative terms, the deployment refers to 4.2% of the national GDP on average, Italy received the most aid (11.4%), ahead of France (9.0%) and Spain (9.7%). Conversely, the countries that employed the least State aid relative to GDP were Ireland (0.5%), Sweden (0.6%), and Luxembourg (1.2%).

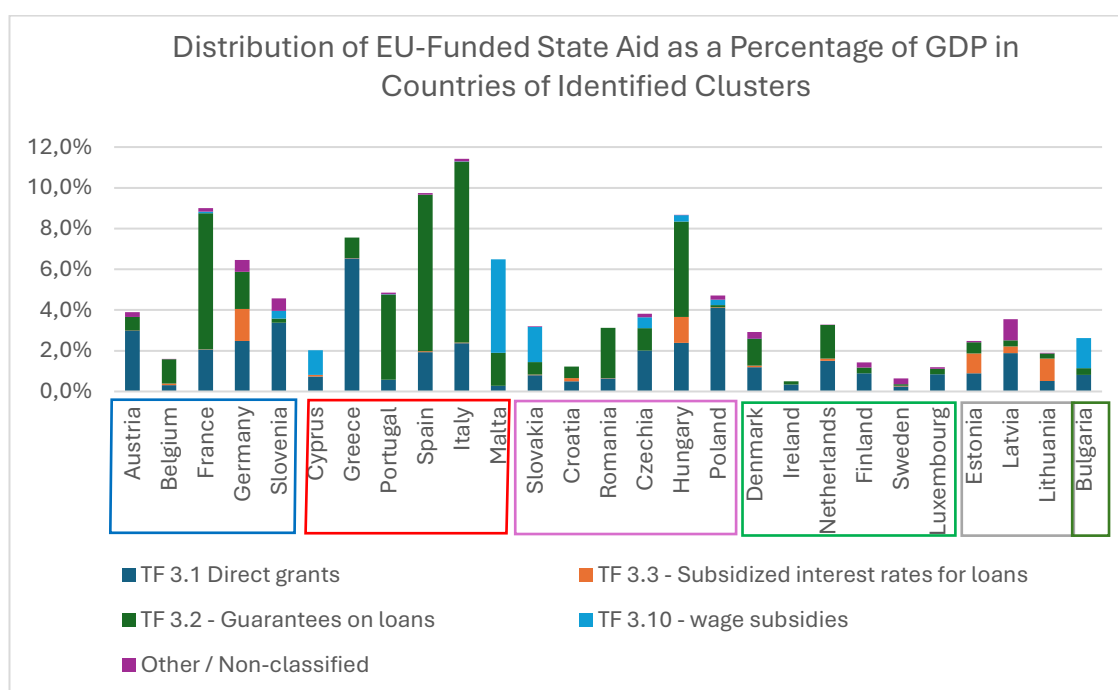
Regarding the form of support, EU27 countries adopted different strategies to assist companies, reflecting varying policy priorities and economic conditions. Approximately 43% of total aid expenditure (€ 409 billion) was in the form of loan guarantees of the Temporary Framework. Italy, Romania, Portugal, and France allocated over 70% of their total domestic expenditure to guarantees. Other significant users included Hungary (47%), Croatia (45%), and Spain (41%).

The second most used was Limited amounts of grants (i.e. direct grants, EUR 270 billion, i.e. 29% of the total), which allows Member States to set up schemes where aid can take forms (direct grants, tax and payment advantages or other forms such as repayable advances). Countries like Poland (86%), Greece (84%), and Slovenia (68%) relied heavily on this measure. Germany (€77.56 billion) and France (€49.56 billion) provided the largest absolute amounts.

The third most employed were the subsidized interest rates for loans sections, which were used in some countries especially in Croatia, Cyprus, Estonia, Germany, Hungary, Latvia and Lithuania. The usage of wage subsidies played a significant role in Cyprus, Bulgaria, Malta and Slovakia.

Finally, the favorable loans (section 3.3) constituted one-fourth of Germany's COVID-19 aid (€54.71 billion), moreover Lithuania and Estonia also relied heavily on this measure.

12. Figure: Total State Aid Expenditure by EU27 Under the Temporary Framework Until 31 December 2021 (as a Percentage of Member States' 2019 GDP)



Source: (EC, 2022b & Eurostat, 2023)

In terms of clusters, Figure 12 shows that South countries primarily relied on guarantee programs based on the allocated amounts and employed substantial funding relative to GDP (4–11%). An exception among these countries is Malta, which, instead of heavily utilizing guarantee programs, directed EU funds towards wage subsidies (6.5% relative

to GDP). Within the CEE region, Hungary stands out with a GDP-proportional employment of 8.7%, also primarily due to the reliance on guarantee programs.

For the Baltic and North countries, the forms of aid employed were mixed (Table 6). However, they relied less on guarantee programs for corporate loans, favoring direct grants, subsidized loan schemes, and wage subsidies. Nonetheless, their allocated amounts were relatively modest, representing approximately 1–3% of GDP. Identified as an outlier, Bulgaria, which was significantly affected by the COVID-19 crisis, exhibited a surprisingly low relative size of aid employed (2.6%) despite its level of impact.

6. Table: Average State Aid Expenditure by Cluster and Type as a Proportion of Countries' GDP (as of 31 December 2021).

Clusters	TF 3.1 Direct grants	TF 3.3 - Subsidized loans	TF 3.2 - Guarantees on loans	TF 3.10 - Wage subsidies	Other / Non- classified	TOTAL
Bulgaria	0.8%	0.0%	0.3%	1.5%	0.0%	2.6%
CEE	1.7%	0.3%	1.6%	0.5%	0.1%	4.1%
Baltic	1.1%	0.8%	0.4%	0.0%	0.4%	2.6%
South	2.1%	0.0%	3.9%	1.0%	0.0%	7.0%
West	2.2%	0.3%	2.1%	0.1%	0.3%	5.1%
North	0.8%	0.0%	0.6%	0.0%	0.2%	1.7%
Total	1.6%	0.2%	1.8%	0.4%	0.2%	4.2%

Source: own work based on EC, 2022b; Eurostat, 2023.

2.5 Discussion

To answer RQ1, we analyzed how the EU27 countries can be clustered based on their COVID-19 preparedness, responses to protective measures, and the resulting health and economic impacts. To address RQ2, we investigated the distribution and forms of European Commission-backed state aid across these clusters, revealing significant heterogeneity in the allocation of EU-backed financial support. The analysis has identified the following distinct clusters, summarizing their key characteristics and the allocation of EU-supported state aid:

- 1 Bulgaria exhibited several extreme values across key indicators. In terms of preparedness, it had the lowest HDI value among the clusters (0.82) but the highest number of hospital beds (7.45). Regarding COVID-19's health impact, Bulgaria

displayed a clear contrast: despite having one of the lowest reproduction rates (1.1, ranging from a maximum of 1.71 to a minimum of 0.61), it recorded the highest excess mortality among the clusters (9 942). This high mortality rate may be linked to the country's low protective measures or its overall lower standard of living (the lowest value HDI index). Bulgaria had the second-lowest average stringency index (46.66), following the Baltic, and the lowest vaccination rate among the EU27 (31.06%). In conclusion, Bulgaria experienced the lowest level of protection and the highest health impact in terms of mortality among EU27 countries. At the same time, its economic growth remained stagnant, with a marginal increase of 0.13% in 2020. Bulgaria also received a surprisingly low level of EC support (2.6% of GDP). It is noteworthy that Bulgaria has uniquely spent a significant part of its support on wage subsidies, amounting to 1.5% of GDP.

- 2 The CEE region (0.86) occupied a median position in terms of HDI, alongside the Baltic (0.88) and South (0.89) clusters. In terms of hospital beds (6.42), it was comparable to the West cluster (6.3). However, it is important to note that the West had a significantly higher HDI (0.92) than the CEE. Despite a high value of reproduction rate, the CEE recorded a much lower excess mortality rate than Bulgaria. CEE represents a moderate approach regarding the stringency index (49.43) and the vaccination rate of 55.58%. In summary, the CEE countries adopted a middle-way strategy across multiple dimensions, resulting in a moderate economic contraction of -3.93%. In terms of EU support, the CEE is in the middle regarding the EC aid level calculated in GDP proportion (4.1%). Hungary stands out within the cluster with an exceptionally high rate of 8.7%, mainly due to its reliance on guarantee schemes.
- 3 The Baltic cluster, like the CEE region, occupies a median position in terms of preparedness, with an HDI of 0.88 and an average of 5.61 hospital beds. Similarly, their health impact was moderate. Although the Baltic region recorded the lowest reproduction rate, like Bulgaria, it still experienced higher excess mortality than the South, West, and North clusters, with significantly higher reproduction rates but less than half the excess mortality. From a protection perspective, the Baltic had the lowest stringency index (44.09) among all clusters. This more relaxed approach contributed to a nearly stagnant economic performance with a minor GDP decline of -0.19% in 2020. Unlike the CEE region, however, the Baltic countries achieved higher vaccination coverage (69.81%) while maintaining the lowest stringency

index. In summary, the Baltic countries adopted a "middle-way" policy, combining minimal restrictions with higher vaccination coverage. This approach resulted in moderate health outcomes and a nearly unchanged economic performance during the pandemic. Notably, the relative value of EU support utilized by the Baltic countries was below average, amounting to just 2.6% of GDP.

- 4 South displayed moderate preparedness for COVID-19, characterized by a medium HDI (0.89) and the second-lowest number of hospital beds (3.61). Despite these limitations, the spread of the virus was most severe in this cluster, with the highest reproduction rate (2.36). Strict measures were implemented to mitigate the health impact, , reflected in the highest stringency index (59.4) and the highest vaccination coverage (~85%) among the clusters. These efforts effectively reduced excess mortality (2 138), the third-lowest. However, these measures came at a significant economic cost, as the South experienced the sharpest GDP decline (-7.79%). In conclusion, the South adopted stringent closures and achieved high vaccination rates, which successfully moderated excess mortality but resulted in the most substantial economic contraction among the clusters. South heavily relied on EU-funded state aid, averaging 7% of GDP – the highest among the clusters –primarily through guarantee programs. An exception is Malta, which, instead of heavily utilizing guarantee programs, directed EU funds predominantly as wage subsidies.
- 5 West cluster ranks as the second-best in terms of preparedness, with an HDI of 0.92 and a high availability of hospital beds (6.3), regarding the hospital beds similar to the CEE cluster. The virus spread was significant, slightly lower than in the South but similar to the CEE countries. Regarding protective measures, this cluster implemented strict lockdowns, with the second-highest stringency index of 52.97. Economically, it experienced a contraction of -3.93%, the second most severe. However, vaccination rates were high, similar to those in the South and North clusters, reaching approximately 75%. This contributed to relatively low excess mortality, making it the second lowest. In conclusion, while this cluster comprises some of the most economically developed countries, its stringent measures during the period effectively moderated mortality rates, albeit at the cost of a moderate economic decline. The West cluster utilized EU state aid programs at an above-average level (5.1%), with France standing out at 9%.
- 6 The North cluster exhibits the highest HDI at 0.94 and the lowest average number of hospital beds (3.13), reflecting two extremes in preparedness indicators. Regarding

health impact, while the reproduction rate was relatively high at 1.98, excess mortality was the lowest among the clusters, totaling 830. In terms of protective measures, the vaccination rate reached 77.68%, and the stringency index, at 47.85, aligned with medium-stringency EU27 countries such as Bulgaria and the Baltic states. Economically, the North cluster was unique in achieving GDP growth between 2019 and 2020, with a modest increase of 1.18%. In summary, the North cluster implemented relatively less stringent measures while maintaining the lowest excess mortality rate, suggesting a balanced approach to public health and economic stability during the pandemic. The modest GDP growth of 1.18% in 2020 is particularly notable given that year's widespread economic contraction. North received the lowest volume of EU state aid programs, amounting to only 1.7% of GDP.

Previous studies have not identified clusters with the same structure, emphasizing the novelty of our approach. Notably, Bulgaria's extreme values in mortality and protective measures, along with the unique balance of low mortality and economic resilience observed in the North cluster, were not captured in earlier research. These differences can be attributed to variations in data selection, methodology, and the tendency of previous studies to focus on shorter timeframes or specific aspects of the pandemic. By encompassing the entire COVID-19 impact period, this study offers a more comprehensive analysis of national responses and long-term outcomes.

2.6 Conclusion

In this study we classify EU27 countries based on the preparedness of healthcare, protective measures, and resulting health and economic impacts during the COVID-19 crisis. As a result, it identified six distinct clusters: West, South, North, Baltic, CEE, and Bulgaria as quasi-outlier, revealing notable differences among them. Additionally, the study examined how the EC State Aid program was distributed and used across these clusters, highlighting significant variations in aid allocation.

Overall, countries with higher Human Development Index (HDI) levels, such as the North and West clusters, generally achieved higher vaccination rates and implemented moderate lockdown policies and experienced lower excess mortality rates. In contrast, Bulgaria, with the lowest HDI and weakest protective measures, exhibited the highest excess mortality despite a relatively low reproduction rate. The South cluster, which implemented the most stringent lockdowns and achieved the highest vaccination coverage with moderated health impacts but suffered the most severe economic contraction. The Baltic and CEE regions adopted a more balanced approach, with lower restrictions and vaccination rates, resulting in moderate health and economic consequences. The North cluster uniquely combined high vaccination coverage with relatively less stringent measures while maintaining the lowest excess mortality and achieving positive GDP growth. These findings align with the conclusions of Aristodemou et al. (2021), who found that stricter confinement measures were typically implemented in countries with weaker healthcare preparedness, leading to more severe socio-economic consequences.

The study also emphasizes differences in allocating and utilizing EU financial support among the clusters. The highest support levels were observed in the South (7% of GDP) and West (5.1%), primarily through guarantee schemes, while the lowest was in the North (1.7%). In general, Countries facing more severe economic recessions, such as Italy, Spain, and France, accessed higher levels of state aid, underscoring the EU's targeted support framework. Bulgaria represents a notable outlier, as it received one of the lowest aid levels (2.6%) despite suffering the highest excess mortality. This suggests that EU-backed aid allocation was primarily driven by economic distress rather than public health impacts.

This study is useful for policy makers, economists and public health officials who want to understand regional differences in pandemic preparedness, response and economic

impacts across the EU27. It provides valuable information for the EU institutions to refine future crisis management frameworks, including the equitable distribution of financial support. In addition, researchers analyzing the intersection of health policy and economic resilience can also benefit from the study's multidimensional clustering approach. Financial and social policy planners may also find the findings relevant for designing targeted interventions in future crises.

Despite the robustness of the clustering approach, the study's limitations include the aggregation of data over two years, which obscures wave-specific dynamics, and the exclusion of nationally funded support programs, potentially overlooking additional financial interventions. Future research could enhance these findings by incorporating sector-specific impacts and extended policy evaluations. A key area for further study is the accuracy of reported reproduction rates, as Bulgaria's low reproduction and excess mortality rates raise concerns about data reliability or healthcare quality, despite its high hospital bed capacity. Additionally, the effectiveness of financial aid should be examined in greater detail, whether certain support measures inadvertently sustained unviable and highly indebted companies – commonly referred to as zombie firms – or provided support to businesses that were not negatively affected by the pandemic. Addressing these issues could provide deeper insights into the long-term economic and policy consequences of COVID-19 in the EU. The ethically sensitive question of valuing human life arises, as more detailed country-level calculations could help decision-makers fine-tune measures in future crises.

2.7 Appendix to the article

2.7.1 Appendix 1 - Correlation analysis between variables - SPSS

7. Table: Correlation analysis between variables - SPSS

Correlations		Stringency Index	GDP CH from 2019 to 2020	Excess mortality	Reproduction Rate range	Vaccinated	Hospital beds	HDI
Stringency Index	Pearson Correlation	1	-,430*	-0,056	0,341	0,263	-0,080	0,029
	Sig. (2-tailed)		0,025	0,780	0,082	0,185	0,691	0,888
	N	27	27	27	27	27	27	27
GDP change from 2019 to 2020	Pearson Correlation	-,430*	1	-0,041	-0,377	-0,246	0,029	0,275
	Sig. (2-tailed)	0,025		0,838	0,053	0,217	0,887	0,166
	N	27	27	27	27	27	27	27
Excess mortality	Pearson Correlation	-0,056	-0,041	1	-0,197	-,706**	,553**	-,774**
	Sig. (2-tail)	0,780	0,838		0,325	0,000	0,003	0,000
	N	27	27	27	27	27	27	27
Reproduction Rate Range	Pearson Correlation	0,341	-0,377	-0,197	1	0,290	-0,040	0,080
	Sig. (2-tailed)	0,082	0,053	0,325		0,143	0,842	0,693
	N	27	27	27	27	27	27	27
Vaccinated	Pearson Correlation	0,263	-0,246	-,706**	0,290	1	-,548**	,611**
	Sig. (2-tailed)	0,185	0,217	0,000	0,143		0,003	0,001
	N	27	27	27	27	27	27	27
Hospital_ beds	Pearson Correlation	-0,080	0,029	,553**	-0,040	-,548**	1	-,454*
	Sig. (2-tailed)	0,691	0,887	0,003	0,842	0,003		0,017
	N	27	27	27	27	27	27	27
HDI	Pearson Correlation	0,029	0,275	-,774**	0,080	,611**	-,454*	1
	Sig. (2-tailed)	0,888	0,166	0,000	0,693	0,001	0,017	
	N	27	27	27	27	27	27	27
*. Correlation is significant at the 0.05 level (2-tailed).								
**. Correlation is significant at the 0.01 level (2-tailed).								

Source: own work, conducted with SPSS software

2.7.2 Appendix 2 – Descriptive statistics

8. Table: Descriptive statistics

Country/ Region	Preparedness		Protective measures		Health effect					Ec. effect
	Hospital beds / t. people	HDI	Avg. of String. index	Vaccination rates	Excess mortality/ m. people	Min. of reprod. rate	Max. of reprod. rate	Avg. of reprod. rate	Range of reprod. rate	GDP change 2019-2020
Bulgaria	7.45	0.82	46.66	31.06%	9 942	1.71	0.61	1.05	1.10	0.13%
CEE										
Croatia	5.54	0.85	42.16	57.59%	4 942	3.29	0.14	1.06	3.15	-9.38%
Czechia	6.63	0.90	50.11	66.47%	4 043	2.26	0.63	1.07	1.70	-4.35%
Hungary	7.02	0.85	47.27	64.42%	3 756	2.11	0.56	1.10	1.76	-5.94%
Poland	6.62	0.88	51.37	57.38%	4 282	2.51	0.34	1.05	2.17	-1.19%
Romania	6.89	0.83	54.96	41.64%	6 103	2.61	0.51	1.05	2.67	-1.65%
Slovakia	5.82	0.86	50.69	46.00%	4 689	1.76	0.44	1.07	1.75	-1.08%
Average	6.42	0.86	49.43	55.58%	5 394	2.42	0.44	1.07	2.20	-3.93%
Min	5.54	0.83	42.16	41.64%	3 756	1.76	0.14	1.05	1.70	-9.38%
Max	7.02	0.90	54.96	66.47%	6 103	3.29	0.63	1.10	3.15	-1.08%
St. dev.	0.60	0.02	4.33	9.90%	837	0.52	0.18	0.02	0.60	3.31%
Baltic										
Estonia	4.69	0.89	39.12	65.54%	2 638	1.63	0.57	1.04	1.06	-1.08%
Latvia	5.57	0.87	46.31	72.74%	4 455	1.81	0.59	1.06	1.22	-1.25%
Lithuania	6.56	0.88	46.84	71.16%	6 890	1.7	0.45	1.04	1.25	1.76%
Average	5.61	0.88	44.09	69.81%	4 661	1.71	0.54	1.05	1.18	-0.19%
Min	4.69	0.87	39.12	65.54%	2 638	1.63	0.45	1.04	1.06	-1.25%
Max	6.56	0.89	46.84	72.74%	6 890	1.81	0.59	1.06	1.25	1.76%
St. dev.	0.94	0.01	4.31	3.78%	2 134	0.09	0.08	0.01	0.10	1.69%
South										
Cyprus	3.40	0.89	59.53	74.88%	1 351	1.83	0.59	1.07	1.47	-5.53%
Greece	4.21	0.89	67.68	76.40%	3 004	1.78	0.68	1.06	1.57	-9.79%
Italy	3.18	0.89	64.20	86.19%	3 145	3.54	0.58	1.09	2.99	-7.55%
Malta	4.49	0.90	51.39	89.77%	1 203	3.62	0.11	1.01	3.51	-7.14%
Portugal	3.39	0.86	56.37	95.23%	2 022	2.69	0.57	1.08	2.28	-6.46%
Spain	2.97	0.90	55.09	86.93%	2 104	2.96	0.65	1.15	2.31	-10.24%

Country/ Region	Preparedness		Protective measures		Health effect					Ec. effect
	Hospital beds / t. people	HDI	Avg. of String. index	Vaccination rates	Excess mortality/ m. people	Min. of reprod. rate	Max. of reprod. rate	Avg. of reprod. rate	Range of reprod. rate	GDP change 2019-2020
Average	3.61	0.89	59.04	84.90%	2 138	2.74	0.53	1.08	2.36	-7.79%
Min	2.97	0.86	51.39	74.88%	1 203	1.78	0.11	1.01	1.47	-10.24%
Max	4.49	0.90	67.68	95.23%	3 145	3.62	0.68	1.15	3.51	-5.53%
St. dev.	0.60	0.01	6.05	7.86%	809	0.80	0.21	0.04	0.79	1.86%
West										
Austria	7.37	0.92	56.68	77.17%	1 785	2.89	0.46	1.07	2.43	-4.06%
Belgium	5.64	0.93	49.13	79.49%	1 832	2.43	0.74	1.11	1.80	-3.93%
France	5.98	0.90	51.81	80.60%	1 372	3.09	0.6	1.11	2.49	-5.22%
Germany	8.00	0.95	56.30	77.81%	1 109	3	0.52	1.12	2.48	-1.95%
Slovenia	4.50	0.92	50.93	59.71%	2 535	1.88	0.35	1.06	1.53	-3.12%
Average	6.30	0.92	52.97	74.96%	1 727	2.66	0.53	1.10	2.15	-3.66%
Min	4.50	0.90	49.13	59.71%	1 109	1.88	0.35	1.06	1.53	-5.22%
Max	8.00	0.95	56.68	80.60%	2 535	3.09	0.74	1.12	2.49	-1.95%
St. dev.	1.40	0.02	3.36	8.63%	542	0.50	0.15	0.03	0.45	1.21%
North										
Denmark	2.50	0.94	43.91	81.35%	286	1.81	0.63	1.05	1.18	0.72%
Finland	3.28	0.94	40.28	81.66%	915	1.92	0.46	1.06	1.85	-0.76%
Ireland	2.96	0.96	55.71	81.76%	853	2.72	0.47	1.07	2.59	4.52%
Lux.	4.51	0.92	46.50	74.42%	209	2.37	0.58	1.10	1.96	3.86%
Netherl.	3.32	0.94	54.99	72.74%	1 673	2.8	0.36	1.06	2.44	-2.03%
Sweden	2.22	0.95	45.71	74.12%	1 042	2.29	0.44	1.16	1.85	0.77%
Average	3.13	0.94	47.85	77.68%	830	2.32	0.49	1.08	1.98	1.18%
Min	2.22	0.92	40.28	72.74%	209	1.81	0.36	1.05	1.18	-2.03%
Max	4.51	0.96	55.71	81.76%	1 673	2.80	0.63	1.16	2.59	4.52%
St. dev.	0.80	0.01	6.19	4.33%	537	0.40	0.10	0.04	0.50	2.56%

Source: own work, conducted with SPSS software

3 ASSESSING THE EVOLUTION OF ZOMBIE FIRM DYNAMICS IN THE EU DURING COVID-19: A NOVEL IDENTIFICATION METHOD AND COMPARATIVE ANALYSIS

ABSTRACT

The purpose of this study is to investigate whether the increase in the number of zombie firms in the manufacturing sector was more pronounced in countries with significant credit easing measures during the COVID-19 pandemic and examines how the annual survival rates of firms identified as zombies over a two-year period evolved between 2016 and 2022. To address this question, we classified EU27 countries based on four national-level pandemic policy indicators. We then identified zombie firms using four methods and analysed changes in their prevalence with descriptive statistics and a cohort matrix approach. The analysis draws on firm-level manufacturing data from five countries (2015-2022) sourced from the ORBIS database. We found that in most supportive countries, the share of zombie firms rose in 2020 and fell in 2022 after subsidies ended, while in less supportive countries, it stagnated or declined in 2020. This research contributes to the existing body of knowledge by offering a new definition and measuring method of zombie firms and introducing a unique clustering methodology for analysing policy impacts across multiple nations. The implications of our study are significant, suggesting that while credit support measures during the pandemic provided necessary relief for some firms, they also inadvertently fostered economic inefficiencies by sustaining non-viable firms.

3.1 Introduction

Previous studies suggest an increasing prevalence of zombie firms since the mid-1980s, primarily focusing on their impacts on productivity, growth, and financial stability. The past decade has seen heightened concern due to the rising number of zombie firms among non-financial companies. Since the sovereign debt crisis, fears have grown about failing firms surviving due to cheap credit and debt forbearance. The COVID-19 lockdowns led many companies to face operational challenges due to revenue shortfalls. In response, governments introduced lending support measures such as supported loan programs, public guarantee schemes (PGS), and loan moratoriums to mitigate economic impacts. However, concerns arose that these policies might unintentionally support zombie firms,

hindering the euro area's post-pandemic recovery. As the pandemic recedes, assessing whether these measures increased the share of zombie firms requires accurate measurement and robust identification methods. With no single formal definition, studies have used various criteria to identify zombie firms (Favara *et al.*, 2022). Mingarelli *et al.* (2022) found limited overlap between methods, reducing comparability.

This study focuses on five European countries, selected based on their level of support for lending grants during COVID-19. Using firm-level data from ORBIS, we apply three established methods and introduce a new approach to address existing methodological limitations. This is, to our knowledge, the first comprehensive study on zombie firm prevalence during the COVID-19 crisis, extending the analysis to 2022. Our findings are important for policymakers in evaluating whether the aid measures effectively targeted the intended firms or if future adjustments are needed.

The remainder of the study is structured as follows: Section 2 discusses the literature; Section 3 presents the research question; Section 4 describes the study's database and methodology; Section 5 presents the results and evaluation; and Section 6 provides the implication and firection for future research. Section 7 describes the limitations and section 8 the conclusion.

3.2 Literature review

COVID-19 reached European countries in the spring of 2020, prompting governments to introduce lockdown measures to contain the spread of the virus. As a result, economic activity declined at an unprecedented rate (Coibion *et al.*, 2020a). The EU States implemented relief measures including moratoria on loan repayments, public guarantee schemes (PGSs), supported loan programs, along with fiscal measures as well (Acharya *et al.* 2021; Laeven *et al.*, 2020). By June 2020, about 16% of all SME loans in the EU were under moratoria (EBA, 2020b). In Spain and France, where fiscal support was mainly provided through guarantee schemes, approximately 65% and 70% of new business loans issued between April and July were backed by government guarantees (Falagiarda, 2020). However, these policy measures may have unintentionally helped also zombie companies. In the euro area, concerns emerge that increased zombification could hinder the post-epidemic recovery. Helmersson *et al.* (2021) observed that zombie firms often exploited broadly eligible support schemes, aligning with findings by Hoshi *et al.* (2023) and Belghitar *et al.* (2021), while Bighelli *et al.* (2022) noted that direct grants in

five European countries were largely well-targeted, with minimal support to zombie firms. Pelosi et al. (2021) studied how zombie firms in Italy used COVID-19 support measures, such as grants and debt moratoriums. They found that zombie firms benefited less than healthy firms, mainly due to eligibility criteria requiring significant revenue drops from April 2019 to April 2020, which often excluded zombie firms with already low baseline revenues.

Understanding the mechanisms behind zombie lending leads to a broader issue: how to identify these firms. Studies have defined zombie firms in different ways. The very first research on zombie companies dates to the mid-2000s by Peek and Rosengren (2005) and Caballero *et al.* (2008) starting with the evidence from Japan in the “lost decade” (1990s the study of Japanese stagnation). The seminal approach developed by Caballero *et al.* (2008) defines zombie firms as companies receiving subsidized credit, where the actual interest rate paid is lower than the hypothetical risk-free rate. The underlying assumption is that financially distressed firms receive interest reductions to continue operating, resulting in lower interest payments compared to healthy firms. A key advantage of the Caballero *et al.* (2008) criterion is its simplicity, if data on debt structure and contracted interest rates are available. Fukuda and Nakamura (2011) critique the Caballero *et al.* (2008) approach for two main reasons. First, it may incorrectly classify healthy firms as zombies, as some healthy companies were found to have interest rates lower than the hypothetical risk-free rate. Second, it may fail to identify truly distressed firms, which might receive debt prolongation (quasi-debt relief) rather than subsidized interest rates. During the Japanese banking crisis, banks engaged in quasi-perpetual lending to obscure the true extent of non-performing loans. Additionally, the Caballero criterion relies on detailed loan structure information, which is readily available for listed firms but not for non-listed ones based solely on balance sheets and profit and loss accounts. To address these issues, Fukuda and Nakamura (2011) proposed two supplementary criteria: low profitability and evergreen lending, which address the limitations of Caballero’s methodology.

Instead of received subsidised loan the interest coverage ratio (ICR) is used as determination of zombie firms (McGowan *et al.* 2018; Andrews and Petroulakis, 2019; Banerjee and Hofmann, 2022; Nurmi *et al.* 2020; Álvarez *et al.* 2023; Feng *et al.* 2022). One advantage of using ICR is its accessibility for non-listed companies. However, there are two significant drawbacks. First, zombie firms are usually associated with

"subsidised" interest payments. In periods of very low interest rates, such as those observed before 2022, the difference between subsidized and non-subsidized rates narrows and often approached zero. Consequently, if zombie firms are defined as those receiving subsidized credit, as suggested by Caballero *et al.* (2008), many actual zombie firms might not be identified using ICR alone. Additionally, changes in local accounting standards can impact ICR values (Carreira *et al.*, 2022). Nurmi *et al.* (2020) showed that ICR to classify zombie firms are inaccurate, as two-thirds of the firms identified as zombies experienced only a temporary drop in their ICR and eventually recovered to a healthy state. As a result, in practice it can be difficult to identify zombie firms using solely ICR as criterion (Banerjee and Hofmann, 2018). Macroeconomic factors, such as low interest rates, inflation, slow growth, influence the persistence of zombie firms during economic downturns (De Martiis & Peter, 2023b; Banerjee and Hofmann, 2018; Zhu *et al.*, 2019).

Subsequent studies have broadened the definition of zombie firms beyond subsidized loans. Researchers identified persistently distressed firms based on various balance sheet and profitability indicators, including negative profitability (Storz *et al.*, 2017; Chang *et al.*, 2021), negative net investment (Storz *et al.*, 2017), or excessive leverage is measured by the ratio total financial debt divided by total liabilities, which is above median value of the industry (Carreira *et al.*, 2022; Schivardi *et al.*, 2017, 2022), high financial debt relative to EBITDA (Storz *et al.*, 2017), or negative equity (Bonfim *et al.*, 2023). Recent research highlights the importance of firm-specific variables, such as shareholders' equity and taxes, in identifying zombie firms, using machine learning methods like tree-based models (De Martiis *et al.*, 2023a).

A comparison of the different methodologies is shown in Table 9., where we present the various zombie identification approaches broken down by categories. Several studies applied multiple criteria for identifying zombie firms.

9. Table: Indicators and Definitions for Identifying Zombie Firms: Sources and Criteria

Category	Meaning	Indicator	Source
Receiving Subsidized Credit	Defined Zombie firms as those receiving subsidized credit, i.e. firms whose actual interest rate paid is lower than the hypothetical market based		Caballero et al (2008) Feng et al (2022)
Receiving New Credit	financially distressed company received new credit from any bank.		Álvarez et al (2023)
Interest Coverage Ratio	The company's interest payment obligations are not covered by the company's Cash flow generating capacity		McGowan (2018) Andrews & Petroulakis (2019) Banerjee & Hofmann (2020) Nurmi et al (2020) Álvarez et al (2023) Feng et al (2022)
Financially distressed company	These measures combine different indicators that characterize financially distressed companies.	ROA < risk free interest rate (i.e EURIBOR)	Schivardi (2017); Carreira et al (2022);
		Negative profitability (net profit /EBIT/EBITDA)	Storz et al (2017) Chang et al (2021)
		Net investment negative	Storz et al (2017)
		Excessive leverage (above median leverage, Total financial debt compared to EBITDA)	Schivardi (2017); Carreira et al (2022); Storz et al (2017)
		Tobin's q model	Banerjee & Hofmann (2020)
		Negative equity	Bonfim (2023) Álvarez et al (2023)

Source: Own editing

Despite various approaches in the literature, the distinction between distressed and zombie firms remains increasingly blurred and debated. Acharya et al. (2022) stress the importance of distinguishing distressed firms from those receiving subsidized loans, while Álvarez et al. (2023) critique zombie identification methods for misclassifying financially troubled firms as zombies due to insufficient sophistication.

Mingarelli et al. (2022) reviewed zombie firm definitions and identification methods, highlighting their strengths and weaknesses. Analyzing euro area firms from ORBIS with

multiple methodologies, they found inconsistencies in zombie classifications, underscoring the challenges of cross-study comparisons.

Our study examines the impact of COVID-19 credit easing measures on the prevalence of zombie firms in the manufacturing sector, focusing on whether these policies led to a greater increase in their numbers. It also analyzes changes in the annual survival rates of zombie firms from 2016 to 2022, comparing pre-pandemic, pandemic, and post-pandemic periods. Based on Helmersson et al. (2021), Hoshi et al. (2023), and Belghitar et al. (2021), we hypothesize that countries with extensive credit support measures, especially those where loan moratoria⁴ were extended for longer periods, saw significant increases in both the number and survival rates of zombie firms.

3.3 Data

Our data set combines detailed firm level and country level data. Country-level data partly are gained from the European Commission's Temporary Framework Programmes (2020-2022) for addressing economic change caused by the coronavirus epidemic detailing the types and amounts of various programs (Cannas *et al.* 2022). Additionally, the European Systemic Risk Board (ESRB, 2022) has released data on national policy measures implemented in response to the COVID-19 pandemic.

We used firm-level ORBIS data across countries in the manufacturing sector (NACE Rev.2 codes 10-33) for the years 2015-2022. We concentrated only on this sector, because this activity was less hit by the implemented restriction during Covid-19 period compared to transportation, real estate activities or accommodation and food services, but received the highest volume of public guarantees in Europe (EUR 33 billion, representing 4% of all sectoral loans) according to the European Banking Authority (EBA, 2020b). Our analysis employed unconsolidated financial statements (U1) to prevent data duplication in line with the approach recommended by McGowan (2018).

We excluded companies without financial leverage and with unavailable leverage data, focusing on entities financed through banking. Additional data refinement was necessary; notably, we eliminated firms that were effectively inactive or lacked financial data and filtered out data points with implausible values (e.g., non-positive financial debt or total

⁴ "Loan moratoria" refers to policies that temporarily allow firms to defer loan repayments without facing penalties. These measures can help financially distressed companies maintain liquidity during crises.

assets). Our data cleaning procedures closely adhere to the guidelines outlined by Kalemli-Ozcan *et al.* (2015) in terms of the removal of observations with missing values for critical variables. Moreover, consistent with the criteria for identifying zombie companies (outlined in Section 5), firms not reporting for at least two to three consecutive years were removed from our sample. Following the data cleaning process, the limited number of Danish companies available up to 2017 led us to exclude Danish firms from further analysis through 2018. Consequently, our final database consists of a sample of 110,000-130,000 enterprises for the eight years 2015-2022, which represents around 700,000 annual enterprise observations.

Bajgar *et al.* (2020) examined the coverage and representativeness of ORBIS in OECD countries, and concluded that ORBIS coverage varies a lot over time and across countries, disproportionately representing larger, older, and more productive firms while underrepresenting smaller, younger, and less productive firms. In the countries we examined, Bajgar *et al.* (2020) found a 30-70% representativeness in terms of wages and value added, which are not outlier values and seem adequate compared to other countries, consistent with the representativeness we observed in the number of companies.

10. Table: Comparison of Original and Final Sample Coverage Across Countries

Country	Italy	Spain	Denmark	Sweden	Finland
Original sample from ORBIS	77 002	65 862	10 040	13 033	8 241
Structural Business Statistics of Eurostat*	137 368	106 717	10 200	29 886	14 355
<i>Calculated coverage of original sample</i>	56%	62%	98%	44%	57%
McGowan (2018)	56 574	45 246	4 253	7 599	4 082
Schivardi (2017)	60 014	50 778	6 068	7 822	4 478
Storz (2017)	53 091	45 561	5 270	6 677	4 374
Our method	52 335	44 747	5 683	6 755	4 177
<i>Calculated coverage of final samples</i>	38-44%	42-48%	42-59%	22-26%	28-31%

Source: Own editing based on ORBIS data

Table 10 presents the number of calculated coverages of the original sample obtained from ORBIS database compared to the number of Limited liability companies according to Structural Business Statistics of Eurostat. The final samples for each country were filtered using various methodologies, including those outlined by McGowan (2018), Schivardi (2017), and Storz (2017), as well as our approach. The coverage percentages reflect the proportion of companies retained after applying the respective filtering methods, as detailed in the methodology section (5. Method). These results highlight the varying degrees of coverage achieved, with differences attributed to the specific criteria used for identifying zombie firms.

3.4 Methodology

Our research investigates the impact of the Covid-19 pandemic on the prevalence of zombie firms across European countries. Given the literature suggesting a potential rise in zombie companies due to extensive government support during the pandemic, we compare the most and least supportive countries. Country selection was based on data from the European Commission and the European Systemic Risk Board using Cluster analyses. Our analysis focuses on the manufacturing sector, which, despite being less affected by pandemic-related restrictions, received substantial public guarantees. Using firm-level data from the ORBIS database, we apply three established methods to identify zombie firms and introduce a new EBITDA-based approach based on bank lending practices. The application of these four methods ensures the robustness of our analysis. We then evaluate the survival rates of these zombie firms over a two-year period from 2016 to 2022.

To select countries for investigation, we used four country-level factors:

1. The “Covid-19 State aid expenditure for Guarantees in GDP%” factor assesses the magnitude of economic stabilization efforts via guarantees during the Covid-19 crisis. Calculated by summing guarantees under the Temporary Framework section 3.2 and any treaty-based guarantees (Cannas *et al.* 2022), then dividing by the aggregate GDP for 2020 and 2021. This percentage ratio reveals the scale of governmental guaranteed interventions relative to economic size.
2. The “Covid-19 State aid expenditure for Subsidised Loans in GDP%” factor presents fiscal support through subsidized loans during the pandemic, expressed

as a percentage of GDP. It is computed by dividing the total loan amount from Temporary Framework section 3.3 (Cannas *et al.*, 2022) by GDP for 2020-2021.

3. The “Moratorium Months” factor quantifies the deferral period for loan repayments granted to non-financial corporates, reflecting the temporal extent of financial relief. This period, denoting governmental support for maintaining corporate liquidity, is directly obtained from the European Systemic Risk Board (ESRB, 2022).
4. The “Scope of Eligibility” factor evaluates the coverage of payment moratoria across sectors, categorized as no implementation (0), sector-specific (1), or universal (2), based on ESRB data (2022).

We employed a three-step clustering approach. First, Hierarchical Clustering with Ward analysis and Squared Euclidean Distance was used to determine the number of clusters, ultimately selecting 7 clusters (Appendix 1 – Figure 15 with detailed statistics). Next, we excluded the countries forming individual clusters, such as Hungary and France, due to their policy deviations (e.g., Hungary’s 33-month moratorium vs. France’s 4-month moratorium), which could skew the analysis. Finally, we reran clustering with K-means, excluding outliers, and obtained the same results, confirming the robustness of the hierarchical clustering. ANOVA testing confirmed that all variables were significant classifiers (p-values < 0.05).

Appendix 2 presents the average maturity of moratoria and the size of guarantee and loan programs for 2020-2021, expressed as a percentage of GDP, with significant variation across clusters. For the firm-level analysis, we focused on two extreme clusters: the "Non-supportive" cluster (Denmark, Finland, and Sweden) and the "Highly supportive, with moratoria and guarantee schemes" cluster (Spain and Italy), which exhibited longer moratoria and more extensive government support. We will focus on these selected five countries in our further analysis.

To identify zombie firms we selected three different methods which investigated companies using ORBIS database or local business registry data (McGowan *et al.* 2018; Schivardi *et al.* 2017; Storz *et al.* 2017). These methods have been widely used in studies and are frequently cited (e.g., Andrews and Petroulakis, 2019; Nurmi *et al.*, 2020).

Our choice of these methods was primarily driven by the availability of ORBIS data and the identification methods are not requiring bank-firm level data or are not built on market

data (i.e not restricted to listed companies). Moreover, the literature review and selection provided by Mingarelli (2022) further validates the relevance of these methods in the identification of zombie firms, confirming our choice.

The extreme economic conditions caused by COVID-19 revealed both the strengths and limitations of the selected methods in analysing the rise in zombie firms. By incorporating bank loan evaluation techniques and comparing the three original methods, we developed a new approach. This new method addresses the limitations of the previous approaches while leveraging their strengths, particularly when focusing on the impact of lending grants. Our new method was developed based on banks' assessment criteria, following EBA guidelines (2020a) and our expert judgement. Banks are becoming increasingly cautious about financing companies with deteriorating credit quality, as reflected in their assessments and ongoing monitoring. Such financial conditions are viewed as red flags for further financing, reinforcing the need for a method that incorporates these considerations to more accurately identify firms at risk, particularly when analysing the effects of lending grants. As a first step, we have identified the following three characteristics that the methodology should measure:

- Characteristic 1 (Ch1): it cannot operate profitably in the medium or long term, so its business is loss-making.
Precondition: Start-ups are an exception to this the criteria of min. 5-year operation is included therefore the start-ups are excluded from the criteria.
- Characteristic 2 (Ch2): over-indebtedness that indicates a heavy debt service burden in the long term, i.e. repayments are uncertain and debt reduction is probably not feasible (quasi-evergreen lending).
- Characteristic 3 (Ch3): It's cash flow generating capacity (OCF) or approached by EBITDA does not cover the interest payable.

In the next step, the three selected methods were evaluated along the characteristics and compare with each other to identify good practices.

McGowan *et al.* (2018) applied purely interest coverage ratio to identify Zombie firms (hereinafter McGowan's method):

$$\text{ICR (EBIT / interest expenses)} < 1 \qquad \text{McGowan (1)}$$

for three consecutive years and ten years must have passed since its establishment, the most stringent precondition among the three methods studied. This method evaluates firms using EBIT to meet Ch1 but does not consider indebtedness, thus Ch2. However, it effectively measures Ch3, although EBITDA - commonly used in banking - would be a more appropriate metric than EBIT for assessing operating cash flow.

Schivardi et al. (2017) classification considers a company to be a zombie (hereinafter Schivardi's method) if

$$\begin{array}{lcl} \text{Return On Assets} & < & \text{low risk interest rate in} \\ (\text{ROA}=\text{EBITDA}/\text{Total Assets}) & & 3\text{y moving avg.} \end{array} \quad \text{Schivardi (1)}$$

$$\begin{array}{lcl} \text{Leverage} & > & \text{the median of the} \\ (\text{Total financial debt}/\text{Total Assets}) & & \text{sector} \end{array} \quad \text{Schivardi (2)}$$

and for a precondition it set a minimum of 5 years of operation which is a sound measurement. Schivardi's method applies the ROA ratio to assess profitability (Ch1), comparing it to the cost of debt capital for the safest borrowers in the sample, which depends on external benchmarks. For Ch2, it classifies companies as zombies if their leverage exceeds the sector's median value which inappropriate measure of over-leverage. Additionally, the method creates challenges in pinpointing the highest-rated debtors within any sector. Furthermore, the method does not consider Ch3.

In the method of **Storz et al.** (2017) (hereinafter Storz's method) a company is zombie, whenever

$$\begin{array}{lcl} \text{Return On Assets} & < & \text{zero.} \\ (\text{ROA}=\text{net income}/\text{Total Assets}) & & \end{array} \quad \text{Storz (1)}$$

$$\begin{array}{lcl} \text{Net change in investments} & < & \text{zero.} \end{array} \quad \text{Storz (2)}$$

$$\begin{array}{lcl} \text{Financial Debt}/\text{EBITDA} & < & 5\% \end{array} \quad \text{Storz (3)}$$

at least two consecutive years. They argue that the combination of conditions (1) and (2) guarantees classification as zombies is limited to firms that are unprofitable and invest no more than the depreciated value of their fixed assets, while the third condition ensures the inclusion of only those firms that are significantly indebted. This method do not set any precondition for the minimum years of operation so young businesses can get a zombie rating in their second years of operation.

Storz's method address Ch1 and Ch2 by using a combination of low profitability, measured by ROA with net income, and high default risk. We recommend incorporating EBITDA into this ratio, aligning with Schivardi's method. Additionally, their method uses a Financial Debt/EBITDA ratio minimum of 20x to indicate over-indebtedness, which is extremely high and excludes many significantly leveraged companies. However, it does not account for a company's ability to make interest payments, failing to meet Ch3. In our view, while Storz's method effectively measure Ch1, their criteria for Ch2 are over-conservative, and they do not address Ch3.

Our methodology classifies zombie firms based on an approach similar to borrowing capacity assessment in bank financing with using of EBITDA (quasi OCF generating approach). Banks annually review all clients using various indicators to assess their repayment capacities and the likelihood of repayment. EBITDA is the preferred profitability indicator. It is widely used as a performance measure in business reports, creditworthiness assessments, and credit risk monitoring (EBA, 2020a), as well as in debt covenants within loan agreements (Chava and Roberts, 2008). EBITDA serves both as a quick tool to evaluate a company's ability to cover interest and repay debts and as an indicator of a company's cash-generating capacity. Financial analysis textbooks sometimes describe the debt-to-EBITDA ratio as a solvency ratio, indicating a firm's capacity to meet future debt obligations (Bouwens et al., 2019).

In line with Schivardi's method, we set a precondition for the minimum 5 years of operation to exclude startups from the zombie firms. Following McGowan method, our first criterion is the interest coverage ratio, but we use EBITDA instead of EBIT, addressing Ch1 and Ch3. Our leverage measurement aligns with Storz (3) criteria but with an adjustment: we set the leverage threshold at 25%, in accordance with the ECB's guidance for leveraged transactions that a borrower's leverage after funding exceeds 4.0 times the ratio of total debt to EBITDA (ECB, 2017), which covers adequately Ch2. Unlike Storz's method and Schivardi's method, our criteria do not include ROA or any other return indicator. However, it is part of the calculation of the interest coverage ratio following McGowan *et al.* (2018), a component absent in the methodologies of both Storz's method and Schivardi's method.

In the new method the following criteria are used to identify zombies:

$$\text{ICR (EBITDA/interest expenses)} < 1 \quad \text{new method (1)}$$

$$\text{EBITDA/Financial Debt} < 25\% \quad \text{new method (2)}$$

First, we use the four methods to examine the change in the proportion of the zombie firms. Then apply our method but the criterion should stand only for one year. Finally, similarly to Carreira *et al.* (2022), we use a cohort matrix to analyse the survival rate of zombie firms over a two-year period from 2016 to 2022. Cohort matrix reports track the long-term survival of firms identified as zombies each year. The proportion of surviving zombie companies is calculated as a proportion of the total number of zombie companies in the year in which they were originally declared zombie.

3.5 Results and discussion

Examining the median net sales, profitability (ROA via EBITDA%), leverage, and interest coverage ratio of manufacturing firms (Table 11, we see that median turnover did not significantly decline in 2020. Profitability dropped in 2020 but showed notable recovery by 2021. This change reflects broader economic trends. In 2020, GDP declined sharply across the EU27, with Spain and Italy experiencing drops of -10.9% and -8.9%, respectively, while industrial production fell by -9.5% in Spain and -11.4% in Italy. Northern countries, like Denmark (-1.8% GDP, -5.5% industrial production) and Sweden (-2.0% GDP, -4.6% industrial production), showed greater resilience (Eurostat, 2024a, 2024b). By 2021, recovery was strong, with GDP growth reaching 6.7% in Spain and 8.9% in Italy, and industrial production rising by 7.5% and 12.2%, respectively.

To validate the accuracy of our methodology in distinguishing between zombie and non-zombie firms, we applied it to 2019 data. Table 12. presents descriptive statistics for our sample, highlighting differences in size, profitability, and financing needs between zombie and non-zombie firms according to our method. Zombie firms exhibit financial weaknesses in several areas such as net revenue, profitability, and indebtedness. Notably, more than half of the zombie firms have a negative ROA and EBITDA margin (EBITDA/net revenue), consequently characterized by negative interest coverage ratios. The undercapitalization is also a typical characteristic of zombie firms, as it is indicated by the striking differences in median solvency values (equity divided by total liabilities)

of zombies and non-zombie firms. The nominal indebtedness of zombie firms is not significantly different from that of non-zombie firms across countries, indicating that excessive debt is not the primary factor behind their classification. Instead, the zombie label is better explained by their inadequate cash flow generation. Additionally, zombie firms experienced a sharper decline in annual turnover compared to healthy firms, as well as a reduction in tangible asset values between 2018 and 2019, limiting their ability to offer collateral for bank loans and further hindering their financial stability.

11. Table: Median Financial Metrics for Selected European Countries (2017-2022).

	LN Net sales ⁵						ROA (EBITDA %) ⁶						Leverage ⁷						ICR ⁸					
Country/ Year	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022
Denmark⁹	-	-	-	-	-	-	-	-	12,4	12,2	13,4	13,3	-	-	0,30	0,25	0,25	0,27	-	-	9,4	10,6	13,4	11,2
Spain	6,4	6,4	6,5	6,4	6,5	6,7	7,2	7,3	7,2	5,6	6,9	7,6	0,22	0,22	0,22	0,27	0,24	0,22	9,4	10,1	10,7	8,2	11,5	12,9
Finland	6,4	6,4	6,4	6,3	6,4	6,6	13,8	14,0	13,8	14,3	14,2	14,1	0,31	0,30	0,29	0,29	0,27	0,25	8,5	8,5	8,5	9,1	10,0	10,0
Italy	7,3	7,3	7,3	7,2	7,5	7,7	7,7	7,8	7,6	6,5	8,0	8,4	0,19	0,19	0,18	0,20	0,19	0,18	10,7	11,3	11,3	11,4	15,5	14,4
Sweden	6,5	6,5	6,5	6,5	6,6	6,6	12,0	11,7	11,4	12,2	13,0	13,0	0,21	0,21	0,21	0,20	0,18	0,17	11,4	11,7	11,4	12,8	16,3	15,0

Source: Own editing based on ORBIS data.

⁵ LN Net sales: Natural logarithm of net sales in thd EUR

⁶ EBITDA/ Total assets

⁷ Total financial debt / Total Assets

⁸ EBITDA/Interest paid

⁹ Due to the highly limited availability of net sales data for Danish companies, in contrast to other financial indicators, these figures were not included in the analysis.

12. Table: Characteristics of Zombie firms in 2019

Country	Zombie?	LN	LN	Solvency	Ln	EBITDA	EBITDA	ROA	ROA	Age	ICR	Leverage	Fixed	Sales
		(TA) ¹⁰	(Net sales)	¹¹	(Debt) ¹²		margin ¹³	EBIT ¹⁴	EBITDA ¹⁵		EBITDA ¹⁶	¹⁷	Assets growth rate	
Spain	Non	6,7064	6,8232	0,4020	4,253	59,6	0,0687	0,04	0,0772	24,0	10,56	0,225	-0,0209	0,0308
	Zombie	6,4247	5,8098	0,1927	4,954	-32,2	-0,0976	-0,09	-0,0581	26,0	-9,02	0,274	-0,0164	-0,0436
Italy	Non	7,6297	7,6213	0,2537	5,817	152,8	0,0767	0,04	0,0774	24,0	10,41	0,196	-0,0174	0,0070
	Zombie	7,5738	6,9200	0,0773	5,802	-106,1	-0,1150	-0,10	-0,0620	29,0	-8,02	0,212	-0,0622	-0,1016
Sweden	Non	6,3384	6,7575	0,3651	4,685	56,48	0,0756	0,07	0,1182	23,0	9,95	0,212	-0,0729	0,0113
	Zombie	6,0303	6,3858	0,1459	4,567	-39,11	-0,0728	-0,16	-0,1136	23,0	-6,51	0,276	-0,1121	-0,0766
Finland	Non	6,4135	6,8101	0,3215	4,990	80,0	0,0895	0,08	0,1449	20,0	9,00	0,288	-0,0435	0,0365
	Zombie	6,3526	6,2246	-0,0137	5,318	-48,0	-0,1077	-0,17	-0,0984	21,0	-3,83	0,408	-0,0718	-0,0567
Denmark	Non	6,8497	n/a	0,3676	5,511	121,3	n/a	0,08	0,1334	18,0	9,7500	0,3012	-0,0408	n/a
	Zombie	6,4171	n/a	0,1007	5,920	-66,08	n/a	-0,14	-0,0988	19,5	-3,9900	0,5279	-0,1048	n/a

Source: Own editing based on ORBIS data.

¹⁰ Natural logarithm of Total Assets

¹¹ Equity/Total Assets

¹² Natural logarithm of Total financial debt

¹³ EBITDA/ Net sales

¹⁴ EBIT/ Total Assets

¹⁵ EBITDA/ Total Assets

¹⁶ EBITDA/ Interest expenses

¹⁷ Total financial debt/ Total liabilities

3.5.1 Rise of zombie firms during COVID-19

Table 13 provides an overview of the prevalence of zombie firms based on alternative measurement methods at both yearly and country levels. The proportion of zombie firms, typically ranges from 4-7% per year, there are no remarkable differences between the results of different measurements across countries. The Storz's method tends to underestimate the proportions compared to the McGowan's and Schivardi's method, which align more closely with ours. However, our analysis indicates that two countries experienced an increase in zombie firms during the COVID-19 affected years (2020 and 2021). Specifically, the share of zombie businesses in Italy rose from 3.54% in 2019 to 4.2% in 2021. In Spain, an even more significant change was observed, with the share of zombie firms increasing from 4.6% in 2019 to 7.2% in 2021. A key difference between the methodologies is the length of time a company must meet criteria to be classified as a zombie. Storz's method and our approach label a company as a zombie if it meets the criteria for two consecutive years. McGowan's method requires three consecutive years, while Schivardi's method flags companies annually. This longer-term analysis smooths the data, as a company must be classified as a zombie not only in the current year but also in previous years (or even earlier, in McGowan's case). Consequently, the ratio of zombie firms varies significantly between countries.

13. Table: Comparing the rate of zombie firms with different measuring methods.

Schivardi's method (1Y)							
Country	2016	2017	2018	2019	2020	2021	2022
Italy		4,20%	3,85%***	3,67%*	5,39%***	5,04%***	4,84%*
Spain		5,04%	4,82%*	4,63%*	6,37%***	7,06%***	7,64%***
Denmark				5,44%	7,47%***	7,45%	8,58%***
Sweden		7,54%	7,81%	7,59%	8,15%	8,27%	9,22%**
Finland		8,42%	7,49%*	7,30%	7,29%	7,50%	8,02%
McGowan's method (3Y)							
Country	2016	2017	2018	2019	2020	2021	2022
Italy		5,53%	4,62%***	4,34%**	4,45%	4,19%**	4,15%
Spain		6,56%	5,62%***	5,12%***	5,54%***	5,77%*	5,95%
Denmark				7,10%	7,19%	6,84%	7,06%
Sweden		7,11%	7,04%	6,59%	7,05%	6,28%**	6,44%
Finland		7,09%	6,57%	5,98%	5,68%	5,06%	5,25%

Storz's method (2Y)							
Country	2016	2017	2018	2019	2020	2021	2022
Italy	3,29%	2,95%***	2,56%***	2,57%	2,55%	2,26%***	1,67%***
Spain	3,39%	2,83%***	2,60%**	2,52%	2,99%***	3,74%***	2,69%***
Denmark				3,95%	5,13%***	5,00%	5,06%
Sweden	3,83%	4,52%**	4,68%	4,85%	4,32%*	3,80%*	3,90%
Finland	5,04%	4,15%**	4,31%	3,64%*	3,73%	3,82%	3,87%
Our method (2Y)							
Country	2016	2017	2018	2019	2020	2021	2022
Italy	4,25%	3,50%***	3,17%***	3,54%***	4,11%***	4,20%	2,88%***
Spain	5,76%	5,03%***	4,60%***	4,55%	5,37%***	7,17%***	5,15%***
Denmark			7,28%	7,00%	7,20%	6,76%	7,39%*
Sweden	6,81%	7,41%*	6,94%	7,77%**	7,20%	7,28%	7,16%
Finland	7,73%	6,69%**	6,22%	6,20%	6,22%	5,84%	6,72%*

Source: Own editing based on ORBIS data.

Z-test was provided for the testing of the means (share) of two Zombie populations proportion is equal to the previous year's Zombie share

* The change compared to previous year is significant at $p < 0.1$

**The change compared to previous year is significant at $p < 0.05$

***The change compared to previous year is significant at $p < 0.01$

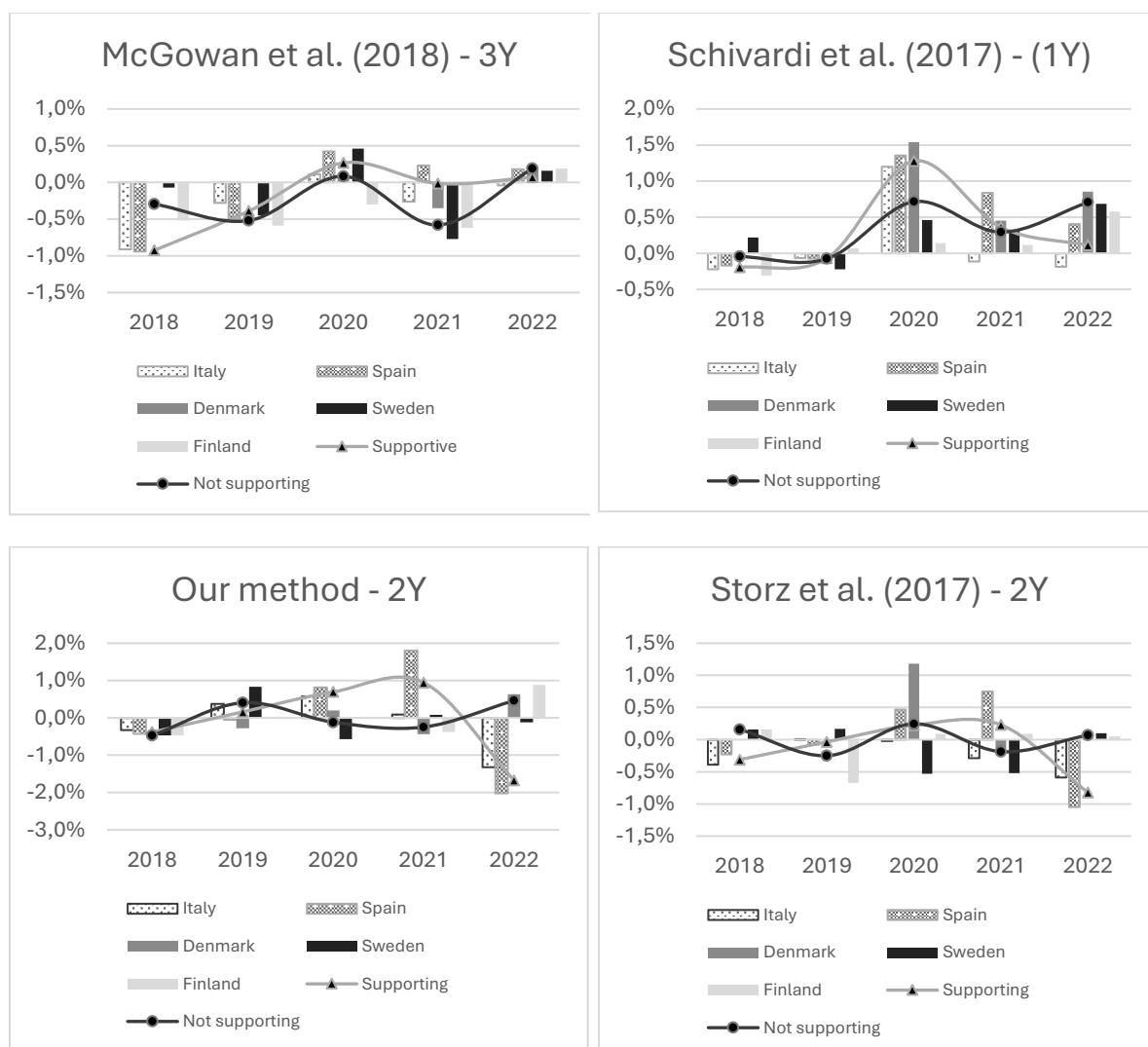
Figure 13. illustrates the fluctuations in the rate of zombie firms over time and the average change of supporting countries (Spain, Italy) and non-supporting countries (Sweden, Finland, Denmark) as well. Across all four methodologies, we observed a similar trend: the zombie firm ratio increased in the supporting cluster in 2020. This increase was at least as high as the growth rate in non-supporting countries using Storz's method, and in most cases, it significantly exceeded the growth rate in non-supporting clusters (McGowan's, Schivardi's, and our method). Specifically, Spain showed a notable rise in zombie firms across all methods, while Italy's increase was particularly pronounced in Schivardi's and our method. McGowan's method, requiring zombie criteria to be met consistently from 2018 to 2020, showed a more moderate increase. Similarly, in 2021, zombie firm ratios increased primarily in supporting countries, except in Schivardi's method, which also noted a rise in non-supporting countries. Schivardi's results were outliers, as other methods generally showed a declining or stagnating trend by 2021, except in Spain where the zombie rate rose across all methods. In Italy, the rate either decreased or showed minimal growth, except according to Storz's method, which registered a decrease. By 2022, the proportion of zombie firms showed a smaller change

for non- supporting countries which can be explained by the phased out of the subsidies. Significant differences across different methodologies highlights the practical problem of the lack of a uniform Zombie identification method.

According to McGowan's method, the variation in zombie rate changes is within a smaller range, which is a consequence of the consecutive three-years examination period. The increase in the zombie rate for 2022 is remarkable in the results calculated in Schivardi's method's which could be attributed to the energy crisis, leading to an increase in interbank interest rates considered in criterion Schivardi (1), thus influencing the results by an external factor beyond the control of the businesses. Overall, in crisis environments like COVID-19, methods using shorter intervals more accurately capture effects than those using longer intervals due to smoothing effect. Schivardi's method, which considers external factors such as changes in interbank interest rates, gives a different result. However, it better aligns with the established three criteria than the other three methodologies.

Our method presents a similar picture regarding the evolution of the zombie rate as the other three methods, meaning that our approach does not yield significantly different results from the previously employed methods. However, examining the data with different methodologies leads to different conclusions similar to the study by Mingarelli *et al.* (2022).

13. Figure: Change of the proportion of zombie firms measuring with four different methods

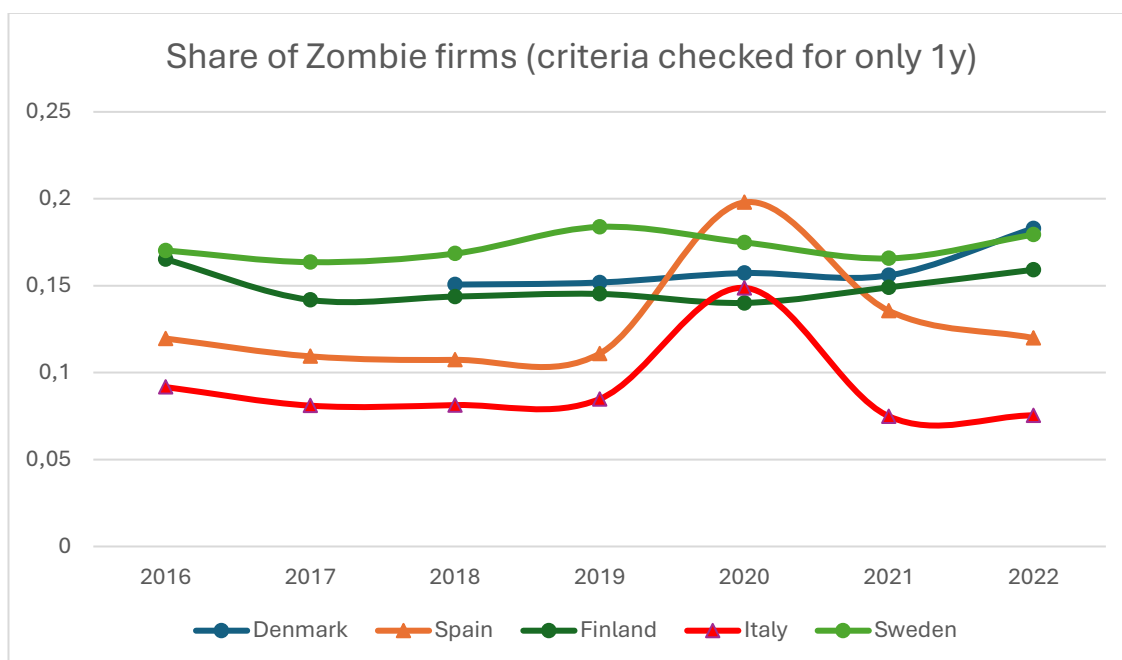


Source: Own editing based on ORBIS data.

In the following step, we examined whether there are any difference between countries investigating the change of the zombie firms' rate by using our method with an interval 1y.

The positive effect between the increase in the share of zombie firms and the state aid related to credit instruments is more pronounced when zombie firms are identified using the new methodology and the criterion in one year period, i.e. the ICR and EBITDA/Financial Debt criteria are met in only one year (see Figure 14). In the case of the COVID-19 one-year zombie measure, our assumption seems to be confirmed, i.e. only in 2020 we observe a significant increase in the Italian and Spanish data, i.e. Spain from 11% in 2019 to 20%, Italy from 8.5% to 15%, but in 2021 the 1-year zombie rate approaches again the 2019 level.

14. Figure: The change of zombie firms measuring with one-year period new measurement.



Source: Own editing based on ORBIS data.

3.5.2 Cohort matrix analysis - survival paths of zombie firms

Finally, in accordance with Carreira *et al.* (2022), we investigate the survival rate of the zombie firms identified by our methodology for the period 2016-2022 using a cohort matrix. According to Carreira *et al.* (2022), a zombie company's path can follow three directions. 1) It may continue as a zombie if its bank maintains or extends loans despite financial difficulties or agrees on a restructuring plan. 2) It may recover by resolving financial issues, improving efficiency, or benefiting from positive external conditions. 3) It may fail if it cannot meet debt obligations, leading to liquidation by the bank or a request for liquidation by the owners.

We examined the survival rate of zombie companies, i.e. whether firms identified as zombies in year $t=0$ remain so in subsequent years ($t=1, 2, \dots$). We have illustrated this in a cohort matrix for each country, as shown in Table 14.

Generally, each year 40-50% of Zombie companies survive the following year, so for example in Italy, of all the companies that were labelled as Zombie in 2016, 44% of them remained Zombie in 2017, 22% in 2018, 13% in 2019, 8% in 2020, 5% in 2021 and only 3% in 2022, respectively.

There is a slight increase in survival rates for 2020 in countries that supported accommodative credit conditions, i.e. in Italy the first-year survival rate before covid was 44-49%, compared to 50% in 2020. In Spain, the pre-covid survival rate of 50-51% increased to 55% in 2020. In contrast, no increase can be detected in the not-supporting countries (Denmark, Finland), moreover in Sweden this ratio rather decreased (from 47-49% to 45% in previous years).

Despite small increases in Spain and Italy, the data does not indicate a mass survival of zombie companies following the lending support measures. These findings align with Helmersson *et al.* (2021), which suggests that zombie firms in the euro area may have benefited only temporarily from loan schemes and lenient credit conditions.

14. Table: The survival of zombi firms measuring with two-year period new measurement.

Spain	2016	2017	2018	2019	2020	2021	2022
2016	100%	51%	28%	17%	11%	8%	5%
2017		100%	50%	29%	18%	12%	7%
2018			100%	51%	30%	18%	10%
2019				100%	55%	30%	15%
2020					100%	48%	22%
2021						100%	36%
2022							100%
Italy	2016	2017	2018	2019	2020	2021	2022
2016	100%	44%	22%	13%	8%	5%	3%
2017		100%	47%	26%	15%	9%	6%
2018			100%	49%	27%	15%	9%
2019				100%	50%	24%	13%
2020					100%	40%	19%
2021						100%	40%
2022							100%

Denmark	2016	2017	2018	2019	2020	2021	2022
2016	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2017		n/a	n/a	n/a	n/a	n/a	n/a
2018			100%	52%	31%	21%	13%
2019				100%	55%	32%	21%
2020					100%	50%	32%
2021						100%	56%
2022							100%
Sweden	2016	2017	2018	2019	2020	2021	2022
2016	100%	49%	25%	15%	8%	4%	3%
2017		100%	47%	24%	13%	8%	5%
2018			100%	47%	23%	14%	8%
2019				100%	45%	23%	13%
2020					100%	43%	22%
2021						100%	44%
2022							100%
Finland	2016	2017	2018	2019	2020	2021	2022
2016	100%	42%	21%	15%	10%	5%	3%
2017		100%	45%	28%	17%	9%	7%
2018			100%	51%	28%	14%	10%
2019				100%	49%	21%	15%
2020					100%	43%	27%
2021						100%	49%
2022							100%

Source: Own editing based on ORBIS data.

3.6 Implication and direction for future research

These findings offer valuable evidence for policymakers in designing future crisis response strategies, ensuring financial support is directed toward viable firms and avoiding prolonged assistance to those unlikely to recover.

For researchers, the clusters presented in this study allow for more nuanced comparisons between groups of countries along state measures, and the novel methodology presented opens the way for further research in this area.

3.7 Limitation

One of the main limitations of the research is that it relies on annual data for unlisted companies, which limits the ability to capture inter-annual fluctuations. Future research could explore additional firm-specific characteristics, such as working capital management and cash burn rates, and assess how these factors vary across countries with differing policy responses.

3.8 Conclusion

The Covid-19 crisis severely impacted the financial health of firms, prompting government and central bank interventions that raised concerns about increased zombification, potentially hindering post-pandemic recovery. To address these concerns, our research examines the impact of the Covid-19 pandemic on the share of zombie firms in selected European countries, focusing on the most and least supportive nations using three established methods and a new EBITDA-based approach, with a specific focus on the manufacturing sector. An important outcome of our research is that we have used cluster analysis to classify the EU-27 countries into different clusters based on their approaches to lending support. On this basis, we identified six clusters and two outlier countries, investigating in this study the most and least supportive countries. Another meaningful output is that we have introduced a new EBITDA-based zombie identification method, in line with the assessment of companies' borrowing capacity in bank financing.

The main result of our research is that we have examined how the share of zombie firms changed from year to year using four different zombie identification methods. Across all four methods, we find that the share of zombie firms in support cluster countries increased more than in non-support cluster countries by 2020. Next, we analysed changes in zombie

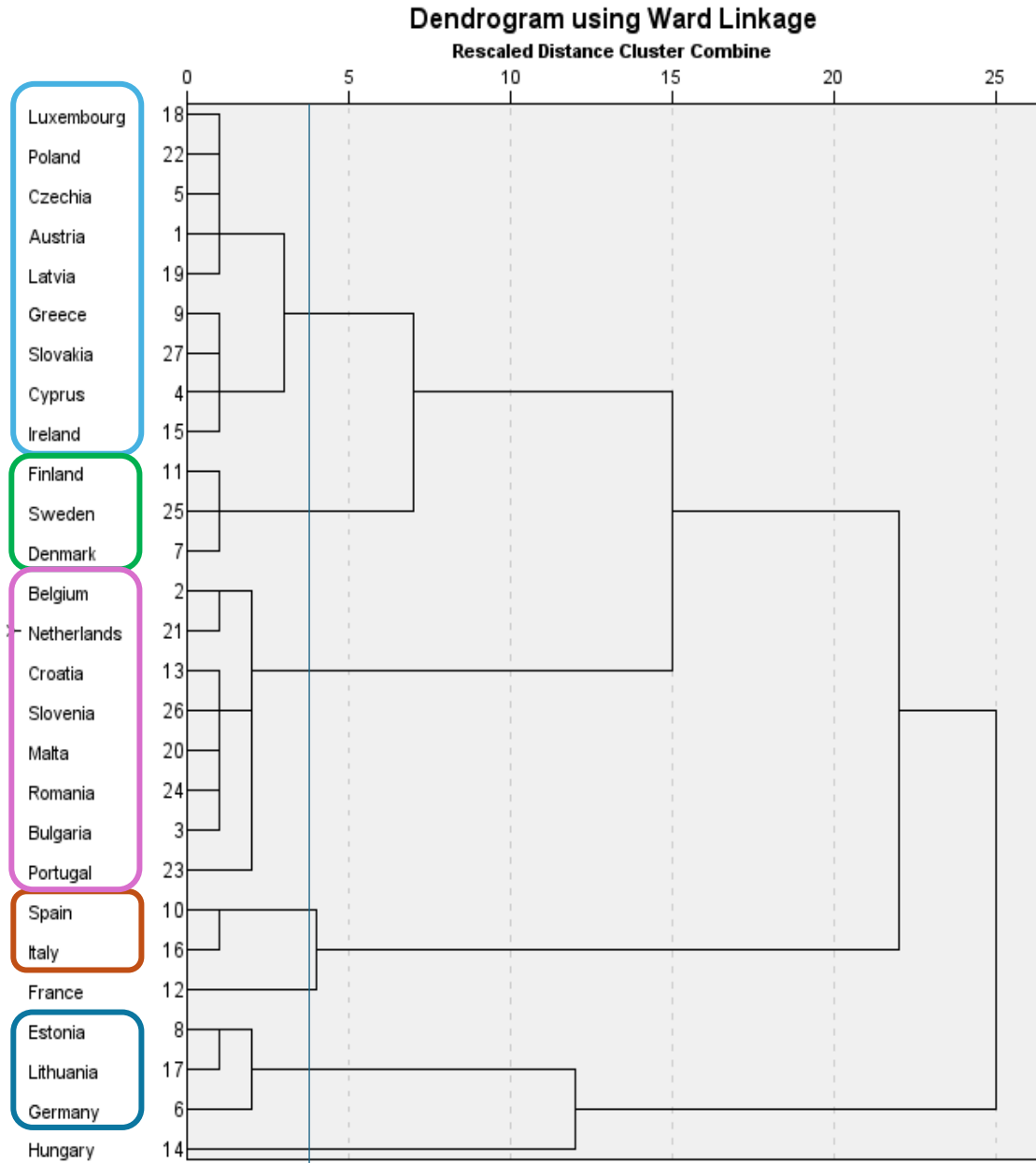
firm rates over a one-year period using our methodology and found that countries in the supporting cluster, experienced a sharp rise in 2020. However, by 2021, the share of zombie firms returned close to 2019 levels, with only a modest increase in countries of the most supportive cluster. Finally, using our methodology and a cohort matrix approach based on Carreira *et al.* (2022), we analysed survival rates of zombie firms from 2016 to 2022. We found a slight increase in supportive countries, while non-supportive countries showed stagnation or decline. These results align with Helmersson *et al.* (2021), indicating that the measures introduced have not significantly increased the number of zombie firms.

Two possible explanations exist: first, companies' ability to generate profits and service debt declined only in 2020, with the manufacturing sector consolidating in 2021; second, following Pelosi (2021), eligibility criteria for support schemes may have filtered out zombie firms, though the latter should be confirmed with company-level data.

3.9 Appendix to the article

3.9.1 Appendix 1. - Dendrogram from the Hierarchical Cluster Analysis

15. Figure: Dendrogram from the Hierarchical Cluster Analysis



Source: Own work.

To define smaller country groups, we examined distances around the 3-5 range on the dendrogram, with a notable increase in coefficients supporting this range. A Silhouette analysis determined whether to use 6 or 7 clusters, with the 7-cluster solution selected due to its higher average Silhouette value (0.541 vs. 0.507). In the 7-cluster solution, France forms a distinct cluster with a Silhouette value of 1.000, highlighting its unique

characteristics. The clustering's robustness was confirmed by applying the Average Linkage method, which yielded identical results to the Ward method at the 3-5 distance range.

3.9.2 Appendix 2 - Main characteristics of the clusters

Examining the characteristics of the five cluster, we give the following names for each cluster:

1. “Moratorium only”: Austria, Cyprus, Czechia, Greece, Ireland, Luxembourg, Latvia, Poland, Slovakia
2. “Long available moratorium combined with state guarantees”: Belgium, Bulgaria, Croatia, Malta, Netherland, Portugal, Romania, Slovenia
3. “Limited moratoria and other minor measures”: Germany, Estonia, Lithuania
4. “Not supportive”: Denmark, Finland, Sweden
5. “Highly supportive with adopted moratoria and guarantee programs”: Spain, Italy

Excluded: France, Hungary

15. Table: Main characteristics of the clusters

Clusters	Country	Average maturity of moratoria (months)	Guarantees programs in GDP 2020-21 % (average)	Loan programs in GDP 2020-21 % (average)
1	Austria, Cyprus, Czechia, Greece, Ireland, Luxembourg, Latvia, Poland, Slovakia	7,4	0,5%	0,1%
2	Belgium, Bulgaria, Croatia, Malta, Netherland, Portugal, Romania, Slovenia	17,8	1,5%	0,0%
3	Germany, Estonia, Lithuania	4,7	0,9%	1,2%
4	Denmark, Finland, Sweden	0,0	0,5%	0,0%
5	Spain, Italy	18,5	8,8%	0,0%
Excluded	France	4	6,8%	0,0%
Excluded	Hungary	33,0	4,7%	1,3%

Source: Own work

4 FINANCIAL ADAPTATION OF SECTORS IN THE HUNGARIAN ECONOMY DURING THE CORONAVIRUS PANDEMIC

ABSTRACT

The coronavirus pandemic and the measures taken to mitigate its effects have had a significant impact on the Hungarian economy, with varying degrees of impact in different industries. The aim of the study is to analyse the financial performance of the industries affected by the pandemic and to identify undertakings in difficulty and so-called zombie companies in the Hungarian economy. The research draws on financial data from more than 68,000 Hungarian small, medium and large enterprises for the period 2019-2022, with a particular focus on EBIT and revenue indicators. A new feature of the paper is an in-depth analysis of the sectoral changes caused by the pandemic and the structural weaknesses of the economy during the crisis. The results show that five of the 74 industries surveyed were particularly vulnerable, while the use of credit support was more widespread than the direct impact of the crisis would have justified. The study contributes to a better understanding of the resilience and weaknesses of the Hungarian economy to crises, helping to take targeted economic policy decisions.

4.1 Introduction

One of the most significant global events of recent years was the outbreak of the coronavirus epidemic in early 2020, which hit society and the economy unexpectedly and unprepared as an exogenous shock. The pandemic not only put healthcare systems in crisis but also caused demand and supply shocks across all areas of economic activity, leading to economic downturns in many countries and increasing uncertainty on a global scale. The examination of this topic is strongly justified by the fact that the consequences of the pandemic were not only short-term but also proved to have long-term effects, permanently changing the behavior of economic actors and the economic environment at both global and national levels. The relevance of the topic lies in the fact that, although the coronavirus pandemic has ended, its return cannot be ruled out, nor can the emergence of other similar pandemics as health-related supply and demand shocks. Therefore, the conclusions of this research can also be used to study potential future health shocks of a similar nature.

The aim of this study is to analyse the consequences and effects of the supply and demand shocks triggered by the coronavirus epidemic. This study seeks to answer the research question of how the coronavirus pandemic influenced the financial performance of small and medium-sized enterprises (SMEs) in Hungary at the sectoral level, and closely related to this, what differences emerged between the various sectors. In this study, a sector in crisis is defined as one characterised by a significant decline in revenues and a fall in profitability. In terms of its genre, the study is an impact analysis, analysing the effects and consequences of an external health shock on Hungarian firms in a descriptive statistical manner, although it does not set out to explore causal mechanisms. Its time horizon covers the years 2019 to 2022.

Research findings from recent years have provided valuable information on the effects of the crisis triggered by the coronavirus pandemic on the corporate sector. However, the domestic literature on the subject has not analysed these effects in detail, with financial indicators and sectoral breakdowns. This gap can therefore be considered a research gap.

The approach of the article is unique because it analyzes in detail, by second-level TEÁOR codes, company data for each sector during the coronavirus epidemic. It also uses a novel cluster analysis that separates distressed and stable sectors on the basis of earnings before interest and taxes (EBIT), revenue decline and the share of undertakings in difficulty, thus allowing for a sectoral comparison to gain a deeper understanding of the changes during the epidemic. The undertakings in difficulty is a competition law concept that determines ineligibility for EU and domestic state aid on the basis of changes in equity. This study is the first to examine the share of zombie firms at the sectoral level. The National Bank of Hungary (Magyar Nemzeti Bank, hereafter 'MNB') defines a zombie firm as "a firm that is unable to repay its debts and/or is unable to operate profitably over a long period of time, but nevertheless does not go out of business." (MNB, 2019:23). This definition ignores the solvency criterion and focuses only on profitability. It considers as zombie firms "those that are at least 10 years old and have not realised revenue for at least three years (a narrower definition)". It even includes companies whose equity has been less than or equal to zero for three years (broader definition)" (MNB, 2019:23). A *zombie firm* is therefore an uncompetitive firm whose profits are only sufficient to repay interest on its debt, thus avoiding bankruptcy, but not to repay debt. The definition is discussed in the literature review in an international context.

Based on the research findings, the study makes recommendations for future crisis management strategies, highlighting the need for better targeting of public support in times of crisis. Indeed, the analysis shows that some sectors have benefited from significant lending support despite the fact that they have not experienced a significant drop in turnover or profitability.

The structure of the study is as follows. The first part focuses on the literature background on the topic, which includes a description of the macroeconomic environment, the zombie economy and the understanding of the undertakings in difficulty situation. The second part presents the data and methodology. The third part presents the research results in descriptive statistical tests and cluster analysis. The fourth part is the summary and conclusions section. The paper concludes with a list of references.

4.2 Literature background

The macroeconomic environment

The emergence of the coronavirus epidemic has challenged socio-economic systems worldwide on an unexpected scale and complexity. The rapid spread of the epidemic and its severe consequences have created considerable uncertainty, not only in health systems, but in all aspects of economic and social life (Donthu & Gustafsson, 2020).

The macroeconomic effects of the crisis caused by the pandemic include major disruptions to global supply chains, which resulted in delays in many industries. The breakdown of supply chains worldwide led to shortages of raw materials and parts, slowing down production processes (Guan et al., 2020). The closures resulted in a drastic reduction in international trade volumes (Baldwin & Tomiura, 2020). Unemployment also increased significantly, particularly in the service sector (Coibion et al., 2020b). With the near-complete suspension of international travel, revenues in the tourism and hospitality industries dropped dramatically (Gössling et al., 2020). At the same time, the crisis has accelerated the digital transformation, as companies have been forced to adopt new technology-based solutions to maintain their operations (Verhoef et al., 2021; Halmai, 2022). The economic downturn has also had a significant impact on government budgets, which have been hit by increased spending on health and economic stimulus (IMF, 2020).

These challenges highlight the critical role of corporate adaptability, or resilience. In recent years, the crisis management and resilience of companies have become central themes in numerous studies (Krishnan et al., 2022; Castro et al., 2020). According to research by Nguyen et al. (2023), specific factors such as cash reserves, the use of knowledge-based assets, selling in international markets, and access to foreign capital markets play a key role in firms' ability to survive such external shocks.

The COVID-19 pandemic had a significant impact on both the Hungarian economy and society. From a macroeconomic perspective, this is reflected in Hungary's GDP, which declined by 0.9% in 2020 due to the pandemic, following a 4.6% growth in 2019. Subsequently, the economy rebounded with a 7.1% increase in 2021 and expanded by 4.6% in 2022. Domestic publications have examined the impact of the epidemic on firms from a variety of approaches and with different methodologies. Szeiner et al. (2023) relied on a questionnaire survey to analyse the economic impact of the coronavirus epidemic and the recovery process. Juhász & Szabó (2021) carried out an enterprise risk analysis based on the experience of the first wave of the epidemic. Kiss-Dobronyi et al. (2024) compared the management practices used with the change in sales between 2019 and 2020, El-Meouch et al. (2024) investigated vulnerability based on financial data and credit information for 2019-2020, and Pogácsás & Szepesi (2023) grouped the effects of the crisis on SMEs in Hungary through in-depth interviews.

The first round of more detailed analyses on the involvement of industries was published by the Hungarian Central Statistical Office (Központi Statisztikai Hivatal, hereafter 'KSH') and the MNB (2020a, 2020b, 2021a). According to KSH (2021), the Hungarian economy experienced a significant downturn in 2020. In tourism, the number of overnight stays fell by 58%, the production volume of the construction sector shrank by 9.1%, industrial production by 6.1%, while the volume of goods shrank by 11%. In contrast, the volume of services in the information and communication sector increased by 6.1 percent.

In May 2020, the MNB classified the four-digit TEÁOR codes into three vulnerability categories based on a peer review in the early days of the coronavirus crisis (MNB, 2020b). Of the 615 sectors, 104 were classified as vulnerable: 64 directly and 40 indirectly. Sectors highlighted included real estate and tourism and hotels, where all TEÁOR codes were classified as vulnerable, construction (68 percent of TEÁOR codes), transport and storage (52 percent), arts, entertainment and recreation (47 percent), and

trade and repair of motor vehicles (23 percent). In June 2021, the MNB reassessed this categorisation based on the 2020 facts (moratorium participation, value added, change in number of employees). Sectors such as tourism, mining, transportation and storage, real estate activities, social care, as well as arts and recreation, remained highlighted (MNB, 2021a).

El-Meouch et al. (2024) examined the vulnerability of firms by industry, area and firm size. They found that the construction¹⁸ (F), accommodation and food service activities (I), administrative and support service activities (N), education (P), and arts, entertainment and recreation (R) were the most affected sectors.

To mitigate the uncertainty caused by the crisis and maintain lending, several measures were introduced, including a payment moratorium in March 2020 and the NHP Hajrá (Growth Loan Program) with a total budget of HUF 3,000 billion. The moratorium provided temporary relief to companies, while the NHP Hajrá enabled longer-term financing without sectoral restrictions. According to data from the MNB (2021a, 2021b), Table 16 summarizes the distribution of the NHP Hajrá loan portfolio contracted by June 30, 2021, and the proportion of companies utilizing the moratorium by sector. According to the table, sectors less affected by the pandemic (manufacturing, agriculture, technical activities) also took advantage of these opportunities.

¹⁸ According to the TEÁOR, the capital letters next to the names represent the national economic sector (referred to as 'sections'/'nemzetgazdasági ág' by the KSH), the two-digit number denotes the sector ('divisions'/'ágazat'), and the three-digit number indicates the sub-sector ('groups'/'alágazat').

16. Table: Contracted volume of the NHP Hajrá loan program until 30 June 2021 and the share of loans remaining in moratorium by sector between June and December 2020

Sections	Payment moratorium		Drawdown of NHP Loans until 30 June 2021 (billion HUF)				
	Participation rate %		Investment credit	Revolv. credit	Repayment of a loan	Total	Share %
	2020 JUN.	2020 DEC.					
<i>Construction</i>	34	19	72	207	7	285	10
<i>Wholesale and retail trade</i>	34	19	113	558	27	698	25
<i>Financial and insurance act.</i>	37	9	55	4	13	72	3
<i>Electricity, gas, steam and air conditioning supply</i>	39	11	74	1	25	100	4
<i>Agriculture, forestry and fishing</i>	46	26	130	121	31	282	10
<i>Manufacturing</i>	46	29	114	234	22	370	13
<i>Transportation and storage</i>	56	34	41	56	13	110	4
<i>Professional, scientific and technical activities</i>	59	30	67	60	10	137	5
<i>Real estate activities</i>	62	42	238	104	82	424	15
<i>Tourism</i>	87	70	44	50	31	125	5
<i>Administrative activities.</i>	n/a	n/a	20	47	3	69	2
<i>Other</i>	n/a	n/a	17	32	6	55	2
<i>Information, comm.</i>	n/a	n/a	11	35	2	48	2

Source: own editing, share of companies remaining in payment moratorium MNB (2021a) Contracted volume of NHP loans based on MNB (2021b) data

Fiscal policy has also played an important role in mitigating the effects of the epidemic, in particular in preserving employment. Initiatives included short-time working subsidies, tax relief and investment promotion (Nagy, 2021). While measures to promote finance were broadly economy-wide, fiscal support was more sector-specific, particularly in the tourism, hospitality, entertainment, sport, culture and passenger transport sectors, where wage subsidies and tax relief helped businesses (Lentner, 2021).

According to previous analyses, the COVID-19 pandemic had a significant impact on Hungarian companies, particularly in the construction, accommodation, hospitality, as

well as arts and entertainment sectors. In contrast, in many cases, companies were able to benefit from credit support measures even without being affected by the coronavirus epidemic. Various studies, including publications by the KSH and the MNB, have analysed the vulnerability of sectors from different perspectives, but only at the level of national economic sectors (codes A to U). This study goes one level deeper, at the sectoral level, i.e. in the structure indicated by the two-digit codes of the NACE. The next subsection reviews zombie enterprises.

Zombie companies

The earliest research on zombie companies dates back to the mid-2000s, with Peek and Rosengren (2005) and Caballero et al. (2008) first mentioning them while analyzing Japan's economic stagnation during the 1990s, often referred to as the "lost decade." Early research focused on the concepts of zombie loans and zombie credit, describing the practices of Japanese banks that extended loans to financially troubled clients under favorable terms, thereby avoiding the liquidation of these debtors. The term "zombie" originates from this practice, referring to the fact that banks keep these companies alive instead of quickly concluding the loan transaction. The banks extended these loans in the hope that the firms would recover in time or be rescued by the government. Conversely, the closing of loan transactions results in capital write-downs that weaken their capital position, (Caballero et al., 2008).

There is no clear definition and guidance on the concept of zombie firms in the international literature. In a broader sense, zombie firms are defined as indebted companies that are in persistent financial difficulty. McGowan et al. (2018) identified zombies in a broader sense. According to the Interest Coverage Ratio (ICR), a company is considered a zombie if its EBIT/interest paid ratio is less than one for three consecutive years. This definition was used to identify a financially distressed situation. In the narrower sense, zombie firms are defined as indebted firms in financial distress that would fail within a short period of time without financial support from creditors (new loans or roll-over of existing loans, even at interest rates favourable compared to market pricing) (Caballero et al., 2008; Storz et al., 2017).

So far, there have been few domestic publications addressing zombie companies. The MNB (2019) has examined the presence of zombie companies in the Hungarian economy,

but only in general, without a sectoral breakdown. According to MNB (2021d), the share of domestic zombie firms is low, with 2.8 percent of firms identified as zombie, accounting for 1.7 percent of corporate credit. Their survival was not supported by the pandemic-related subsidized loan programs. In light of this, an analysis with sectoral breakdown is justified. The concept of zombie companies is closely related to that of companies in financial distress.

The concept of "undertakings in difficulty" in the literature

The concept of 'undertakings in difficulty' is particularly important for SMEs from a legal point of view, as it determines which businesses are eligible for state or EU aid. Both the Commission Regulation (EU) No 1388/2014 and the domestic Government Decree No 37/2011 (22.3.2011) stipulate that a company is considered to be in undertakings in difficulty status if it is unable to prevent losses from accumulating through its own resources, for example if its equity has significantly decreased over the past two years or if it has been subject to insolvency proceedings. This status excludes the company from state aid and aid co-financed by the EU on the basis of Article 107(1) TFEU. The regulation changed in 2020, with the calculation method narrowing from two indicators to one, thus simplifying it by considering only a decrease in equity below the subscribed capital as a reason, compared to the two variables before the pandemic, one of which was a 25 percent decrease in equity over a one-year period.

Schmidt-Köttlers & Rademacher (2011) and Lupu (2014) have examined the undertakings in difficulty mainly from a legal perspective, comparing different national bankruptcy regimes and EU legislation. Szücs (2018) and Jáki et al. (2023) analysed the legal framework of state aid in the light of changing EU regulation, while Losoncz (2019) pointed out the problems of internationalisation of Hungarian SMEs.

The study by Hegedűs (2023) was the first to assess the situation of undertakings in difficulty among Hungarian SMEs based on 2019 data. It found that the share of undertakings in difficulty was only 1.9% in the sample. They were concentrated mainly in Budapest and Pest county, and in the trade, manufacturing, transport, catering and scientific activities sectors. The main finding of Hegedűs (2023) is that the onset of distress is mainly a function of declining sales, deteriorating liquidity and firm size. The key predictor is dynamic liquidity, which is the ratio of operating profit to current

liabilities. The emergence of undertakings in difficulty status is a process and depends not primarily on regional but on sectoral specificities (Hegedűs, 2023; Zéman & Lentner, 2018; Zéman & Tóth, 2018). The next section presents the database and methodology.

4.3 Data and methodology

The study examined the financial performance of SMEs in Hungary at sectoral level and the emergence of zombie firms at firm level during the coronavirus epidemic. The paper relied on financial data from 2019 to 2022, but financial data from previous years were also needed to identify zombie firms. The data was derived from companies' annual reports and official statistical databases. The examined sample covered the financial indicators of more than 68,000 companies, such as revenue, EBIT, equity, and interest payments. Regarding undertakings in difficulty, the decision to focus on the SME category was justified by the fact that a different regulatory framework applies to large enterprises. Moreover, domestic publications have predominantly analyzed this segment. A further argument in favour of the SME segment is that the undertakings in difficulty situation is typically a capital structure problem, which, due to their nature, are less likely to affect large enterprises. According to the KSH (2024), in 2023, 99 % of enterprises were SMEs, accounting for 65 % of employment. SMEs account for 36 percent of turnover and 41 percent of value added generated by enterprises, 12 percent of exports and 28 percent of investment. These figures underline the importance of the SME category.

The study used descriptive statistical tools (sector median values) and cluster analysis to identify clusters based on the financial performance of sectors and to identify the most important changes during the crisis. We used the TwoStep¹⁹ cluster analysis algorithm, which can automatically determine the optimal number of clusters and can handle mixed types of data (continuous and categorical variables). The advantage of this method is that it evaluates the suitability of the analysis and reveals the influencing power of the variables. The importance ranking indicates this by presenting which variables determined the cluster composition. In this research, the two-step cluster analysis method

¹⁹ Two-step cluster analysis is a statistical technique used for clustering large data sets, especially when there are mixed data types (continuous and categorical) among the variables. In the first step of the procedure, a preliminary clustering is performed by forming microclusters, and in the second step, these microclusters are consolidated into larger clusters using a hierarchical algorithm. The method automatically optimises the number of clusters and evaluates the quality of the clusters using diagnostic indicators, making it an efficient and flexible solution for various research problems.

was used in the SPSS statistical software, which is particularly suitable for analysing large data sets that contain both continuous and categorical variables. The procedure consists of two main steps:

In the first step, the data set is divided into smaller, homogeneous groups, which we can call "microclusters," using a fast preprocessing algorithm. At this stage, the Bayesian Information Criterion (BIC) is used to form the clusters. This step minimizes computational complexity and efficiently prepares the data for the final clustering. The pre-formed microclusters are consolidated into larger clusters in the second step using a hierarchical clustering procedure. To determine the number of clusters, the algorithm automatically optimises the Bayesian Information Criterion (BIC) to produce the most appropriate number of clusters. The data was pre-standardised. In favour of this method, Tseng and Wu (2007) used two-stage cluster analysis in their study of 60 hotels in the Taiwanese hotel industry to explore the relationship between innovation activities and performance. Based on the results of the study, they identified four clusters that were representative of performance differences in the service sector. It may be criticized that the method is primarily suitable for grouping large samples, heavily dependent on predefined criteria, and the clusters formed through automated decisions are not always accurate. However, the method is considered well-validated due to the presentation of the Silhouette index.

The five key variables used for the analysis were: the proportion of companies showing a revenue decline of at least 10 percent and 30 percent, the change in the EBIT margin (operating profit divided by net sales, hereafter EBIT margin), and the proportion of companies classified as undertakings in difficulty based on the concept before and after the crisis. As an outlook, the study also looks at the ratio of zombie firms, but due to the specificities of Hungarian accounting regulations, only a narrower set of firms was observed, as interest payments can only be examined for companies submitting annual reports, i.e., not simplified annual reports.

In the analysis, descriptive statistical methods were used to examine the financial indicators (e.g. EBIT, decline in turnover) for each sector. The median of the EBIT percentage indicator was used and changes between years were analysed. Descriptive statistical tests were carried out on the variables and cluster analysis was used to detect

changes over time. The variables analysed in the cluster analysis are presented in Table 17.

17. Table: The set of variables considered in the cluster analysis

Variable name	Description
EBIT percentage_Median	Median EBIT/Revenue (EBIT margin) ratio for the sector
BEV_10 percent	Percentage of companies with a turnover decrease of at least 10 percent in the sector in a given year
BEV_30 percent	Percentage of companies with a fall in turnover of at least 30 percent in the sector in a given year
NH_previous	Proportion of companies in the sector that meet the criteria for being in undertakings in difficulty based on the pre-covid definition.
NH_new	Proportion of companies in the sector that meet the criteria for being in undertakings in difficulty based on the post-covid definition.
d_NH_previous	Changes in the proportion of companies in the sector that meet the criteria for being in undertakings in difficulty based on the pre-covid definition.
d_NH_new	Changes in the proportion of companies in the sector that meet the criteria for being in undertakings in difficulty based on the post-covid definition.
d_EBIT_median	Change in EBIT/revenue median ratios

Source: own work

The company-level data analysed are taken from the ORBIS database, managed by Moody's and available online. The database contains information on companies in a large number of countries (including key items from balance sheets and income statements, as well as other publicly disclosed supplementary information from company registers, etc.). The ORBIS database serves as the basis for several international (McGowan et al., 2018; Storz et al., 2017; Muñoz-Izquierdo et al., 2024) and domestic (Fáró & Hajdu, 2018; Hegedűs, 2023; Kiss-Dobronyi et al., 2024) publications. Financial data for 2018 and

2022 were downloaded in June and July 2024. The basic data were processed MS Office software package and SPSS 29 and presented in tabular form.

For the selection of distressed firms, different screening criteria were applied for each year under review (following the approach of Hegedűs (2023)), filtering out dormant firms (i.e. inactive) with no meaningful activity. The screening criteria were as follows:

- SME category classification,
- at least 3 years of operational history,
- a turnover of at least HUF 12 million,
- at least 5 employees,
- availability of the annual report for the examined year.

To identify zombie companies, we followed McGowan's (2018) approach, as it is one of the most frequently cited methodologies in the literature review. The data available in the ORBIS database allow for a comprehensive analysis of this group of companies. According to this methodology, a company is considered a zombie company if its operating profit does not exceed its interest payments for three consecutive financial years.

When selecting companies, we had to consider that a significant portion of domestic SMEs prepares simplified financial statements, which do not include the interest expense necessary for identifying zombie companies. Therefore, when examining zombie companies, we did not apply size-related constraints, meaning that we did not limit the analysis to SMEs. According to the Act C of 2000 on Accounting, a company may choose to prepare simplified financial statements if its balance sheet total, revenue, and number of employees are below the statutory thresholds for two consecutive years.

We aimed to present the most significant national economic sectors based on added value and the number of employees. Another important criterion was the availability of sectoral data on the participation rate of companies in the payment moratorium and the contracted NHP loans (Table 16). We selected the following 11 national economic sectors (and the corresponding 74 sectors): Agriculture, forestry and fishing (A); Manufacturing (C); Electricity, gas, steam and air conditioning supply (D); Construction (F); Wholesale and retail trade (G); Transport and storage (H); Accommodation and food service activities (I); Information and communication (J); Real estate activities (L); Professional, scientific and technical activities (M); Administrative and support service activities (N). According

to KSH (2024), SMEs in the selected sectors accounted for about 93 percent of enterprises in terms of number of employees and value added. This allowed for a sectoral-level analysis of the financial performance of Hungarian SMEs and the identification of differences between sectors during the COVID-19 pandemic. The results are presented in the next chapter.

4.4 Research results

4.4.1 Descriptive statistical tests

Undertakings in difficulty and Zombie companies - Sectoral analysis

Based on the data, we examined which national economic sectors were most affected by the COVID-19 pandemic in terms of changes in the proportion of zombie firms and undertakings in difficulty. At the level of the 11 analyzed national economic sectors, we assessed the proportions of zombie firms calculated using McGowan's (2018) methodology, as well as undertakings in difficulty situation based on both the old and new definitions (Tables 18 and 19).

According to McGowan's (2018) methodology, the primary characteristic of zombie firms is that their generated EBIT fails to cover their interest payments for three consecutive years. However, the crisis significantly impacted the economy for only two years, 2020 and 2021. Therefore, we relaxed the original condition and also examined the interest coverage ratio for two consecutive years instead of three.

The share of zombie firms typically ranged from 2 to 10 percent in each sector over the period (Table 18). Notable among these is the accommodation and food services sector, which was hardest hit by the coronavirus crisis, where the share of zombie and distressed firms also increased significantly. The share of zombie firms increased from 7-8 in 2020 to 25.9 percent in 2021 under the two-year methodology, while it increased from 5-6 percent in 2020 to 12.7 percent in 2022 under the three-year methodology. The proportion of undertakings in difficulty (Table 19) showed a similar trend: based on the old definition, it increased from 7 percent in 2019 to 9.5 percent in 2020. According to the new definition, it rose from 16.7 percent to 18.7 percent. In 2021, however, the financial difficulties of companies eased, and the proportion of undertakings in difficulty dropped below the 2019 level.

For the other sectors, there were no significant changes in 2020 and 2021. This could indicate several things: in these sectors, firms were better able to adapt to the challenges of the crisis, were less exposed to its direct effects or the support received mitigated the effects of the crisis and improved the examined financial indicators. Given the descriptive nature of the analysis, it is not possible to provide direct evidence of possible causes, but it can be concluded that only in the Accommodation and food service activities sector did the proportion of firms in difficulty and in difficulty increase during the crisis. The next section looks at turnover sensitivity at sector level.

18. Table: Share of zombie firms in the examined sectors between 2019 and 2022

		McGowan (2018) - 3y				McGowan (2018) - 2y			
	Industry classification	2019	2020	2021	2022	2019	2020	2021	2022
A	Agriculture	4,6	5,6	2,9	2,3	9,6	7,2	5,9	5,3
C	Manufacturing	6,5	5,8	5,2	5,4	9,9	10,0	8,1	8,1
D	Electricity, gas supply.	12,4	16,7	15,5	11,6	18,5	20,8	22,0	18,3
F	Construction	2,1	0,0	0,7	2,1	3,0	1,4	4,2	3,5
G	Wholesale and retail trade;	4,3	3,5	2,6	2,8	6,2	5,6	4,3	4,3
H	Transportation and storage	4,8	6,1	7,3	4,0	9,2	10,5	10,7	7,9
I	Accommodation and food service activities	6,7	6,4	5,5	12,7	7,1	8,1	25,9	15,0
J	Information and communication	8,5	9,1	8,2	8,5	13,2	10,1	11,1	10,5
L	Real estate activities	5,8	4,0	3,9	7,1	8,2	7,1	8,4	11,2
M	Professional, scientific and technical activities	9,9	9,9	8,0	8,8	13,6	12,4	12,3	10,1
N	Administrative and support service activities.	5,1	6,8	5,6	3,6	9,2	9,0	11,0	3,7

Source: own work

19. Table: Share of undertakings in difficulty in the examined sectors between 2019 and 2022

		Undertakings in difficulty - pre-crisis definition				Undertakings in difficulty - post-crisis definition			
	Industry classification	2019	2020	2021	2022	2019	2020	2021	2022
A	Agriculture	1,4	1,3	1,1	1,1	2,5	2,3	2,2	1,8
C	Manufacturing	2,5	2,5	2,1	1,9	4,7	4,3	4,0	3,9
D	Electricity, gas supply.	3,4	3,5	4,5	2,3	3,4	5,9	7,9	3,4
F	Construction	1,8	2,1	1,7	1,7	2,9	3,3	2,8	2,8
G	Wholesale and retail trade;	2,8	2,8	2,6	2,3	5,8	5,7	5,5	4,9
H	Transportation and storage	3,0	2,7	2,6	2,1	5,4	5,2	4,7	4,0
I	Accommodation and food service activities	7,0	9,5	6,6	6,7	16,7	18,7	13,6	13,0
J	Information and communication	2,2	2,7	2,1	2,0	3,6	3,9	3,6	3,8
L	Real estate activities	3,2	3,4	3,2	3,4	7,4	7,1	7,0	7,0
M	Professional, scientific and technical activities	2,2	2,3	2,0	2,1	4,0	4,0	3,4	3,1
N	Administrative and support service activities.	3,5	4,7	4,6	3,6	6,4	7,3	7,4	5,8

Source: own work

EBIT median values and revenue sensitivity at sector level

During the years of crisis triggered by the coronavirus epidemic, there were significant changes in many industries, reflected in a decline in profitability and revenue, especially in 2020. In several sectors, the proportion of companies whose turnover fell by more than 10 or even 30 percent increased. In addition to turnover, we also looked at changes in median EBIT margin across sectors in 2020 and 2021, highlighting the main differences compared to 2019. Table 20 presents the median EBIT margins of selected sectors and the proportion of companies within each sector whose revenue declined by at least 30% in the given year.

Accommodation services (TEÁOR 55) and *Food and beverage services* (56) showed one of the largest declines in both turnover and profitability. For *Accommodation services* (56), roughly one in two firms saw their turnover fall by at least 30 percent in 2020, with

the median EBIT margin also falling significantly (2019: 7.9 percent, 2020: 2.2 percent). This suggests that travel habits changed substantially due to the pandemic. However, in the following years, the sector's profitability recovered (2021: 10.9 percent, 2022: 12.7 percent). In the hospitality sector, the evolution of revenue and profitability shows a similar picture.

The *travel agency and tour operator* sector (79) was the only sector to feel the negative effects of the crisis the most, with its median EBIT margin turning negative in 2020 (-11.9%, i.e. half of companies recorded a higher loss at EBIT level), and the pre-crisis profitability recovered only by 2022. In this sector, 90 per cent of companies saw their revenues fall by more than 30 per cent in 2020, a proportion that was exceptionally high compared to other sectors.

In 2020, the performance of the *Accommodation and food services* (I) national economic sector in terms of gross value added fell by almost a third in one year (KSH, 2021). In addition to these sectors, the crisis may have also had an impact on the *Manufacture of beverage* (11), *Construction* (41, 42, 43), *water transport* (50), *air transport* (51), *Motion picture, video and television programme production* (59) and *Employment activities* (78) sectors.

It is important to highlight that the *Real estate activities* (68) sector, which the MNB (2020b, 2021a) identified as vulnerable, but there was no significant decline in median profitability: the median EBIT margin fell from 16.9% in 2019 to 15.1% in 2020. Certain segments of the retail real estate market (office market, industrial-logistics) proved resilient, and vacancy rates did not increase significantly overall. Temporary rent discounts were only observed in the retail sector (MNB, 2021c).

Some sectors proved to be the winners of the pandemic. *Manufacture of chemicals and chemical products* (20) and *Manufacture of basic pharmaceutical product* (21) have significantly improved their pre-crisis profitability, especially in 2020, when the epidemic has increased demand for health products and services.

The *Warehousing and support activities for transportation* (52) and *Postal and courier services* (53) sectors also saw a strong improvement in their median EBIT levels. This could be attributed to the rise of e-commerce during the lockdowns, the increased demand for courier services and home deliveries, and the expansion of local supply chains and

warehousing capacities (MNB 2021c; KSH 2021). The epidemic therefore not only caused losses but also created new growth opportunities for some sectors.

The EBIT margin in *Manufacture of food products* (10) remained relatively stable, reflecting the importance of the sector and its resilience to the crisis. The food industry proved to be essential even during the crisis, which contributed to its stable performance. The more important *Wholesale trade* (46→ 461-469) and *Retail trade* (47 → 471 - 479) were broken down into three-digit TEÁOR codes, but no significant decline was observed in either sub-sector. The retail sector's quick adaptation to the pandemic challenges helped maintain performance, especially due to the growth of e-commerce, which grew by 39 percent in 2020 (KSH, 2021). The discussion of this topic is complemented by the cluster analysis reported in the next section.

20. Table: EBIT margin trends in the highlighted sectors and the share of companies within sectors with a revenue decline of at least 30% in the given year

		<i>Median value of sector</i>				<i>Share of companies</i>			
		<i>EBIT-margin ratio</i>				<i>with a min. revenue decline of 30%</i>			
	Industry classification	2019	2020	2021	2022	2019	2020	2021	2022
10	Manufacture of food products	3,4	3,8	4,7	4,8	2,9	6,8	2,7	2,6
11	Manufacture of beverages	4,6	3,6	5,5	6,3	8,7	19,0	3,4	4,9
20	Manufacture of chemicals and chemical products	5,5	9,1	8,0	9,3	4,7	4,3	7,3	3,8
21	Manufacture of basic pharmaceutical product	4,6	7,7	6,2	3,3	14,8	0,0	12,0	10,0
41	Construction of buildings	6,7	4,7	6,8	6,8	10,3	28,1	13,5	13,0
42	Civil engineering	10,1	7,8	8,6	8,7	9,4	20,5	12,8	13,4
43	Specialised construction activities	8,7	7,0	8,6	8,8	7,6	17,3	9,1	7,4
46	Wholesale trade	4,2	4,7	5,8	6,5	5,2	9,1	4,0	3,8
47	Retail trade	3,4	3,5	4,2	4,3	2,6	6,5	2,1	1,7
50	Water transport	4,1	1,1	4,0	6,9	3,3	48,0	16,0	0,0
51	Air transport	2,2	3,5	2,2	2,4	7,7	18,2	33,3	7,1
52	Warehousing and support activities for transportation	4,8	6,4	6,4	8,5	5,5	12,5	4,5	4,0
53	Postal and courier activities	4,6	8,1	8,0	7,3	3,6	5,8	2,8	4,8
55	Accommodation	7,9	2,2	10,9	12,7	4,2	48,9	5,5	1,6
	Industry classification	2019	2020	2021	2022	2019	2020	2021	2022

56	Food and beverage service act.	4,7	2,3	9,6	5,5	3,2	33,1	2,4	1,5
59	Motion picture, video and television programme production	4,8	3,3	8,4	9,7	10,1	39,6	4,0	5,7
68	Real estate activities	16,9	15,1	18,1	18,6	11,6	20,3	10,9	11,2
78	Employment activities	5,7	4,6	7,1	7,2	12,5	34,4	8,8	8,1
79	Travel agency, tour operator reservation service	2,2	-11,9	1,5	4,3	7,4	90,1	17,5	0,7

Source: own work

Descriptive statistical analysis of the variables in the cluster analysis

This section presents a descriptive statistical analysis of the variables examined in the cluster analysis for the full sample, broken down by year from 2019 to 2022. We sought to answer the question what changes occurred in each year for the variables under study and whether normalisation was observed in 2022. From the preceding sections, it can be seen that changes in financial performance during the epidemic showed different patterns across years and sectors in several respects, and it is therefore essential to examine the full sample (Table 21).

One of the most significant changes during the crisis was the fall in turnover due to closures. Based on the average and median proportions of companies registering at least a 10% revenue decline, the largest drop occurred in 2020. However, by 2021, the share of affected companies had decreased below the 2019 level. A similar trend was observed for companies experiencing a revenue decline of at least 30%, with the difference that their proportion in 2021 was nearly equal to that of 2019, signaling a normalization in economic conditions. Based on descriptive statistics, a negative spike was mainly observed in 2020, followed by a recovery to the values of previous years. However, to a certain extent, some revenue declines are natural, as not every year is successful - market losses, order reductions, or capacity decreases may occur. Nevertheless, the changes in proportions during the crisis clearly highlight its impact.

Based on the previous definition of undertakings in difficulty, determined using two indicators, it can be seen that the epidemic has not significantly increased the proportion of undertakings in difficulty. This measure was termed as the „pre-pandemic undertakings in difficulty”. Although this ratio was highest in 2020, the increase was not significant. During the epidemic, the definition of undertakings in difficulty was relaxed, so that only one of the two indicators had to be taken into account (this was interpreted as new definition), which led to an increase in the number of distressed firms. This suggests that the impact of the coronavirus epidemic at the economy-wide level only affected the year 2020. The median EBIT margin indicator across sectors improved steadily between 2019 and 2021, with all sectors showing positive results in 2021.

Based on the analyzed data, the decline in revenue peaked in 2020, but by 2021, the proportion of companies experiencing revenue loss fell below the 2019 level. Although the share of undertakings in difficulty increased during the epidemic, there was a significant improvement in 2021. After a downturn in 2020, the economic situation returned to normal in 2021, largely and fully in 2022. The subsequent analysis in this paper focuses on the most critical years, 2020 and 2021.

21. Table: Descriptive statistics of variables examined in the cluster analysis

Variables	2019EBIT percentage _Median	2019BEV 10 percent	2019BEV 30 percent	2019NH previous	2019NN ew	2020EBIT percentag e _Median	2020BEV 10 percent	2020BEV 30 percent	2020NH previou s	2020NH new
Average	5,1	19,6	6,1	3,6	6,2	5,2	33,6	14,5	3,9	6,5
Median	4,8	19,4	6,0	2,7	4,9	5,2	30,8	11,6	2,6	4,4
Source	4,0	8,3	3,3	5,7	6,3	3,8	15,2	13,0	6,2	6,9
Minimum	-20,3	0,0	0,0	0,0	0,0	-11,9	0,0	0,0	0,0	0,0
Maximum	16,9	53,8	14,8	50,0	50,0	15,1	95,9	90,1	50,0	50,0
Q1	4,0	14,9	4,0	1,6	3,3	3,7	25,8	7,8	1,5	3,0
Q3	6,8	23,7	8,1	3,8	7,4	6,9	38,9	17,8	4,0	8,0
Variables	2021EBIT percentage _Median	2021BEV 10 percent	2021BEV 30 percent	2021NH previous	2021NN ew	2022EBIT Percent _Median	2022BEV 10 percent	2022BEV 30 percent	2022NH previou s	2022NH new
Average	6,8	16,6	6,2	3,3	5,6	7,5	12,9	5,1	2,8	5,3
Median	6,9	15,2	5,4	2,3	4,3	7,5	12,6	4,2	2,1	4,0
Source	2,7	11,7	4,8	4,3	5,1	3,1	6,5	4,5	4,0	4,9
Minimum	0,6	4,4	0,0	0,0	0,0	-3,9	0,0	0,0	0,0	0,0
Maximum	18,1	100,0	33,3	33,3	33,3	18,6	33,3	33,3	33,3	33,3
Q1	4,9	10,7	3,2	1,5	2,7	5,5	7,5	2,3	1,3	2,4
Q3	8,5	18,7	7,3	3,8	7,3	8,9	16,8	6,4	3,2	6,3

Source: own work

Note: The explanation of the set of variables under consideration is given in Table 17.

4.4.2 Multivariate methods - cluster analysis

In the cluster analysis, sectoral data for 2020 and 2021 were examined using two approaches. The first approach was based on the variables and ratios for the year (median EBIT, 10% and 30% revenue decline, share of undertakings in difficulty according to pre- and post-covid definitions). In the second approach, changes in these indicators compared to the previous year were taken into account. The cluster analysis based on variables and changes for 2020 proved successful, as in each case two distinct groups were identified: distressed sectors and stable sectors. Clustering on variables for 2021 data was also successful. However, the analysis of changes in 2021 was unable to produce satisfactory results, as it failed to clearly distinguish between improving sectors and those that continued to struggle. Consequently, clustering on changes in 2021 was not presented. The TwoStep clustering algorithm was used for the analysis. The quality of the clusters was assessed using the Silhouette indicator²⁰, which showed "fair" level results in all three clustering runs, indicating that the clusters are moderately well separated from each other and that their internal cohesion is acceptable

Results of the 2020 cluster analysis

In the cluster analysis for the 2020 variables, the proportion of undertakings in difficulty under the post-covid definition (2020NH20_new) was the most important factor in the cluster analysis, with an importance value of 1.0. This was followed by the share of companies suffering a 30 percent decline in sales (2020BEV_30 percent_20) with an importance value of 0.65, and then the median value of EBIT (2020EBIT percent_Median_20) with an importance value of 0.55. The pre-covid undertakings in difficulty ratio (2020NH20_previous) and the variable indicating a 10 percent decrease in turnover (2020BEV_10 percent_20) closed the ranking with lower importance values of around 0.4 and 0.3, respectively.

²⁰ The Silhouette indicator is a diagnostic tool to measure the quality of clustering. The value of the indicator indicates how well the data fit into its own cluster and how well it is separated from other clusters.

22. Table: Results of the cluster analysis for the year 2020

Clusters		2020 EBIT percent_Media n_20	2020 BEV_10 percent_20	2020 BEV_30 percent_20	2020 NH20 _previous	2020 NH20 _new
20KL1 - Sectors in crisis	N	7	7	7	7	7
	Average	-1,64	55,10	39,68	15,06	21,36
	Source	7,07	30,15	28,21	16,38	14,12
	Median	2,16	60,00	39,57	9,97	17,36
20KL2 -Stable sectors	N	67	67	67	67	67
	Average	5,88	31,81	12,06	2,84	5,07
	Source	2,37	10,26	6,34	1,89	3,06
	Median	5,37	30,23	11,39	2,53	4,15
Total	N	74	74	74	74	74
	Average	5,17	34,02	14,67	3,99	6,61
	Source	3,75	14,73	12,96	6,18	6,92
	Median	5,15	30,86	11,67	2,63	4,47

Source: own work

Note: The set of variables under consideration is explained in Table 17.

In the cluster analysis for 2020, we have identified two main groups reflecting the financial situation of the sectors (Table 22). The first cluster, referred to as "sectors in crisis", comprised seven sectors that faced exceptionally adverse financial conditions. On average, these sectors had a negative EBIT margin (-1.64 percent) and experienced considerable revenue declines, with over half of the companies reporting a revenue drop exceeding 10%, while 39.7% suffered declines greater than 30%. Additionally, the proportion of undertakings in difficulty was also high in these sectors, particularly based on the post-covid definition (21.4%).

The second cluster, known as the stable sectors cluster, comprises 67 sectors that performed better financially in 2020. Sectors in this group had a positive EBIT margin (5.9 percent) on average, with a smaller decline in turnover: 31.8 percent had a decline of more than 10 percent and only 12.1 percent had a decline of more than 30 percent. The proportion of undertakings in difficulty was much lower here, both according to the pre-covid (2.8%) and post-covid definitions (5.1%).

According to the cluster analysis, while the sectors in crisis faced severe financial difficulties in 2020, the stable sectors group, although confronted with challenges, had better financial stability.

Cluster analysis based on the 2020 change

In the cluster analysis based on the 2020 changes, the most significant factor, according to the ranking of variable importance, was the "d_NH_previous_20_19" variable, which reflects the change in the proportion of undertakings in difficulty according to pre-covid criteria between 2019 and 2020, with an importance value close to 1.0. This was followed by the proportion of companies experiencing a 30% revenue decline in 2020 ("2020BEV_30_percent") with an importance value of 0.75, and the change in the proportion of undertakings in difficulty based on post-pandemic criteria ("d_NH_new_20_19") with an importance value of 0.6. Less significant were the proportion of companies with a 10% revenue decline ("2020BEV_10_percent") and the change in the EBIT median between 2019 and 2020 ("d_EBIT_median_20_19"), with importance values around 0.5 and 0.3, respectively.

23. Table: Results of the cluster analysis based on the 2020 changes

Clusters based on 2020 changes		2020 BEV_10 percent	2020 BEV_30 percent	d_EBIT_ median_ 20_19	d_NH_ previous_ 20_19	d_NH_ new_ 20_19
d20KL1 - Highly affected sectors	N	9	9	9	9	9
	Average	56,39	37,14	0,0008	2,9692	1,9308
	Source	21,46	24,65	2,07502	1,49031	0,88067
	Median	58,89	34,39	0,6907	2,4	1,5313
d20KL2- Less affected sectors	N	63	63	63	63	63
	Average	31,61	11,78	1,074	0,9894	0,9578
	Source	9,73	5,80	0,22701	0,4635	0,2963
	Median	30,71	11,39	1,0602	0,9774	0,929
Total	N	72	72	72	72	72
	Average	34,71	14,95	0,9398	1,2368	1,0794
	Source	14,24	13,01	0,8111	0,93415	0,5187
	Median	31,39	11,75	0,995	1,0026	0,9687

Source: own work

Based on the 2020 cluster analysis, two distinct groups were identified according to the financial situation of the sectors (Table 23). The first cluster, which we can call highly affected sectors, contains 9 sectors that suffered a severe decline in turnover: a decline in turnover of more than 10 percent was observed for 56.4 percent of the companies in the affected sectors, while 37.2 percent of them experienced a decline in turnover of more

than 30 percent. The change in the median EBIT was minimal, indicating that these sectors already had low or negative EBIT. Additionally, the proportion of undertakings in difficulty, according to both pre-crisis and new methodologies, slightly increased.

The second cluster, referred to as less impacted sectors, comprises 63 sectors. These sectors were less affected by revenue declines: 31.6% experienced a revenue drop of over 10%, and only 11.8% saw declines exceeding 30%. The EBIT median in these sectors slightly improved, and the proportion of undertakings in difficulty showed only minimal change. This suggests that these sectors maintained a more stable financial position during the crisis.

24. Table: The sectors most affected according to the 2020 cluster analysis

Sectors based on 2020 variables	Sectors based on 2020 change
	<i>Manufacture of other transport equipment</i>
<i>Motion picture, video and television programme production</i>	<i>Motion picture, video and television programme production</i>
<i>Air transport</i>	<i>Rental and leasing activities</i>
<i>Accommodation</i>	<i>Employment activities</i>
<i>Travel agency, tour operator reservation service</i>	<i>Manufacture of paper and paper products</i>
<i>Food and beverage service activities</i>	<i>Accommodation</i>
<i>Water transport</i>	<i>Travel agency, tour operator reservation service</i>
	<i>Food and beverage service activities</i>
	<i>Water transport</i>

Source: own work

These are representative of the sectors most affected during the crisis triggered by the coronavirus outbreak, identified through cluster analysis (Table 24). The selection is based on the economic changes of 2020 when the impacts of the pandemic were particularly pronounced across the economy. Examples include food and beverage services, air and water transport, accommodation services, and film and media production. In addition, paper products manufacturing and rental and leasing activities have also faced significant changes. In Table 24, the sectors impacted by the crisis, which

also appeared in clusters based on variables and their changes, are highlighted in red. The results of the 2021 cluster analysis are presented below.

Results of the 2021 cluster analysis

Key predictors included the share of sectors in difficulty in 2021, according to pre- and post-crisis rules. These variables received maximum or near-maximum importance scores, indicating that the ratio of undertakings in difficulty played a decisive role in cluster formation. The proportion of a 30% revenue decline within sectors was also a significant predictor, though it had a smaller influence on the clustering process. The EBIT median variable was less important, suggesting that sector profitability was less determinant in the clustering analysis.

25. Table: Results of the cluster analysis for the year 2021

2021 cluster analysis results		2021 EBIT percent_Median	2021 BEV_10 percent	2021 BEV_30 percent	2021 NH21_Previous	2021 NH21_new
21KL1-Stable sectors	N	70	70	70	70	70
	Average	7,1	14,8	5,7	2,5	4,8
	Source	2,5	5,7	3,1	1,4	2,7
	Median	7,1	14,8	5,2	2,3	4,2
21KL2-Sectors in crisis	N	4	4	4	4	4
	Average	2,1	26,8	16,7	17,3	22,2
	Source	1,4	8,3	13,6	11,3	9,2
	Median	1,9	29,0	16,7	13,9	21,6
Total	N	74	74	74	74	74
	Average	6,8	15,5	6,3	3,3	5,7
	Source	2,7	6,4	4,8	4,3	5,1
	Median	6,9	15,1	5,4	2,3	4,3

Source: own work

The 2021 cluster analysis identified two main groups based on the financial situation of the sectors (Table 25). The first cluster, which can be called stable sectors, includes 70 sectors. These sectors achieved strong operating performance, with an average EBIT margin of 7.1%. Their revenue decline was relatively moderate: 14.8% of the sectors experienced a drop of more than 10%, while only 5.7% faced a decline exceeding 30%. Furthermore, the proportion of undertakings in difficulty remained low under both pre-

covid (2.5%) and post-covid definitions (4.8%), indicating that these sectors remained relatively stable during the pandemic.

The second cluster, which we can call sectors in crisis, includes four sectors facing severe financial difficulties. Their operating profitability was significantly lower, with an average EBIT margin of 2.1%. A higher proportion of these sectors suffered a significant drop in turnover, with 26.8 per cent experiencing a fall of more than 10 per cent and 16.7 per cent more than 30 per cent. The proportion of undertakings in difficulty was high under both pre-covid (17.3%) and post-covid definitions (22.2%). These sectors were under significant financial pressure in 2021. The two clusters reflect the financial challenges in 2021: while stable sectors performed relatively well and remained stable, distressed sectors faced severe difficulties (Table 26).

26. Table: The sectors most affected according to the 2021 cluster analysis

Sectors based on 2021 variables
<i>Travel agency, tour operator reservation service</i>
<i>Water transport</i>
<i>Food and beverage service activities</i>

Source: own work

4.5 Summary, conclusions

As both an external supply and demand shock, the coronavirus epidemic had a significant impact on the world and Hungarian economies. The decline in different sectors, especially in 2020, differed in intensity. The sectors most affected by the crisis include tourism, hospitality and construction. Financial incentives and subsidies have helped many sectors to stay afloat. This study aims to examine the extent to which the sectoral financial performance of Hungarian small and medium-sized enterprises (SMEs) changed during the COVID-19 pandemic. Additionally, it investigates the evolution of the proportion of zombie firms and undertakings in difficulty, filling an analytical gap in the domestic literature in terms of detailed financial and sectoral breakdowns.

For the analysis, we used financial data from 2019 to 2022, collected from the ORBIS database. The sample included financial indicators of more than 68,000 companies, such as turnover, EBIT and equity. The study covered 11 national economic sectors, divided into 74 sectors. In addition to the assessment of descriptive statistics, cluster analysis was also carried out to identify differences in performance between sectors.

The main findings of the research show that there was a significant change in the financial performance of Hungarian SMEs during the period of the coronavirus epidemic, especially in 2020, when almost all sectors were affected by the decline in sales. However, by 2021, many businesses showed an improvement in their financial performance, as evidenced by the positive change in EBIT indicators. The sectors most affected included those related to tourism and travel, such as travel agency services and hospitality, where substantial declines in revenue and profitability were observed. In contrast, the chemical industry, pharmaceutical manufacturing, as well as warehousing and supporting transportation activities showed growth.

The cluster analysis highlighted that sectors could be divided into crisis-hit and stable groups, with the primary distinction being the extent of revenue decline. Another important finding is that there was no mass emergence of zombie companies during the crisis and that the situation in the most affected sectors had normalised by 2022.

In Table 27, we compare the findings of previous publications (MNB 2020b; MNB, 2021a; El-Meouch et al., 2024) with the results of our study. The different methods identified different sectors, suggesting that the economic impacts were diverse, with sector-specific differences. Our study confirmed the vulnerability of construction and accommodation and food services. It also identified the vulnerability of sectors such as travel agency and tour operator activities, employment services, motion picture, and television program production, beverage manufacturing, as well as water and air transport. Significant negative changes could not be confirmed in the real estate activities and wholesale and retail trade sectors, previously classified as vulnerable by the MNB. Due to their lesser economic significance, our study did not cover the Arts, entertainment and recreation, Education, Human health and social work activities sectors, and therefore, we cannot provide an assessment of their vulnerability. Our results show that there was no mass emergence of zombie firms and undertakings in difficulty during the crisis, temporarily showing a deterioration in the accommodation and food services sectors, but that the shares of these firms returned to pre-crisis levels in 2022.

27. Table: Sectors affected by the coronavirus outbreak based on the first and second levels of the TEÁOR classification

MNB (2020b)	MNB (2021a)	El-Meouch et al. (2024)	Own research - Zombie and NH	Own research - Revenue and EBIT	Own research - Cluster
Construction (F)	Mining and quarrying (B)	Construction (F)	Accommodation and food service activities (I)	Accommodation and food service activities (55, 56)	Motion picture, video and television programme production (59)
Accommodation and food service activities (I)	Accommodation and food service activities (I)	Accommodation and food service activities (I)		Travel agency and tour operator (79)	Accommodation and food service activities (55, 56)
Real estate activities (L)	Real estate activities (L)	Administrative and support service activities (N)		Manufacture of beverages (11)	Travel agency and tour operator (79)
Transportation and storage (H)	Transportation and storage (H)	Education (P)		Construction sectors (41, 42, 43)	Water transport (50)
Wholesale and retail trade (G)	Arts, entertainment and recreation (R)	Arts, entertainment and recreation (R)		Water transport (50) and Air transport (51)	
Arts, entertainment and recreation (R)	Human health and social work activities (Q)			Motion picture, video and television programme production (59)	
				Employment activities (78)	

Source: own work and cited literature sources.

In our theoretical introduction, we also pointed out that measures to promote lending, such as the moratorium and NHP loans, were used by many firms without being directly affected by the crisis. Our results suggest that in the future, economic policy measures should be better targeted to support the sectors most affected. Our study will help policy makers build on this experience to successfully shape future crisis management strategies. In addition, we stress that the data we examine - such as company turnover - are available through the public finance system (MNB, NAV, Ministry of Finance), even on an intra-year basis, providing a prompt response for policy makers.

Limitations of our research include the fact that the analysis was based only on annual financial data, so it did not take into account inter-annual changes caused by the coronavirus waves. Additionally, due to the specific features of Hungarian accounting regulations, analyses concerning the proportion of zombie firms were limited to a narrower subset of companies that submitted financial statements. Based on the results of the study, a possible direction for future research could be panel modelling based on event analysis, which could be used for a deeper causal investigation of the sectoral financial effects of the coronavirus crisis. In addition, if firm-level data on subsidies were available, it would be worthwhile to investigate their impact, in particular to analyse the extent to which different economic policy measures contributed to the financial stability of firms and to reducing sectoral differences.

5 ON THE TRAIL OF IMMUNITY: SECTORAL AND REGIONAL FEATURES BASED ON ACCOUNTING REPORTS OF HUNGARIAN TOURISM COMPANIES IN THE PERIOD OF POLYCRISIS

ABSTRACT

To fill the gap in the Hungarian and international literature, this study aims to present the financial impact of the Covid-19 pandemic on about 27 thousand Hungarian tourism companies, as well as their sectoral and regional characteristics. The research examined the changes in turnover and operating profit in tourism between 2018 and 2022, the changes in the volume of investment in fixed assets, and the pattern of the headquarters/ establishments of firms that ceased to exist between 2016 and 2023, by area and administrative classification. The research explored the performance of the sector through different approaches: median values at the company level, aggregated data at the sub-sector level, and analysis of the proportion of discontinued businesses. Among the key findings, the research revealed that the camping sub-sector emerged as one of the winners of the crisis, while the beverage service sector managed to improve its profitability despite declining revenues. Additionally, the Balaton region, particularly the hospitality sector, was the least affected by the COVID-19 pandemic-related lockdowns.

5.1 Introduction

The state and municipal measures restricting mobility and social interactions, coupled with public fear of illness, rendered the functioning of tourism, which had been breaking records year after year until 2019, impossible almost overnight. The recurring waves of the pandemic over several years posed significant challenges to the majority of tourism service providers (Harchandani & Shome 2021, Yepez & Leimgruber 2024). Global tourist traffic declined by 72% in 2020, 69% in 2021, 34% in 2022, and 11% in 2023 compared to the record year of 2019 (UNWTO 2024). Regional differences in the decline of international tourist arrivals reflect the combined impact of policy decisions, vaccination effectiveness, discipline on closures and levels of fear (Michalkó et al. 2022b, del Mar Alonso-Almeida et al. 2024). While the forced growth of domestic tourism within national borders helped to mitigate the

losses caused by the decline in international demand, service providers in large cities used to overtourism faced greater challenges in coping with the hardships brought about by the global pandemic (Koh, 2020; Anguera-Torrell et al. 2021; Duro et al. 2023).

The World Health Organization (WHO) officially declared the end of the COVID-19 pandemic on May 5, 2023, which it had originally announced on March 11, 2020. However, the emergence of new international military conflicts, particularly the ongoing Russian–Ukrainian war since February 24, 2022, confronted representatives of the European tourism sector with crises of a fundamentally different nature (Sebastian et al., 2023). The restart of the economy after the pandemic's subsiding was accompanied by significant energy needs, the fulfillment of which, due to the energy price increases caused by both the sector's structural issues and the European Union's sanctions on Russia and the responses to them, resulted in price hikes (Gajdzik et al., 2024). The sharp rise in energy prices affected both the residential and corporate sectors and, due to its ripple effects, was accompanied by inflation varying in magnitude across countries (Shahzad et al., 2024). The overlapping COVID-19 pandemic, energy crisis, and surging inflation created a so-called polycrisis, with tourism being one of the affected sectors (Michalkó et al., 2022a). The polycrisis of tourism in Hungary was further deepened by adverse market developments related to the war between neighbouring Ukraine and Russia, which had also experienced a recovery in tourism demand (Misini & Tosuni, 2023). Although the polycrisis of domestic tourism, which was marked by minor and major turbulences (e.g. the conflict in Gaza, falling real wages, lack of EU subsidies), was presumably offset by various government measures, the operation of companies underwent significant transformations with sectoral and regional characteristics (Boros & Kovalcsik, 2021; Jászberényi et al., 2021; Fekete-Fábián & Jánosi, 2022).

While the COVID-19 pandemic, which played a decisive role in the emergence of the polycrisis we observe today, was mitigated by a vaccine worthy of the Nobel Prize in Medicine, the key to survival was the condition of an individual's immune system. Tourism can be considered one of the pandemic's hardest-hit sectors, with the once-thriving industry experiencing an unprecedented decline in traffic and revenue. The financial impact of this downturn is reflected in the annual reports of companies dedicated to meeting the demands of tourism.

The study, conducted in spring 2024, is the first in the Hungarian and international literature to attempt to show the effects of the polycrisis on turnover and profitability, as well as the change in investment volume, by analysing the data available in the ORBIS database for all tourism companies in Hungary between 2016 and 2022. Our research also extends to the territorial and administrative distribution of company closures. In this context, companies that were still operating in 2024 were considered resilient, and their resilience was analyzed based on sectoral, territorial, and administrative settlement categories. These findings were then compared with the characteristics of companies that ceased operations between 2020 and 2023. The novelty of the study, which is based on the merging of tourism and finance for crisis prevention, lies primarily in the number of firms included in the database, the simultaneous representation of sectoral complexity and sectoral diversity, and the highlighting of the territorial and administrative characteristics of immunity.

5.2 Theoretical background

Tourism entered the 21st century facing an unprecedented level of crisis, and the past quarter-century has been marked by recurring global and regional crises that have periodically caused minor or major recessions in this sector of the national economy (Michalkó et al., 2023). The phenomena that have interrupted the growth trajectory of tourism for some time are mainly attributable to terrorist attacks, epidemics and disruptions in the economic environment (Jászberényi et al., 2021). A search for the combination of the terms 'tourism' and 'crisis' in the title keyword abstract filter of Scopus, one of the largest global bibliographic databases, yields 5220 results. If we divide the period since the first co-occurrence of "crisis" and "tourism" in scientific publications (Dupuy, 1972) into three equal parts, we find that 92.4% of all records are from 2007 to 2024, and that the term "crisis" occurs in 0.95% of all publications on tourism between 1972 and 1989, 2.10% between 1990 and 2006, and 3.41% between 2007 and 2024. Thus, tourism crises are mostly the subject of recent academic research, which also indicates the frequency of occurrence of phenomena that negatively affect the economic sector under study (Hall, 2010; Drammeh, 2024).

Terrorism entered the mainstream of tourism security research in the context of the 11 September 2001 attacks on the Twin Towers (World Trade Center) and other US targets (Goodrich, 2002). However, the unexpected and faceless aggression that also impacted

innocent tourists - particularly in Egyptian and Turkish resorts - had already been an integral part of the "theoretical canon" (Sönmez & Graefe, 1998). Terrorist attacks linked to the Islamic State, such as those in Port El Kantaoui, Tunisia (2015), Paris (2015), Brussels (2016), Nice (2016), and Barcelona (2017), not only necessitated efforts to help process the grief caused by such bloodshed but also posed significant communication challenges for the management of these popular tourist destinations (Barbe et al., 2018). While most terrorist attacks caused relatively short-term declines in tourism activity within affected destinations, the aforementioned attacks - similar to the 2002/2003 SARS outbreak and the 2008–2009 financial crisis - led to global crises characterized by a significant drop in international tourist arrivals (UNWTO, 2023). The COVID-19 pandemic, which brought unprecedented declines in tourism flows and a historic downturn in industry performance, was preceded by the global health crisis linked to the spread of SARS, primarily affecting Southeast Asia. During this period, tourism service providers and destination management organizations (DMOs) gained valuable experience in both survival strategies and recovery efforts (Dwyer et al., 2006; Mao et al., 2010; Min et al., 2011). Despite the accumulated knowledge, tourism-related service providers and destination management were almost powerless in the face of the COVID-19 pandemic, which became global in 2020 and lasted for several years. State and municipal restrictions, on the one hand, made it impossible to maintain the previous sales volume, and on the other hand, fear of illness and the difficulties associated with travel hindered mobility, especially cross-border tourism (Rather, 2021; Seyfi et al. 2023). The third group of crises that significantly influenced the indicators of international tourism is represented by the economic environment. The 2008–2009 global financial crisis had a profound impact on lending, investments, operations, and most notably, on travel demand. Its effects, which highlighted sectoral and regional differences, disrupted the development trajectory of one of the world economy's leading sectors (Smeral, 2009; Song et al., 2010; Dumičić et al., 2017; Armstrong & Read, 2018).

In the recent history of tourism, prior to the outbreak of the Covid-19 pandemic in 2020, it had never happened that the number of international tourist arrivals would decline continuously over two consecutive years globally, deviating from its development trajectory, and, in addition, against the backdrop of a three-year recession, a specific polycrisis emerged due to the interference of negative impacts (UNWTO, 2023). The spread of the concept of

polycrisis in the international literature began with the Covid-19 pandemic, which fundamentally shaped it, appearing in overlapping, rapidly emerging, and yet difficult-to-resolve crises (Lawrence et al., 2024). The interpretation of polycrisis in the tourism context is still in its early stages, as tourism is deeply intertwined with the economy and society of the Anthropocene era, and particularly the analysis of its environmental impacts predicts consequences closely linked to negative externalities (Matlovič & Matlovičová, 2024). Analysing the nature of the post-Covid polycrisis, Bianchi & Milano (2024) conclude that orthodox interpretations of tourism impacts need to be replaced by approaches that reassess the relationship with capitalism. Higgins-Desbiolles (2024) argues that the key to the future lies in deep adaptation, in transforming tourism, which is partly responsible for the impending collapse, so that the ecosystem can be preserved along the lines of reconciliation, resignation, resilience and recovery. Polycrisis can thus be understood as a never-returning opportunity for tourism to put the principle of sustainability into practice (Candia & Pirlone, 2022).

While tourism companies strive to operate with sustainability in mind, the period of polycrisis for them was about survival, rebooting, and strengthening their immune systems (Cheng et al., 2022, Huang et al., 2024). The research results published so far in the post-Covid period suggest that tourism companies are pursuing a combined survival strategy, including the use of public subsidies, solidarity-based business relationships, the use of reserves, profile expansion or even profile change, reducing the number of employees and units, reducing opening hours and attracting new demand segments (Rukumnuaykit et al., 2022; Wijaya et al., 2022; Castro-Moreira, 2024; Gupta et al., 2024; Hovardaoglu & Calisir-Hovardaoglu, 2024). The key to survival is the resilience of tourism, which relies on the immunity of the companies involved in the sector (Colmekcioglu et al., 2022). While resilience is a widely used concept in international and domestic tourism research (Gonda, 2022), the key moments of resilience, in particular its sectoral and territorial determinants, have yet to be explored. Bod (2020), analysing the European economy in the post-Covid period, concludes that cohesion is the key to immunity.

The specificities of the impact of the COVID-19 pandemic crisis on the financial reporting of tourism companies have been only marginally explored using the tools of science until now. In Hungary, there have been no such efforts, and even in the international literature,

analyses based on a significant database that examines the tourism sector in its complexity - covering sectoral, territorial, and administrative peculiarities - are scarce. Sequeira et al. (2023) examined accounting operations used during the pandemic in the tourism sector, specifically in the wine industry, based on 13,000 companies in the ORBIS database in Portugal from a legal perspective. Saus-Sala et al. (2024) focused on rural tourism enterprises in Spain (Catalonia and Galicia) from the perspective of "financial health" in order to assess their survivability by focusing on their profitability and solvency.

5.3 Research questions

The objective of the exploratory research is to define new directions and questions for analyzing specific sectors within the accommodation and hospitality industry. In examining the impact of the 2020–2024 polycrisis on Hungarian tourism, we focused on revenue, operating profit, and changes in fixed assets, as well as the distribution of immunity by geographic and administrative settlement categories. The primary goal of our research is to uncover which geographically and administratively defined areas were most affected by the Covid-19 crisis in the accommodation and hospitality sectors.

Our research questions are:

1. How did the revenue and operating profit (earnings before interest and taxes - EBIT) of the domestic tourism industry change in the period 2020-2022 compared to 2019?
2. What level of fixed asset investments characterized the various subsectors of Hungarian tourism between 2016 and 2022?
3. Can a pattern be identified in the companies that ceased operations between 2020 and 2023, based on geographical location and administrative settlement category in the two tourism sectors in Hungary?

5.4 Database

Despite tourism, defined as a change of environment coupled with the pursuit of experiences and the consumption of services, becoming an integral part of contemporary social and economic life with undeniable presence in daily life, (Michalkó 2023), it is also statistically measurable and represented in national accounts as an economic sector (Hinek 2020, Tóth & Tóth, 2020). This research examines two sectors of tourism - accommodation services (TEÁOR 55) and food and beverage services (TEÁOR 56) - along with their sub-sectors, as classified by the Hungarian activity classification (TEÁOR'08). From the ORBIS database, managed by Moody's, we have downloaded the financial data of enterprises belonging to the eight tourism industry sectors (TEÁOR codes) for the years 2016-2022. This database contains the financial data of approximately 489 million public and private enterprises worldwide, including Europe (Moody's, 2024), and is an increasingly sought-after source of data for the international study of tourism (Succurro & Boffa, 2018; Tobón Perilla et al., 2022; Paule-Vianez et al., 2024). According to data from the Hungarian Central Statistical Office (KSH), there were 30 624 enterprises active in the accommodation and food service sector in 2018 (KSH, 2024), and we downloaded financial data (balance sheet and income statement figures) from ORBIS for 27 169 enterprises based in Hungary, covering about 90% of the enterprises in our study. From the ORBIS database, we also extracted the following data of companies up to May 2024: date of establishment and termination (the latter when relevant), and the registered address of the company. Geographical classification was determined by postcode and administrative classification by head office. Table 28 shows the number of enterprises included in the study by the TEÁOR codes of their main activity.

28. Table: TEÁOR codes with sectoral description.

TEÁOR code	Main activities	Number of firms
Accommodation (55)		
5510	Hotels and similar accommodation	2 347
5520	Holiday and other short-stay accommodation	1 548
5530	Camping grounds, recreational vehicle parks and trailer parks	146
5590	Other accommodation	1 349
Food and beverage service activities (56)		
5610	Restaurants and mobile food service activities	16 377
5621	Event catering activities	256
5629	Other food service activities	1 521
5630	Beverage serving activities	3 625
Total		27 169

Source: own work

In our study, we use the following simplified terms in Accommodation (TEÁOR 55) sector: *Hotel services* are referred to as *hotels*. The category of *Holiday and other short-stay accommodation services*, which includes holiday homes, guesthouses, bungalows, rural houses, cabins, youth hostels, tourist lodges, and shelters, is called *holiday accommodation*. *Camping services* are referred to as *camping*, and *Other accommodation services*, which include student dormitories, worker hostels, family-run pensions, and room rentals, are called *other accommodation*.

For the Food and beverage service activities (TEÁOR 56, hereafter *hospitality*) sector: *Other catering services*, which include food preparation, meal delivery, and workplace catering, is referred to as *other catering*, while all other terms are used unchanged.

5.5 Methodology

We have analysed the performance of tourism from three approaches: at the firm level, with aggregated data at the sectoral level, and also the share of firms that have ceased to exist. For firm-level data, median values were considered, and the following filtering criteria were applied: the company must have data on fixed assets and total assets, generate revenue greater than zero, employ at least one person, and have recorded wage expenses. For each year, the median of the EBIT margin (margin) and the median of the annual change in turnover at

sector level was tested using a Wilcoxon test to verify whether there is a significant difference between the median of the two years. For aggregate data at the industry level, the turnover and EBIT values for the base year (2019) were adjusted by the consumer price index (CPI) published by the KSH for 2020-2021-2022 in order to remove the impact of price changes and thus provide an approximation of the volume change. The CPI for services was applied to accommodation services, while the CPI for food was used for catering. The consumer price index for services was 2.9% in 2020–2021, increasing to 7.1% in 2022. The food CPI rose by 7.2% in 2020, decreased to 4.1% in 2021, and then surged to 26% in 2022. As an example, we demonstrate the calculation of the cumulative adjusted value (revenue and EBIT) for 2022, based on 2019 values:

$$\sum Adjstuted\ value\ 2019_{2022} = \frac{\sum Nominal\ value\ 2022}{(1 + i_{2020})(1 + i_{2021})(1 + i_{2022})}$$

Where i is the relevant consumer price index for that year.

The value of tangible assets must be accounted for over the years as specified in the Accounting Act. The level of tangible asset investment for a given year was calculated indirectly (based on the change in tangible assets and depreciation, relative to the tangible asset stock of the base year $T-1$) using the following formula:

$$Tangible\ Asset\ Investment_T\ (\%) = \frac{Tangible\ Asset_T - Tangible\ Asset_{(T-1)} + Depreciation_T}{Tangible\ Asset_{(T-1)}}$$

Where T presents the year of investment.

We considered companies "immune" if they were established before 2018 and had not been dissolved by 2024 (20,662 companies). We reviewed the number of company closures each year and examined the rate of closures in each sector to ensure comparability. A Z-test was used to determine whether there was a statistically significant difference between the units of analysis. For the analysis by geographic location and administrative classification, we excluded firms that closed before 2020, so we examined 18 792 enterprises. Among the

administrative settlement categories, towns and villages were combined, while county-level cities and county seats were grouped under the label "county cities." We compared four administrative units: the capital city, county cities, other cities, and towns and villages. Geographically, nine territorial units were distinguished. The capital city, Pest county and the Lake Balaton tourism region were considered as separate units, and the six planning statistical regions were used for the territorial breakdown, based on the first two digits of the postcode.

5.6 Results

In this chapter, we detail the impact of the Covid-19 crisis on the accommodation and hospitality sectors, with a particular focus on the evolution of turnover and EBIT indicators and the dynamics of fixed investment. Through the analysis of corporate and sectoral level data, we reveal the distinct responses of each sector to the crisis, as well as the role of government support in ensuring survival and long-term stabilization. In the remainder of the chapter, the resilience of sectors is analysed by examining firm closures and the associated immunity across areas.

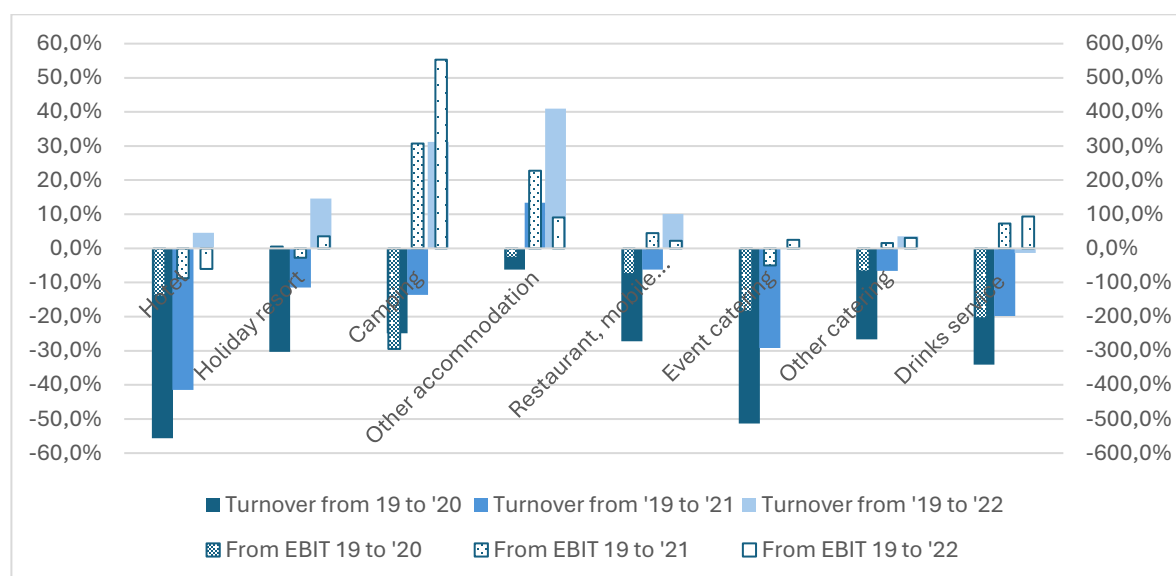
5.6.1 Company and sectoral analysis of turnover and EBIT

In Figure 16, we compare the sectoral-level aggregated annual revenue (solid-colored bars, primary axis) and EBIT (patterned bars, secondary axis) values of the examined enterprises to those from the pre-Covid year, 2019. The first four columns represent the sub-sectors of accommodation services (Hotels, Holiday Resorts, Campsites, and Other Accommodation), while the last four correspond to the sub-sectors of hospitality (Restaurant and Mobile Catering; Event Catering; Other Food Services; Beverage Service Activities). The data are detailed in Appendix Table 30.

The analysis of aggregated sectoral-level revenue and EBIT was further integrated with the median values of annual sectoral-level revenue (Appendix Table 31) and EBIT margin (Appendix Table 32). For the analysis of the median values of EBIT margin and turnover change at sectoral level for each year, a Wilcoxon test was performed at 5% and 10% significance level to test whether there is a significant difference between the median values of the sector for two consecutive years. The results indicate that the median performance and

revenue declines due to the Covid-19 crisis (from 2019 to 2020), followed by recovery in 2021 (improvement in median performance and revenue growth), were statistically significant for most sub-sectors. However, exceptions were observed in sub-sectors such as campsites and other accommodation services, where the relatively low sample size of enterprises meant that the tests did not confirm significant changes in performance for these sectors.

16. Figure: Annual change in average inflation-adjusted turnover and EBIT of tourism branches compared to 2019.



Source: own work based on ORBIS database.

Accommodation

In the accommodation services sector, hotels experienced the largest revenue decline in 2020 (-56%), primarily due to government and municipal restrictions, temporary closures, and the absence of foreign tourists. Based on the change in median revenue, the turnover of half of the businesses decreased by at least one-third (-32%) from 2019 to 2020 (Appendix, Table 31), indicating that a substantial portion of the sector's enterprises suffered significant revenue losses. Neither the aggregate figures nor the median values showed notable improvement in 2021. However, by 2022, inflation-adjusted turnover had increased by 5% compared to 2019 (Table 30), showing that demand and revenue levels returned to their 2019 baseline in the third year after the outbreak of the COVID-19 pandemic.

The hotels sector also declined significantly in aggregate EBIT in 2020, but in 2021 and 2022 it did not reach the level of 2019. In contrast, the median EBIT margin at the firm level returned to the pre-COVID-19 rate of 8% (Table 32), indicating that half of the businesses in the subsector restored their profitability. The difference is due to the fact that the larger hotel chains (e.g. Danubius Hotels, Hunguest Hotels, Accor), which still had a significant profit margin in the aggregated data in 2019, were not able to recover their profitability by 2022, and thus suffered the impact of the Covid-19 episode in the longer term. In the other accommodation sector, aggregate revenue decreased by 6% in 2020 (company median change -13%) and increased by 35% in 2022 compared to 2019. Aggregate EBIT in this sector rose by 200% in 2021 and 100% in 2022 relative to 2019, indicating that this sector proved more resilient in terms of EBIT and revenue. In fact, it emerged as a beneficiary of the crisis in 2021. In the camping sub-sector, revenue declined by 25% in 2020 and by 14% in 2021, while in the holiday accommodation sub-sector, revenue dropped by 30% in 2020 and by 11% in 2021. The EBIT in the holiday accommodation sub-sector showed moderate fluctuations (ranging between -27% and +35%), whereas the camping sub-sector experienced a dramatic EBIT decline of -295% in 2020 (due to the large-scale disposal of tangible assets by a single company), followed by an increase of 307% in 2021 and 553% in 2022. Overall, while the other accommodation sub-sector demonstrated greater resilience, the camping sub-sector can be regarded as one of the beneficiaries of the COVID-19 crisis. Future research should empirically examine the changes within the latter sub-sector between 2020 and 2022.

Hospitality

In the hospitality sector, the biggest drop in turnover in 2020 was in event catering, followed by beverage serving activities, whose revenue in all three examined years remained below the 2019 level. However, the EBIT volume of beverage serving increased by 73% in 2021 and 93% in 2022 compared to 2019 (Appendix Table 30). The median values show a similar trend. The median EBIT margin in the beverage services sector was -6% in 2020, indicating significant losses (Appendix Table 32). Despite the declining turnover, the increasing result can be explained by the optimisation of operations and cost reduction. An interesting topic for further research could be examining how the beverage serving sub-sector reorganized its operations and implemented innovative solutions in response to the COVID-19 crisis. In

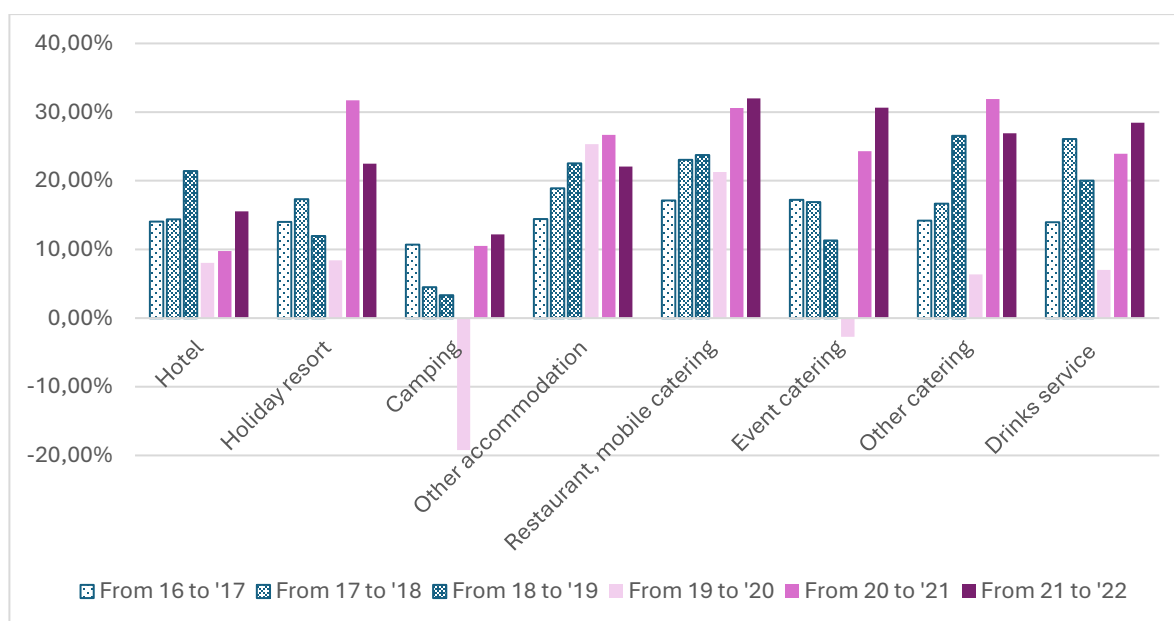
restaurant and mobile food service activities, as well as in other catering, revenue declined by 27% in 2020. However, by 2022, both sub-sectors had exceeded their 2019 revenue levels. EBIT also increased in both sub-sectors in 2021 and 2022 (Appendix Table 30).

5.6.2 Examination of the investment in fixed assets

During the COVID-19 pandemic, the government provided substantial support to the tourism sector, including tax and social contribution reliefs, accommodation development grants, subsidized loans, and the expansion of the Széchenyi Card Program (Pajrok, 2022). Under the Kisfaludy Programme, HUF 150 billion and HUF 60 billion were allocated to the renewal of accommodation facilities, including HUF 85 billion and HUF 60 billion respectively for the development of rural hotels with a capacity of over 100 rooms and private accommodation, and HUF 5 billion were opened for the development of campsites and holiday homes (Kormany.hu, 2020). Based on company data, a total investment intensity of HUF 225 billion was identified in the accommodation sector in 2020 and 2021, showing the significant impact of state subsidies.

According to the survey by Soós & Várhelyi (2021), the majority of accommodations took advantage of reduced traffic to carry out renovations. While 43% renovated buildings, 15.1% modernised equipment, 10% made major investments and 9% upgraded services, 22.4% did not make any investments during the restrictions. In the examined sector, significant investments were observed in 2020–2021 based on changes in tangible assets.

17. Figure: Change in fixed investment by sector compared to the previous year



Source: own work based on ORBIS database.

Figure 17 shows the change in fixed investment in each sector compared to the previous year.

Accommodation service

In 2021, capital expenditure on tangible assets increased significantly in the case of holiday accommodations and other accommodations, while it grew moderately for hotels. For camping sub-sector, after a 20% decline in capital expenditure (explained by the significant asset write-off of one company), the increase was the smallest, rising by 10–12%. Despite the more modest investment amounts in the holiday accommodation and other accommodation sub-sectors, the growth in tangible assets stood out (Appendix Table 33). The median investment intensity at the corporate level did not decline notably in the first year of the COVID-19 crisis, and in fact it increased remarkably in 2021 in the holiday sector (from 4-6% to 10%) and camping (from 3-4% to 8%) sectors (Appendix Table 34). Therefore, at the company level, investments increased, likely driven by significant government subsidies.

Hospitality

In the hospitality sector, the value of tangible assets in the restaurant and mobile food service sub-sector increased by 21% in 2020 (Appendix Table 35). During the first year of the COVID-19 crisis, investment intensity declined significantly in event catering, beverage serving activities, and other catering services (Appendix Table 35), but by 2021, recovery was observed across all sub-sectors. Median values at enterprise level also fell in 2020, from 14% to 7% in Event catering, from 14% to 10% in Restaurant and mobile food service activities, from 13% to 10% in Other food service and from 5% to 2% in Beverage serving activities (Appendix Table 34-35). Overall, investment in hotels and restaurants has also fallen as demand in the sector has fallen due to the COVID-19 crisis.

5.6.3 Examining resilience through business closures

Table 29 presents the annual breakdown, by sub-sector, of the number of companies established before January 1, 2018, that closed or remained active. We examined nearly four times as many firms in hotels and restaurants as in accommodation services. A Z-test was employed to compare the percentage shares of closed businesses within the total population for each year, and significant differences were marked with asterisks at various significance levels.

Figure 18 shows what percentage of the companies examined were closed in a given year. In the hospitality sector, the share of closures increased significantly between 2016 and 2019, and then decreased from 2020 to 2021, partly due to the state aids announced during the Covid-19 crisis and the moratorium on payments. The processing time for bankruptcies, liquidations, and dissolutions typically takes 1–2 years, suggesting that the 2022 peak (confirmed at the 1% significance level) indicates that closures in the hospitality sector may have already begun in 2021. In the accommodation sector, the number and proportion of closed businesses began to rise in 2019, peaking in 2022. This change, compared to 2021, was also confirmed at the 1% significance level.

29. Table: Number and share of firms closed down by year between 2017 and 2023.

Sectors	2017	2018	2019	2020	2021	2022	2023	Operating	Total
	Closed companies								
Accommod.	68	103	95	110	117	240	214	3 291	4 238
Hospitality	375	511	697	616	593	1 439	1 074	11 098	16 403
Total	443	614	792	726	710	1 679	1 288	14 389	20 641
Accommod.	1,6%	2,5% **	2,3%	2,8%	3,0%	6,4% **	6,1%		
Hospitality	2,3%	3,2% **	4,5% **	4,2% *	4,2%	10,6% **	8,8% **		

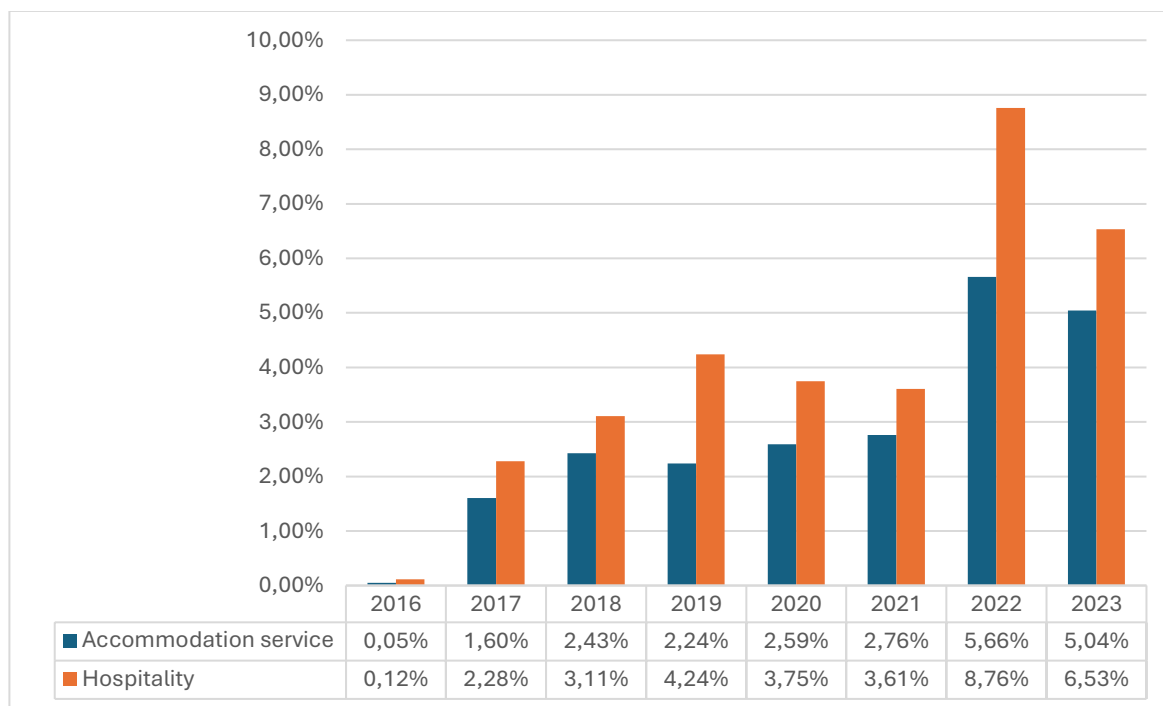
Note: A Z-test statistical procedure was run to test whether the termination rate in a given year was significantly different from the previous year.

* The change in the rate compared to the previous year is significant at $p < 0.1$.

** The change in the rate compared to the previous year is significant at $p < 0.01$.

Source: own work based on ORBIS database.

18. Figure: Sectoral share of closures in the sample of firms created before 1 January 2018

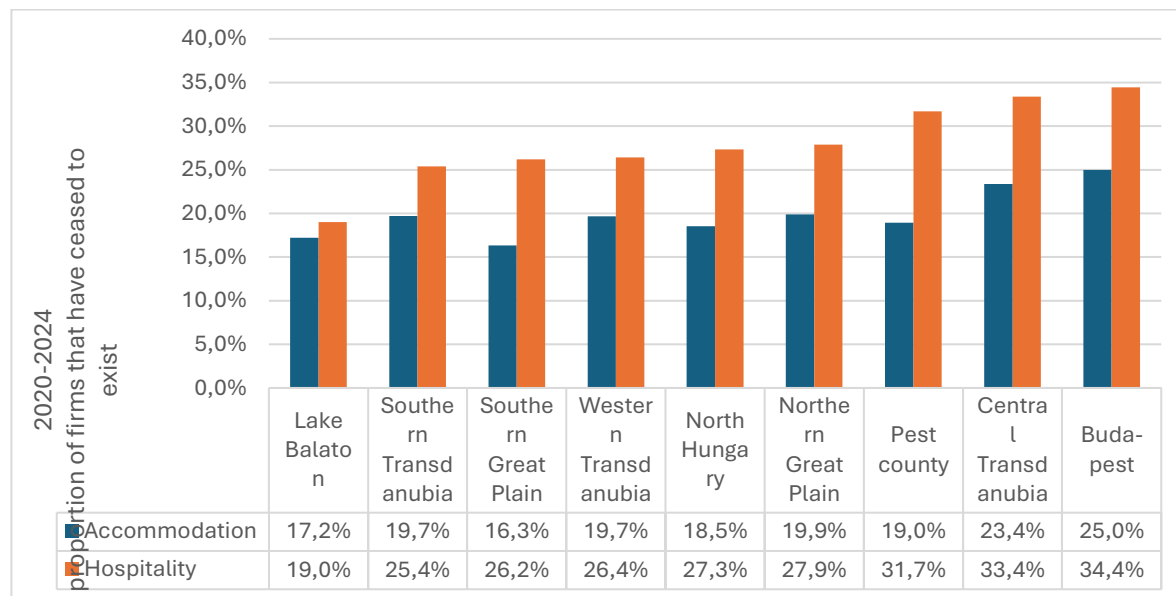


Source: own work based on ORBIS database.

Regional Characteristics of Immunity

We also examined the immunity of enterprises by geographical location and administrative settlement category. Figure 19 shows the proportion of businesses that closed down between 2020 and 2024, broken down by geographical unit, focusing on hospitality companies. Based on the geographical distribution, it is clear that hospitality businesses in the Balaton region have the lowest proportion of closures (19%), while the highest closure rates were observed in Budapest (34.4%) and Central Transdanubia, the region connecting the capital with Lake Balaton (33.4%). Pest County, which includes the metropolitan area surrounding Budapest, ranks third with 31.7% of hospitality business closures. There is a significant difference between the share of Balaton region and Budapest-based firms that closed between 2020 and 2024 (Z-test at 1% significance level). This is due to the fact that both the hospitality and accommodation services sectors in Budapest have been significantly affected by the decline in the number of foreign visitors (KSH, 2020). For the other geographical units, the share of firms that closed in the hospitality sector ranges between 25.4% and 27.9%.

19. Figure: Regional share of firms that will cease to exist between 2020 and 2024



Source: own work based on ORBIS database.

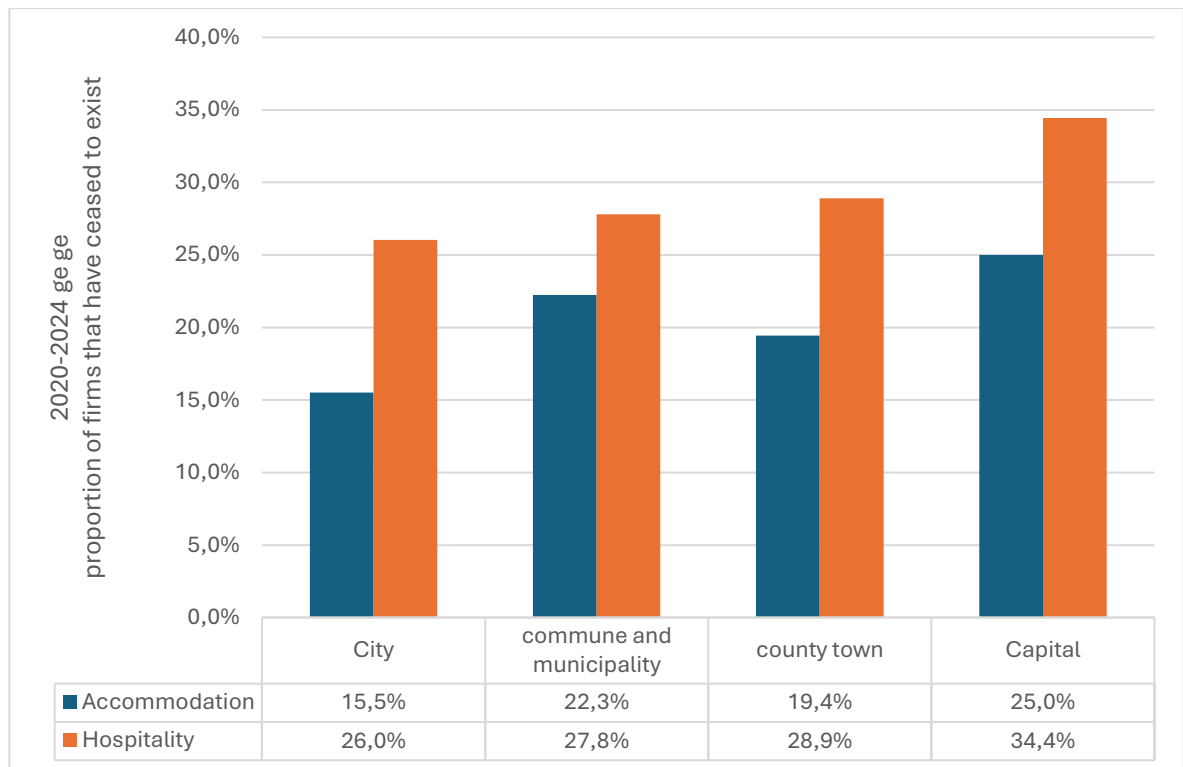
The order is also similar in the accommodation services sector: while the lowest rates of company closures were in the Southern Great Plain (16.3%) and the Balaton region (17.2%), the highest rates were in Budapest (25%) and Central Transdanubia (23.4%). In the other geographical units, the rate of company closures ranged between 18.5% and 19.9%. Also for accommodation services, the Z-test shows a significant difference between Budapest and Lake Balaton.

The significant difference in business closures between Budapest and Lake Balaton can be termed as "Balaton effect". This phenomenon can be attributed to the fact that, during the lockdowns, those who had the means temporarily relocated to their own holiday homes or long-term rented properties in the Balaton area to escape the pandemic. This is supported by the finding of Fekete et al. (2021) that in the Lake Balaton Special Resort Area (Balaton Kiemelt Üdülőkörzet), municipal leaders estimated that on average 26% of holiday home owners moved to the area for longer periods during the mobility restrictions. KSH (2020) points out that the number of nights spent in commercial accommodation decreased most in Budapest, while the share of national turnover in the Lake Balaton tourist region increased for both domestic and foreign visitors. In summary, in the case of hospitality, businesses based in the Lake Balaton region proved to be more immune and the Covid-19 crisis hit businesses based in Budapest and Central Transdanubia the hardest.

By category of administrative settlement

Figure 20 shows that between 2020 and 2024, while the share of closures in the hospitality sector was lowest in cities (974 enterprises, 26%), the highest share was in the capital city (1891 enterprises, 34.4%). The 8.4 percentage point difference, tested with a Z-test at a 1% significance level, proved to be statistically significant. Similarly, in the accommodation services sector, the highest proportion of closures was recorded in the capital city (273 businesses, 25%), while the lowest was in cities (172 businesses, 15.5%). According to the Z-test, this difference is also statistically significant. In summary, examining tourism by administrative units reveals that businesses headquartered in the capital experienced the highest proportion of closures, whereas those operating in towns faced the lowest. Thus, businesses in towns demonstrated greater immunity.

20. Figure: Proportion of dissolved companies by administrative unit, 2020–2024



Source: own work based on ORBIS database.

5.7 Conclusions

In this research, we examined the operation of sub-sectors within the sectors of accommodation and food and beverage service activities during the polycrisis triggered by the Covid-19 pandemic, using data available from the ORBIS database for the period 2016–2023. The focus of the study was the immunity of firms, characterized by the proportion of discontinued firms based on geographical location and administrative classification. The significance of the differences was verified using a Z-statistic test. Corporate-level data were analyzed using median values, while revenue and EBIT figures were aggregated at the sub-sector level, with adjustments made to eliminate the effects of inflation. Investment intensity was also examined.

The results show that within the accommodation sector, hotels experienced the largest revenue decline in 2020, while the losses of other accommodation sub-sector were less

severe, moreover, the latter achieved a 41% growth in 2022. Campsites can be considered as one of the winners of the Covid-19 epidemic, as despite a decline in turnover in 2020 and only moderate growth thereafter, their EBIT increased significantly in 2021 and 2022. In the food and beverage service sector, event catering and beverage services declined significantly, but both sectors recovered by 2022, as shown by their EBIT growth. The investment rate in the accommodation services sector increased moderately, except for the low-intensity camping sector. The investment ratio in the accommodation sector showed moderate growth, except for the low-intensity campsite sub-sector. Government support measures and investment programs implemented during the Covid-19 pandemic played a significant, though differentiated, role in the survival and development of enterprises, thereby strengthening their resilience (Gonda, 2022).

The rate of enterprise deaths in the accommodation and food services sectors showed significant regional variation over the period. For example, the situation for hotels was particularly negative in Budapest, where strict closures and a lack of foreign tourists led to a significant drop in revenues, and several large hotel chains were unable to recover their pre-Covid-19 crisis performance by 2022. The "Balaton effect" is characterized by the fact that between 2020 and 2023, while the share of firms that closed down was lowest in the Balaton tourism region (19.0%), most firms closed down in Budapest (34.4%). This can be attributed to the fact that many people relocated to the Balaton area during the pandemic, and domestic tourism was favored over international travel, which often involved inconveniences such as testing and quarantine. These trends further reinforced the tourism significance of the region surrounding the "Hungarian sea".

Our research uncovered numerous phenomena calling for further, in-depth investigation. Among these, it highlighted the substantial increase in the profitability of the previously less-examined campsite sub-sector. To better understand the reasons behind this, we recommend conducting an empirical analysis of the changes that occurred in campsites during the 2020–2022 period. A similar question that needs to be answered for the hospitality sector is whether, despite their declining turnover, beverage service firms have been able to increase their profitability. Another key question is how the examined sectors reorganized their operations and what innovative solutions were implemented in response to the Covid-19

crisis. Finally, it is important to examine the sources and types of fixed asset investments undertaken by various sub-sectors and the extent of support received for these investments.

Given the weight and societal role of the examined sectors, the supplement to the "National Tourism Development Strategy 2030," titled *Tourism 2.0*, published by the Hungarian Tourism Agency during the Covid-19 pandemic in 2021, identified data-driven sector management as one of the 12 most critical directions. In our opinion, a broadening of the analysis presented in this study could contribute to decision making based on information from the National Tourism Data Supply Centre (Nemzeti Turisztikai Adatszolgáltató Központ). Regular or periodic analyses of the financial reports of businesses in the accommodation and food service sectors would effectively support tourism management in Hungary. Expanding the study to include foreign companies would also facilitate international comparisons.

5.8 Appendix to the article

30. Table - Change in aggregate turnover and EBIT at sector level compared to 2019

Sector	Turnover			EBIT		
	2020	2021	change in value 2022	2020	2021	2022
Hotel services	-56%	-41%	5%	-141%	-88%	-61%
Holiday and other temporary accommodation services	-30%	-11%	15%	5%	-27%	35%
Camping services	-25%	-14%	31%	-295%	307%	553%
Other accommodation services	-6%	13%	41%	-27%	228%	91%
Restaurant, mobile catering	-27%	-6%	10%	-75%	45%	23%
Event catering	-51%	-29%	0%	-185%	-50%	25%
Other food service activities, i.e. food service activities of kitchen establishments, food serving activities of factory catering	-27%	-7%	4%	-67%	16%	31%
Drinks service	-34%	-20%	-1%	-204%	73%	93%

31. Table - Annual change in turnover of enterprises compared to the previous year, median values

TEÁOR	Sector	2018	2019	2020	2021	2022
5510	Hotel services	13%	8%**	-32%**	25%**	50%**
5520	Holiday and other temporary accommodation services	9%	8%**	-28%**	21%**	30%
5530	Camping services	16%	10%**	-19%**	19%**	36%
5590	Other accommodation services	9%	10%**	-13%**	16%**	30%
5610	Restaurant, mobile catering	21%	12%**	-21%**	27%**	36%**
5621	Event catering	18%	11%**	-47%**	21%**	31%
5629	Other catering	10%	10%**	-20%**	20%**	39%
5630	Drinks service	9%	9%**	-27%**	12%**	45%**

* The change in the median from the previous year is significant at $p < 0.1$.

** The change in the median compared to the previous year is significant at $p < 0.05$.

Note: Change in turnover for a given company: $\text{net turnover}_T / \text{net turnover}_{(T-1)} - 1$

We ran the Wilcoxon signed-rank test, which is used to examine differences between paired samples. The purpose of the test is to determine whether there is a significant difference between the median of two years (two samples). Changes were analysed by comparing the median for each year to the median for the previous year, so we were not able to analyse changes for 2018

Source: own work based on ORBIS database.

32. Table - Median annual change in company EBIT margins

TEÁOR code	Sector	2018	2019	2020	2021	2022
5510	Hotel services	9,0%	7,7%**	1,3%**	8,0%**	10,6%**
5520	Holiday and other temporary accommodation services.	5,1%	5,3%*	0,8%**	6,9%**	8,5%**
5530	Camping services	5,8%	10,2%	5,8%	11,7%*	7,0%
5590	Other accommodation services	4,7%	5,2%	4,2%	8,7%**	8,6%**
5610	Restaurant, mobile catering	3,7%	3,9%**	1,6%**	8,0%**	4,3%**
5621	Event catering	2,7%	2,6%	0,3%**	3,9%*	2,0%
5629	Other catering	2,3%	2,4%	0,9%**	3,5%**	3,1%
5630	Drinks service	1,4%	1,8%**	-6,4%**	1,4%**	1,4%**

* The change in the median from the previous year is significant at $p < 0.1$.

** The change in the median compared to the previous year is significant at $p < 0.05$.

Note: EBIT margin for a given company is calculated as the ratio of Operating profit / Net sales_(T).

We ran the Wilcoxon signed-rank test, which used to examine differences between paired samples. The purpose of the test is to determine whether there is a significant difference between the median of two samples (two years). Changes were analysed by comparing the median for each year to the median for the previous year, so we were not able to analyse changes for 2018

Source: own work based on ORBIS database.

33. Table - Amount of investment in capital goods at sectoral level (aggregate nominal value) calculated on the basis of capital stock and depreciation (thousand forints)

Sector	2020	2021	2022	Total
Hotel services	82 862 031	105 531 254	178 331 869	366 725 154
Holiday and other temporary accommodation services	3 471 603	13 553 629	12 124 078	29 149 310
Camping services	-1 102 226	460 612	555 138	-86 476
Other accommodation services	8 998 875	11 354 566	11 369 454	31 722 896
Total				427 510 884
Restaurant, mobile catering	45 162 766	71 651 284	89 090 959	205 905 009
Event catering	-82 522	645 248	909 528	1 472 254
Other catering	1 501 524	7 136 687	7 029 545	15 667 756
Drinks service	1 234 796	3 985 868	5 203 327	10 423 991
Total				233 469 010

Note: the amounts shown in the table above represent the total investment in each sector.

Source: own work based on ORBIS database.

34. Table - Corporate annual fixed investment, median values

TEÁOR code	Sector	2018	2019	2020	2021	2022
5510	Hotel services	5%	8%	6%	6%	6%
5520	Holiday and other temporary accommodation services	4%	6%	7%	10%	7%
5530	Camping services	4%	3%	3%	8%	3%
5590	Other accommodation services	9%	11%	9%	9%	6%
5610	Restaurant, mobile catering	12%	14%	10%	13%	15%
5621	Event catering	16%	14%	7%	15%	41%
5629	Other catering	13%	13%	10%	10%	14%
5630	Drinks service	4%	5%	2%	4%	6%

Note: The calculation of the % of investment in fixed assets of a company was derived in Methodology Chapter 5.

Source: own work based on ORBIS database.

35. Table - Change in aggregate annual fixed capital formation at sector level

Sector	From 16 to '17	From 17 to '18	From 18 to '19	from 16 to 19	From 19 to '20	From 20 to '21	From 21 to '22	from 19 to 22
Hotel services	14,06%	14,39%	21,41%	56,18%	8,03%	9,78%	15,55%	36%
Holiday and other temporary accommodation services	14,01%	17,33%	11,94%	47,46%	8,40%	31,73%	22,51%	71%
Camping services	10,69%	4,49%	3,34%	18,97%	-19,21%	10,53%	12,19%	-2%
Other accommodation services	14,42%	18,92%	22,55%	63,13%	25,31%	26,68%	22,08%	89%
Restaurant, mobile catering	17,15%	23,03%	23,74%	70,25%	21,27%	30,61%	31,98%	97%
Event catering	17,22%	16,88%	11,29%	48,42%	-2,73%	24,30%	30,65%	49%
Other catering	14,19%	16,65%	26,53%	58,72%	6,38%	31,89%	26,92%	67%
Drinks service	13,98%	26,10%	20,01%	64,25%	7,03%	23,93%	28,45%	59%

Note: The calculation of the % of investment in fixed assets of a company was derived in Methodology Chapter 5.

Source: own work based on ORBIS database.

6 SUMMARY AND FURTHER RESEARCH QUESTIONS

In my dissertation, I set out to explore the financial impact of the COVID-19 crisis on businesses. I focused particularly on corporate financial performance, crisis management strategies, and sectoral differences across the EU27, while also narrowing some of the analyses specifically to Hungary. To address the research objectives from multiple angles, I conducted five studies with different scopes, methodologies, and data sources.

In this final Chapter, I first summarize the research objectives and main findings of the five articles, presenting the results in light of the research questions and with a focus on emphasizing how the findings relate to each other. Following that, I address the research limitations and propose future research directions, supported by methodological reflections and relevant literature. Finally, I summarize the key implications for both economic policy and the academic community, in line with the practical relevance of the dissertation's results.

As this dissertation follows an article-based format, it is based on findings from completed and published (or submitted) research studies. Overall, the dissertation is built around three main research objectives, which were addressed through four individual studies. Across these studies, I formulated and answered a total of nine research questions.

6.1 Summary of the research objectives and main results

A central theme of the dissertation is **the role and impact of crisis support programs**. Article 2 identifies major differences in the size and structure of government support measures across the EU27, showing that support was not always in line with the severity of the health or economic impact. Article 3 shows that in countries with extensive credit-based support, the temporary rise in zombie firms was more visible. Article 4 concluded that in Hungary, support was often distributed without taking into account how severely different sectors were affected. Article 5 further expanded on this picture, showing that investment in the tourism sector was maintained largely due to targeted programs. These results together suggest that the crisis support programs had a stabilizing effect. However,

a better targeting - by firm size, sector, or financial health - could improve efficiency and reduce long-term zombification risks.

Articles 4 and 5 highlight that the **pandemic hit sectors and regions differently**. Tourism-related sectors, travel agencies, video and television program production, and water transport suffered the most, while chemical and pharmaceutical industries, warehousing, and transportation support activities experienced growth. Regional differences were evident: Budapest's hospitality sector struggled due to the drop in foreign visitors, whereas the Balaton area benefited from increased domestic tourism - this pattern, known as the "**Balaton effect**," which underlines the value of considering regional dynamics in policy planning.

The findings show that the **COVID-19 crisis had its strongest impact in 2020**, causing short-term disruption in several sectors. Article 3 reports that the increase in share of zombie firms was temporary, with levels returning to normal by 2021. Articles 4 and 5 show improvements in key financial indicators - such as EBIT and investment intensity - across different sectors from 2021 onward. The crisis followed a clear **V-shaped recovery path**: after the sharp downturn in 2020, most sectors showed signs of consolidation by 2021. In the long run, none of the examined industries suffered lasting structural damage.

The key findings of each article are presented in Table 36 and discussed further in subchapters 6.1.1–6.1.3. These sections provide an overview of the findings, respond to the research questions, and place them in the context of the dissertation's broader objectives.

36. Table - Overview of Research Objectives, Questions, Methods, and Main Findings

Research Question	Method/Main Statement
RO 1: Comparison of European countries' crisis management strategies in the EU27 countries	
A2.RQ1: <i>How can the EU27 countries be grouped based on their preparedness for the challenges of COVID-19, as well as their responses to protection measures and the resulting health and economic impacts?</i>	Method: Hierarchical clustering
	Statement: EU27 grouped into six clusters; North–South contrast; CEE followed middle-way strategy.
A2.RQ2: <i>How do the levels (as a percentage of GDP) and forms of European Commission-backed state aid measures differ across the identified clusters of EU27 countries?</i>	Method: Descriptive statistics
	Statement: EU aid varied by cluster; driven by economic distress; Hungary received high support via guarantees.
RO 2: The share of zombie companies during the time of Covid-crisis	
A3.RQ1: <i>Was the increase in the number of zombie firms in the manufacturing sector greater in countries with significant credit easing measures during the COVID-19 pandemic?</i>	Method: Hierarchical clustering, Z-test
	Statement: Zombie share rose in support countries; effect was temporary; no long-term zombification.
A3.RQ2: <i>How do the annual survival rates of firms identified as zombies over a two-year timeframe change from 2016 to 2022?</i>	Method: Cohort-matrix
	Statement: Zombie survival slightly increased in support countries; effect was short-lived.
A4.RQ2: <i>How did the proportion of zombie firms and undertakings in difficulty change over this period in Hungary?</i>	Method: Descriptive statistics
	Statement: Zombie share increased in Accommodation and Food Services sector; other sectors stable
RO 3: Sectoral analysis of corporate financial performance during the COVID-19 crisis	
A4.RQ1: <i>How did the sectoral financial performance of Hungarian small and medium-sized enterprises (SMEs) change during the COVID-19 pandemic?</i>	Method: Two-Step cluster analysis and descriptive statistics
	Statement: SME performance dropped in 2020; V-shaped recovery; hardest hit: tourism, media, water transport.
A5.RQ1: <i>How did the revenue and operating profit (earnings before interest and taxes - EBIT) of the domestic tourism industry change in the period 2020-2022 compared to 2019?</i>	Method: Wilcoxon signed-rank test and descriptive statistics
	Statement: Severe 2020 downturn in tourism; hotel revenues fell most; other segments showed strong recovery by 2022.
A5.RQ2: <i>What level of fixed asset investments characterized the various subsectors of Hungarian tourism between 2016 and 2022?</i>	Method: Descriptive statistics
	Statement: Tourism investments sustained by government support; accommodation sector grew; hospitality recovered after 2020
A5.RQ3: <i>Can a pattern be identified in the companies that ceased operations between 2020 and 2023, based on geographical location and administrative settlement category in the two tourism sectors in Hungary?</i>	Method: Z-tests and descriptive statistics
	Statement: Firm closures highest in Budapest; lowest at Balaton due to domestic tourism—“Balaton Effect.”

Source: own work

6.1.1 Research Objective 1: Comparison of European countries' crisis management strategies in the EU27 countries

Previous studies have examined how European countries were affected and responded to the COVID-19 crisis from various aspects, such as health system capacity (Aristodemou et al., 2021), the timing and stringency of policy interventions (Bouckaert et al., 2020; Gros et al., 2021), and excess mortality (Ziakas et al., 2022; Sobczak & Pawliczak, 2022). Others have applied cluster analysis to explore regional disparities and government strategies (Bucci et al., 2022; Dzurova & Květoň, 2021). However, these works typically focused on a single dimension or a short timeframe.

My aim in Article 2 is to build on previous literature by introducing a novel, multidimensional clustering framework that integrates health, policy, and economic variables over an extended period (January 2020 – April 2022), which helps provide a more comprehensive classification of EU27 countries' crisis management strategies.

A2. Research Question 1: *How can the EU27 countries be grouped based on their preparedness for the challenges of COVID-19, as well as their responses to protection measures and the resulting health and economic impacts?*

To answer the question hierarchical clustering was applied with Ward linkage to form comparable groups. The main conclusion of the research is that EU27 countries were categorized into six clusters (West, South, North, Baltic, CEE, and Bulgaria as a quasi-outlier) based on healthcare preparedness, protective measures, and pandemic impacts. Hungary is part of the Central and Eastern Europe (CEE) cluster, which followed a middle-way strategy across multiple dimensions, leading to a moderate economic contraction. Our analysis confirmed the contrast between Northern and Southern European countries: the South cluster faced the strictest lockdowns and highest vaccination coverage but experienced the most severe economic contraction. The North cluster maintained positive GDP growth with relatively loose measures.

The article continues to assess the EU27 countries' use of State Aid under the COVID-19 Temporary Framework by comparing the relative size and types of financial support

measures across and within country clusters. The following research question was addressed:

A2. Research Question 2: *How do the levels (as a percentage of GDP) and forms of European Commission-backed state aid measures differ across the identified clusters of EU27 countries?*

To explore this question, we examined the distribution of state aid in both nominal and relative terms (as a share of GDP), and aggregated national data to identify patterns across country clusters. Based on our analysis, we found that EU financial support varied significantly, with the South cluster countries averaging 7% of GDP, and the Western cluster reaching 5.1%, while the Northern cluster had the lowest average at 1.7%. Bulgaria received only 2.6% of GDP in EU support, despite experiencing high mortality. These results indicate that the aid was driven more by economic distress than health impacts. Hungary stands out within the CEE group due to its exceptionally high level of EU support (8.7% of GDP) driven by its reliance on guarantee schemes.

6.1.2 Research Objective 2: The share of zombie companies during the time of Covid-crisis

As I outlined and discussed in Section 1.4.2, concerns have emerged in the literature that COVID-19 support measures, while aimed at stabilizing the economy, may have also prolonged the survival of financially weak or zombie firms, potentially hindering recovery (EBA, 2020b; Laeven et al., 2020; Acharya et al., 2021; Pelosi et al., 2021; Bighelli et al., 2022). To address this concern, Article 3 investigates whether the prevalence of zombie firms increased more in countries that introduced extensive credit easing measures during the pandemic:

A3. Research Question 1: *Was the increase in the number of zombie firms in the manufacturing sector greater in countries with significant credit easing measures during the COVID-19 pandemic?*

Based on firm-level financial data from the Orbis database and using four different identification methods, I found that the share of zombie firms in the manufacturing sector increased more in support-cluster countries (Spain and Italy) than in non-supporting

countries (Denmark, Sweden, and Finland) during 2020. These clusters were identified through a three-step clustering process that grouped countries based on the extent and type of credit-facilitating measures and interventions, including the size of loan guarantees and the scope of moratoria. However, this increase remained temporary, as the share of zombie firms nearly returned to 2019 levels by 2021, indicating that government measures did not lead to long-term zombification. This result, as observed in our analysis of the manufacturing sector, is in line with previous findings suggesting that COVID-related support did not systematically benefit zombie firms in the long run (Bighelli et al., 2022; Pelosi et al., 2021).

In addition to examining the share of zombie firms, we wanted to understand their persistence over time, so we applied a cohort matrix analysis to explore whether government support influenced their long-term survival. Following Carreira et al. (2022), who distinguished three possible paths for zombie firms - continued zombification, recovery, or exit - we applied this framework to track their status over time.

A3. Research Question 2: *How do the annual survival rates of firms identified as zombies over a two-year timeframe change from 2016 to 2022?*

The cohort matrix analysis showed that zombie firms in supporting countries had slightly higher survival rates in 2020 compared to pre-COVID years (e.g. in Italy, first-year survival increased from 44–49% to 50%; in Spain, from 50–51% to 55%), while in non-supporting countries, survival rates stagnated or even declined (e.g. in Sweden, from 47–49% to 45%). These results indicate that support measures had only a temporary effect on the persistence of zombie firms in supporting countries.

To complement the EU-wide analysis, in **Article 4** we narrow the focus to Hungary, in order to examine how the share of zombie firms and undertakings in difficulty changed across different sectors during the crisis.

A4. Research Question 2: *How did the proportion of zombie firms and undertakings in difficulty change over this period in Hungary?*

To the best of our knowledge, we were the first to examine zombie firm ratios at the national economic sector level using Hungarian firm-data. We looked at 11 sectors and

calculated the ratios using McGowan's (2018) methodology, applying both the original three-year and a modified two-year definition for the 2019–2022 period. The share of zombie firms typically ranged between 2% and 10% across sectors, but in the **Accommodation and Food Services sector** - which was hardest hit by the crisis - it increased from 7–8% in 2020 to 25.9% in 2021 (2-year method), which also reflects the sector's vulnerability. Similarly, the share of undertakings in difficulty in this sector rose modestly in 2020 (from 16.7% to 18.7% under the post-crisis definition), but improved in 2021 and remained below 2019 levels thereafter. In other sectors, both indicators showed no significant deterioration during the crisis.

6.1.3 Research Objective 3: Sectoral analysis of corporate financial performance during the COVID-19 crisis

As discussed in Section 1.4.3, my experience and the literature both suggest that the financial impact of the COVID-19 crisis varied considerably across industries, with some sectors - especially tourism and certain service industries - more severely affected than others (MNB, 2020b; El-Meouch et al., 2024; Shen et al., 2020). The earlier studies often focused on macroeconomic trends or analyzing of publicly listed firms' financial data, I found that less attention has been paid to sector-level developments using firm-level data, particularly for SMEs. **Article 4** aims to address this gap by analyzing how the financial indicators of Hungarian SMEs changed across sectors during the pandemic.

A4. Research Question 1: *How did the sectoral financial performance of Hungarian small and medium-sized enterprises (SMEs) change during the COVID-19 pandemic?*

To better understand the sectoral impact of the pandemic on SMEs, I analyzed how key financial indicators changed across sectors during the crisis. The analysis based on EBIT and turnover changes shows that the financial performance of Hungarian SMEs deteriorated significantly in 2020, but showed clear signs of recovery by 2021, particularly in terms of EBIT indicators - suggesting a V-shaped rebound. However, the crisis did not affect all sectors equally. Tourism-related industries (Accommodation and Food Services sector), travel agencies, video and television production, and water transport suffered the most, while others - such as the chemical and pharmaceutical industries, warehousing, and transport support services - experienced growth during this period.

In Article 4, I found that tourism was one of the most vulnerable industries during the COVID-19 crisis, mainly due to lockdown measures. This is consistent with international findings, as the tourism sector experienced an unprecedented and prolonged decline in global activity, which caused overlapping and closely connected disruptions often referred to as a 'polycrisis' (UNWTO, 2023; Lawrence et al., 2024). Global tourist traffic declined by 72% in 2020, 69% in 2021, 34% in 2022, and 11% in 2023 compared to the record year of 2019 (UNWTO, 2024). Based on this literature and my previous professional experience, it is clear to me that the deep integration of tourism within economic and social systems contributed to especially complex and long-lasting financial consequences. In line with the aim of Research Objective 3, **Article 5 presents a detailed analysis of two key tourism-related sectors - accommodation services (in the Hungarian sectoral classification: TEÁOR 55) and food and beverage services (TEÁOR 56) -** including their sub-sectors. In this article, I aimed to explore the changes in revenue and operating profit between 2019 and 2022, patterns of fixed asset investment across sub-sectors between 2017 and 2023, and regional differences in firm closures within the Hungarian tourism industry over the same period.

A5. Research Question 1: *How did the revenue and operating profit (earnings before interest and taxes - EBIT) of the domestic tourism industry change in the period 2020-2022 compared to 2019?*

To answer this question, I analyzed the trends using sector-level aggregate and median-based indicators derived from the ORBIS database. To assess whether the observed year-on-year changes were statistically significant, I applied the Wilcoxon signed-rank test. The results show that the accommodation and food service sectors were among the hardest hit by the pandemic. Hotels experienced the sharpest revenue decline in 2020 (declined by 56%), while other accommodation types showed remarkable resilience, achieving 41% revenue growth by 2022 compared to pre-crisis levels.

A5. Research Question 2: *What level of fixed asset investments characterized the various subsectors of Hungarian tourism between 2016 and 2022?*

In order to examine capital expenditure intensity, I used an indirect calculation based on annual changes in tangible assets and depreciation, which allowed me to assess investment intensity across sectors and over time.

Overall, government-backed investment programs played a key role in sustaining capital expenditures during the crisis. According to the analysis, tangible asset investments in accommodation services increased during 2020-2021, with notable growth in holiday accommodations (+10% median investment intensity in 2021). In the hospitality sector, initial investment declines in 2020 were followed by recovery in 2021. This trend was likely driven by targeted government support, most notably the Kisfaludy Tourism Development Program, which provided more than HUF 200 billion in funding for the renovation and modernization of accommodation facilities across Hungary (Kormany.hu, 2020; Pajrok, 2022).

A5. Research Question 3: *Can a pattern be identified in the companies that ceased operations between 2020 and 2023, based on geographical location and administrative settlement category in the two tourism sectors in Hungary?*

To address this question, I examined business closures among firms established before 2018 that were still active in 2020, and tracked their operational status through 2024. Using a sample of nearly 19,000 companies, I applied Z-tests to compare sectoral, regional, and administrative differences in closure rates, and examined whether the observed patterns were statistically significant.

The findings highlight significant differences across regions. Budapest recorded the highest rate of firm closures (34.4%), likely due to stricter lockdowns and a sharp decline in foreign tourism. In contrast, the Balaton region showed the lowest closure rate (19.0%), benefitting from a shift toward domestic travel.

We referred to this regional resilience as the “Balaton Effect”, which reflects how increased domestic travel helped businesses in the area remain more stable compared to other regions. This can be explained by the fact that many people temporarily relocated to the Balaton area during the pandemic, and domestic tourism was preferred over international travel, which often involved additional burdens such as testing and

quarantine. These trends further highlighted the tourism significance of the region surrounding the “Hungarian sea”.

Overall, Article 5 contributes to a deeper understanding of the tourism sector’s financial resilience during the COVID-19 crisis by combining firm-level, sectoral, regional, and investment-related aspects, while also providing novel, data-driven evidence on Hungary’s tourism industry.

6.2 Research limitations

In terms of **research limitations**, several restrictive factors emerged in the individual studies. In terms of support measures, it should be noted that in *Article 2*, only EU-level support (The State aid Temporary Framework program) was analyzed, while government-level measures were not considered. A unified database in this regard could facilitate future research.

Regarding zombie firms in *Article 3* and Article 4, there is no standardized taxonomy for defining them. In this study, a broader methodological approach was applied, as determining whether a company received additional credit during the analyzed period (a narrower definition) would require access to credit registers or banking databases. However, if the Central Credit Information System (KHR – Központi Hitelinformáció Rendszer in Hungarian) were available for research purposes in Hungary, it could allow for the application of a narrower zombie firm definition within the context of domestic analysis.

Three articles applied a longitudinal approach - Article 3 covering 2016 - 2022, Article 5 analyzing the period from 2016 to 2023, and Article 4 focusing only on 2019 - 2022 - the shorter pre-crisis baseline in Article 4 reduces the robustness of conclusions regarding pre-pandemic financial trends. Although the pre-crisis baseline in Article 4 is limited to 2019, this year is widely accepted as the last 'normal' pre-pandemic year, with stable economic growth in Hungary. Another limitation of Articles 4 and 5 is that the analyses were based on sector-level aggregates and medians rather than firm-level data. While this approach helped to highlight overall sectoral trends, it may have hidden important differences between individual firms and their individual responses to the crisis.

Finally, a general limitation of the research is that the analyses were based solely on annual financial data, meaning that intra-year fluctuations caused by different waves of the coronavirus were not taken into account.

6.3 Further research questions

The studies presented in this dissertation highlight several areas where further research could contribute to a more detailed understanding of the financial impacts of the COVID-19 crisis on businesses. These directions build on the questions and limitations identified throughout the articles:

- **Other aspects of financial effects of Covid-19 crisis:** First, there is scope to explore the financial effects of the crisis in greater depth and from additional perspectives. Article 1 highlighted that while financial impacts were often referenced in systematic literature reviews (SLRs), they were rarely addressed as a primary research focus. Future studies could examine more systematically how operational disruptions and demand-side changes influenced financial outcomes, specifically within the framework of SLRs. Additionally, it would be valuable to examine how the COVID-19 crisis influenced banking, cash flows, borrowing, and especially dividend policies - an area where most studies so far have only covered 2020, suggesting scope for further systematic reviews.
- **Evaluating the targeting of crisis support measures:** Second, future studies could focus on the targeting and effectiveness of crisis support measures. Although the role of support programs was examined across Articles 2–5, analyses were limited to aggregate data. Access to firm-level information would allow for more precise assessment of how financial support contributed to business survival and stability. A good example is the study by Bighelli et al. (2022), who used micro-level data from five countries through the CompNet database. In addition, event-based panel modelling could provide stronger causal insights into the sector-specific effects of the COVID-19 crisis.
- **The tourism sector** also offers several directions for future research. As highlighted in Article 5, further analysis is needed to understand the surprising profitability trends in campsites, as well as the recovery patterns of beverage

service firms. It would also be valuable to examine how tourism-related businesses reorganized their operations and adopted innovative responses during the pandemic. These topics could be explored through firm-level case studies or targeted surveys to examine managerial practices and strategic adaptations during the pandemic.

- **Sectors impacted by the COVID-19 crisis** could be further explored by expanding the sectoral analysis in Article 4 due to their limited economic weight, both in scope and through international comparisons. Sectors such as Arts, Entertainment and Recreation, Education, and Health and Social Work - not covered in Article 4 - were heavily affected by lockdowns, as noted by Jeannotte (2021), Betzler et al. (2021), and Wall-Andrews et al. (2021). Firm-level research in these sectors, along with comparative studies across countries, could provide further insight into the broader economic impacts of the pandemic.

6.4 Implications

The findings of this dissertation also highlight several practical lessons for economic policy and researchers. In this chapter, I would like to summarize them.

The first clear recommendation is that future crisis support programs should take sectoral differences more carefully into account. As shown in Article 4, financial support during the COVID-19 crisis was often distributed in a generalized manner in Hungary, which did not always reflect the actual sectoral vulnerabilities identified. This is particularly important given the temporary zombification risks observed: according to Article 3 while widespread zombification was avoided, some warning signs appeared in countries with extensive credit support. Helmersson et al. (2021) also showed that despite eligibility criteria, up to 90% of zombie firms may have qualified for public support schemes in the euro area, which highlights the need for stricter screening mechanisms. Future programs could therefore include mechanisms to filter out non-viable firms more effectively. Well-targeted approaches could improve effectiveness, for example by incorporating financial vulnerability indicators, such as leverage, interest coverage, capital adequacy or cash-flow ratios into the eligibility criteria of future programs. These indicators can be easily

assessed by banking professionals based on audited financial statements or even interim ledger data, for instance during new loan applications or periodic credit reviews.

The next policy recommendation is the access to firm-level data on crisis-related subsidies should be expanded in Hungary for research purposes. This would allow for a more thorough ex-post assessment of the efficiency of public support schemes. As highlighted in Articles 3–5, the lack of firm-level support data limits the ability to evaluate whether aid reached the most vulnerable or strategically important firms. The usefulness of such micro-level evaluation is well illustrated by Lalinsky and Pál (2021), who used firm-level data from Slovakia to assess the impact of COVID-19 policy support on corporate performance. Controlled access to anonymized records, similar to initiatives like CompNet or the ECB’s AnaCredit, would significantly improve the effectiveness of policy evaluation in Hungary.

The sectoral results also suggest several policy considerations for tourism. Article 5 highlighted the unequal geographical effects of the crisis: Budapest’s hotel industry was heavily affected by the decline in international visitors, while the Balaton region saw increased domestic tourism. The “Balaton effect” shows that strengthening domestic tourism can reduce risks during crises, and that regional differences should be better considered when planning support. These findings, drawn from across the dissertation, emphasize the importance of more data-informed and responsive policy-making in preparing for future economic shocks.

From a research perspective, I believe this dissertation contributes to the academic literature by providing longitudinal, sector-level insights into how Hungarian SMEs responded to the COVID-19 crisis. In terms of zombie firm identification, the EBITDA-based method introduced in Article 3 may support future research into zombification, offering an approach that is more closely aligned with banking practice than traditional EBIT-based models. In addition, through the multidimensional country-level clustering developed in Article 2, I aimed to offer a valuable framework for cross-country comparisons within the EU27, supporting future research into the deeper understanding of different crisis management strategies.

7 REFERENCES

- Aas, T. H., & Pedersen, P. E. (2011): The impact of service innovation on firm-level financial performance. *The Service Industries Journal*, 31(13), 2071-2090. <https://doi.org/10.1080/02642069.2010.503883>
- Acharya, V. V., & Steffen, S. (2020): The risk of being a fallen angel and the corporate dash for cash in the midst of COVID. *The Review of Corporate Finance Studies*, 9(3), 430-471. <https://doi.org/10.1093/rcfs/cfaa013>
- Acharya, V. V., Lenzu, S. & Wang, O. (2021): “Zombie lending and policy traps”, National Bureau of Economic Research No. 29606, available at: https://www.nber.org/system/files/working_papers/w29606/w29606.pdf
- Acharya, V. V., Crosignani, M., Eisert, T. & Steffen, S. (2022): “Zombie lending: Theoretical, international, and historical perspectives”, *Annual Review of Financial Economics*, Vol. 14, pp.21-38, doi.org/10.1146/annurev-financial-111620-114424
- Akula, S. C. & Singh, P. (2021): Impact of Covid 19 on entrepreneurship: A systemetic literature review. *International Journal of eBusiness and eGovernment Studies*, 13(1): 1-22. DOI:10.34111/ijebeg.202113101
- Al-Awadhi, A. M., Alsaifi, K., Al-Awadhi, A., & Alhammadi, S. (2020): Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of behavioral and experimental finance*, 27, 100326. <https://doi.org/10.1016/j.jbef.2020.100326>
- Albuquerque, B., & Iyer, R. (2024): The rise of the walking dead: Zombie firms around the world. *Journal of International Economics*, 152, 104019. <https://doi.org/10.1016/j.jinteco.2024.104019>
- Alcidi, C., & Corti, F. (2021): The EU response to Covid-19: breaking old taboos. Social policy in the European Union: state of play, 1, 39-60. ISBN: 978-2-87452-618-3
- Alemanno, A. (2020): The European response to COVID-19: from regulatory emulation to regulatory coordination?. *European journal of risk regulation*, 11(2), 307-316. <https://doi.org/10.1017/err.2020.44>
- Ali, H. (2022): Corporate dividend policy in the time of COVID-19: Evidence from the G-12 countries. *Finance Research Letters*, 46, 102493. <https://doi.org/10.1016/j.frl.2021.102493>
- Aliber, R. Z., Kindleberger, C. P., & McCauley, R. N. (2015): Manias, panics, and crashes: A history of financial crises (p. 256). Basingstoke: Palgrave Macmillan. ISBN: 978-1137525758
- Álvarez, L., García-Posada, M. & Mayordomo, S. (2023): “Distressed firms, zombie firms and zombie lending: a taxonomy”, *Journal of Banking & Finance*, Vol. 149, 106762, doi.org/10.1016/j.jbankfin.2023.106762
- Amankwah-Amoah, J. - Khan, Z., Wood, G. & Knight, G. (2021): COVID-19 and digitalization: The great acceleration. *Journal of business research*, 136: 602-611. <https://doi.org/10.1016/j.jbusres.2021.08.011>

Andrews, D. & Petroulakis, F. (2019): “Breaking the shackles: Zombie firms, weak banks and depressed restructuring in Europe”, *European Central Bank Working Paper Series* No 2240, available at: <https://ssrn.com/abstract=3957694>

Anguera-Torrell, O.–Vives-Perez, J. & Aznar-Alarcón, J. P. (2021): Urban tourism performance index over the COVID-19 pandemic *International Journal of Tourism Cities* 7 (3): 622–639. <https://doi.org/10.1108/IJTC-0D-2020-0206>

Ardolino, M. - Bacchetti, A. - Dolgui, A. - Franchini, G. - Ivanov, D. & Nair, A. (2024): The Impacts of digital technologies on coping with the COVID-19 pandemic in the manufacturing industry: a systematic literature review. *International Journal of Production Research*, 62(5): 1953-1976. <https://doi.org/10.1080/00207543.2022.2127960>

Aristodemou, K., Buchhass, L., & Claringbould, D. (2021): The COVID-19 crisis in the EU: the resilience of healthcare systems, government responses and their socio-economic effects. *Eurasian Economic Review*, 11(2), 251-281. <https://doi.org/10.1007/s40822-020-00162-1>

Armstrong, H. W. & Read, R. (2018): The impact of the 2008 global crisis on small economies in the Caribbean *Canadian Journal of Latin American and Caribbean Studies* 43 (3): 394–416. <https://doi.org/10.1080/08263663.2018.1513718>

Arroyo-Marioli F, Bullano F, Kucinskas S, Rondón & Moreno C (2023): processed by Our World in Data. “Reproduction rate” [dataset]. Available: <https://ourworldindata.org/coronavirus>

Asztalos P., Baksay G., & Szalai Á. (2020): Versenyképes járványkezelés – a számok a magyar modell sikerét bizonyítják. Published on the official website of MNB: Kiadványok/Szakmai Cikkek/Versenyképesség. Available: <https://www.mnb.hu/letoltes/asztalos-peter-baksay-gergely-szalai-akos-jarvanykezeles-versenykepessége-v5.pdf> Published on 24 July 2020

Baas, J. - Schotten, M. - Plume, A. - Côté, G. & Karimi, R. (2020): Scopus as a curated, high-quality bibliometric data source for academic research in quantitative science studies. *Quantitative science studies*, 1(1): 377-386. https://doi.org/10.1162/qss_a_00019

Bacher, J., Wenzig, K., & Vogler, M. (2004): SPSS TwoStep Cluster - a first evaluation. (2., corr. ed.) (Arbeitsund Diskussionspapiere / Universität Erlangen-Nürnberg, Sozialwissenschaftliches Institut, Lehrstuhl für Soziologie, 2004-2), <https://nbn-resolving.org/urn:nbn:de:0168-ssoar-327153>

Bajgar, M., Berlingieri, G., Calligaris, S., Criscuolo, C., & Timmis, J. (2020): Coverage and representativeness of Orbis data. ECD Science, *Technology and Industry Working Papers*, No. 2020/06, OECD Publishing, Paris, <https://doi.org/10.1787/c7bdaa03-en>.

Baker, S. R., Bloom, N., Davis, S. J., Kost, K. J., Sammon, M. C., & Viratyosin, T. (2020): *The unprecedented stock market impact of COVID-19* (No. w26945). National Bureau of economic research. <https://doi.org/10.3386/w26945>

Baldwin, R. E., & Tomiura, E. (2020): Thinking ahead about the trade impact of COVID-19. *Economics in the time of COVID-19*. Centre for Economic Policy Research, 2020. - Pages 59-71 ISBN: 978-1-912179-28-2

- Banerjee, R. & Hofmann, B. (2018): “The rise of zombie firms: causes and consequences”, *BIS Quarterly Review*, Vol. 3, pp.67-78, available at: https://www.bis.org/publ/qtrpdf/r_qt1809g.htm
- Banerjee, R. & Hofmann, B. (2022): “Corporate zombies: Anatomy and life cycle”, *Economic Policy*, Vol. 37 No. 112, pp.757-803, doi.org/10.1093/epolic/eiac027
- Banerjee, R., Illes, A., Kharroubi, E., & Garralda, J. M. S. (2020): Covid-19 and corporate sector liquidity (No. 10). *Bank for International Settlements*. ISSN: 2708-0420
- Barbe, D.–Pennington-Gray, L. & Schroeder, A. (2018): Destinations’ response to terrorism on Twitter *International Journal of Tourism Cities* 4 (4): 495–512. <https://doi.org/10.1108/IJTC-04-2018-0027>
- Bekaert, G., Engstrom, E., & Ermolov, A. (2020). Aggregate demand and aggregate supply effects of COVID-19: A real-time analysis. The Federal Reserve - Finance and Economics Discussion Series (FEDS) <https://doi.org/10.2139/ssrn.3611399>
- Belghitar, Y., Moro, A., & Radić, N. (2022): When the rainy day is the worst hurricane ever: the effects of governmental policies on SMEs during COVID-19. *Small Business Economics*, 58(2), 943-961. <https://doi.org/10.1007/s11187-021-00510-8>
- Belitski, M., Guenther, C., Kritikos, A. S., & Thurik, R. (2022): Economic effects of the COVID-19 pandemic on entrepreneurship and small businesses. *Small Business Economics*, 58(2), 593-609. <https://doi.org/10.1007/s11187-021-00544-y>
- Betzler, D., Loots, E., Prokůpek, M., Marques, L., & Grafenauer, P. (2021): COVID-19 and the arts and cultural sectors: Investigating countries’ contextual factors and early policy measures. *International journal of cultural policy*, 27(6), 796-814. <https://doi.org/10.1080/10286632.2020.1842383>
- Bianchi, R. V. & Milano, C. (2024): Polycrisis and the metamorphosis of tourism capitalism *Annals of Tourism Research* 104, 103731. <https://doi.org/10.1016/j.annals.2024.103731>
- Bighelli, T., Lalinsky, T. & Vanhala, J. (2022): “Covid-19 pandemic, state aid and firm productivity”, *Bank of Finland Research Discussion Paper* (1), doi.org/10.2139/ssrn.4009439
- Biondi-Zoccai, G. (2016): Umbrella reviews. Evidence synthesis with overviews of reviews and meta-epidemiologic studies Cham, Switzerland: Springer International. ISBN 978-3-319-25655-9 <https://doi.org/10.1007/978-3-319-25655-9>
- Bloom, N., Fletcher, R. S., & Yeh, E. (2021): The impact of COVID-19 on US firms (No. w28314). National Bureau of Economic Research. <https://doi.org/10.3386/w28314>
- Bod, P. Á. (2020): Európa gazdasága a vírus után: legyengül vagy immunitást szerez? *Köz-gazdaság* 15 (3): 5–17. <https://doi.org/10.14267/RETP2020.03.01>
- Bolisani, E., Scarso, E., Ipsen, C., Kirchner, K., & Hansen, J. P. (2020): Working from home during COVID-19 pandemic: Lessons learned and issues. *Management & Marketing*, 15(1), 458-476. <https://doi.org/10.2478/mmcks-2020-0027>

- Bonfim, D., Cerqueiro, G., Degryse, H. & Ongena, S. (2023): “On-site inspecting zombie lending”, *Management Science*, Vol. 69 No. 5, pp.2547-2567, doi.org/10.1287/mnsc.2022.4452
- Boone, L. - Haugh, D. - Pain, N. & Salins, V. (2020): Tackling the fallout from COVID-19. *Economics in the Time of COVID-19*, 37, 44. CEPR Press ISBN: 978-1-912179-28-2
- Boros, L. & Kovalcsik, T. (2021): A COVID-19-járvány hatása a budapesti Airbnb-piacra *Területi Statisztika* 61 (3): 380–402. <https://doi.org/10.151D6/TS610306>
- Bouckaert, G., Galli, D., Kuhlmann, S., Reiter, R., & Van Hecke, S. (2020): European coronationalism? A hot spot governing a pandemic crisis. *Public administration review*, 80(5), 765. <https://doi.org/10.1111/puar.13242>
- Bouwens, J., De Kok, T. & Verriest, A. (2019): “The prevalence and validity of EBITDA as a performance measure”, *Comptabilité-Contrôle-Audit*, Vol. 25 No. 1, pp.55-105, doi.org/10.3917/cca.251.0055
- Bucci, A., Ippoliti, L., Valentini, P., & Fontanella, S. (2022): Clustering spatio-temporal series of confirmed COVID-19 deaths in Europe. *Spatial statistics*, 49, 100543. <https://doi.org/10.1016/j.spasta.2021.100543>
- Caballero, R. J., Hoshi, T. & Kashyap, A. K. (2008): “Zombie lending and depressed restructuring in Japan”, *American economic review*, Vol. 98 No. 5, pp.1943-1977, DOI: 10.1257/aer.98.5.1943
- Candia, S. & Pirlone, F. (2022): Tourism environmental impacts assessment to guide public authorities towards sustainable choices for the post-COVID era *Sustainability* 14 (18): 1–16. <https://doi.org/10.33D0/su14010018>
- Cannas, G., Ferraro, S., Collin, A. M., & van de Castele, K. (2022): Looking back at the State aid COVID Temporary Framework: the take-up of measures in the EU. *Competition State aid brief*, (3), 2022. DOI: 10.2763/631679
- Carletti, E., Oliviero, T., Pagano, M., Pelizzon, L., & Subrahmanyam, M. G. (2020): The COVID-19 shock and equity shortfall: Firm-level evidence from Italy. *The Review of Corporate Finance Studies*, 9(3), 534-568. <https://doi.org/10.1093/rcfs/cfaa014>
- Carreira, C., Teixeira, P. & Nieto-Carrillo, E. (2022): “Recovery and exit of zombie firms in Portugal”, *Small Business Economics*, Vol. 59 No. 2, pp.491-519, doi.org/10.1007/s11187-021-00483-8
- Castro, M. P., & Zermeño, M. G. G. (2020): Being an entrepreneur post-COVID-19—resilience in times of crisis: a systematic literature review. *Journal of Entrepreneurship in Emerging Economies*, 13(4), 721-746. <https://doi.org/10.1108/JEEE-07-2020-0246>
- Castro, R. & Moreira, A. C. (2024): Unveiling paradoxes: navigating SMEs readiness in the post-pandemic normality. *Cogent Business & Management*, 11(1): 2330114. <https://doi.org/10.1080/23311975.2024.2330114>
- Chang, Q., Zhou, Y., Liu, G., Wang, D. & Zhang, X. (2021): “How does government intervention affect the formation of zombie firms?”, *Economic Modelling*, Vol. 94 No. 1, pp.768-779, doi.org/10.1016/j.econmod.2020.02.017

- Chava, S., & Roberts, M. R. (2008): How does financing impact investment? The role of debt covenants. *The journal of finance*, 63(5), 2085-2121. <https://doi.org/10.1111/j.1540-6261.2008.01391.x>
- Chen, J., Lu, H., Melino, G., Boccia, S., Piacentini, M., Ricciardi, W., Wang Y., Shi Y. & Zhu, T. (2020): COVID-19 infection: the China and Italy perspectives. *Cell death & disease*, 11(6), 1-17. <https://doi.org/10.1038/s41419-020-2603-0>
- Cheng, D.–Liu, K.–Qian, Z.–Chen, Z. & Mao, H. (2022): Study on survival and sustainable development of small-and medium-sized tourism and hospitality enterprises in Macao based on regional soft environment and competitive advantage *Frontiers in Psychology* 12, 817695. <https://doi.org/10.338D/fpsyg.2021.8176D5>
- Cho, S. W. (2020): Quantifying the impact of nonpharmaceutical interventions during the COVID-19 outbreak: The case of Sweden. *The Econometrics Journal*, 23(3), 323-344. <https://doi.org/10.1093/ectj/utaa025>
- Chung, H. J., Jhang, H., & Ryu, D. (2023): Impacts of COVID-19 pandemic on corporate cash holdings: Evidence from Korea. *Emerging Markets Review*, 56, 101055. <https://doi.org/10.1016/j.ememar.2023.101055>
- Citi, M., & de la Porte, C. (2022): NGEU and vaccines strategy in the wake of the covid-19 pandemic: Outgrowing the regulatory state. *Journal of Common Market Studies*. <https://doi.org/10.1111/jcms.13414>
- Coibion, O., Gorodnichenko, Y., & Weber, M. (2020a): The cost of the covid-19 crisis: Lockdowns, macroeconomic expectations, and consumer spending (No. w27141). National Bureau of Economic Research. <https://doi.org/10.3386/w27141>
- Coibion, O., Gorodnichenko, Y., & Weber, M. (2020b): Labor markets during the COVID-19 crisis: A preliminary view (No. w27017). *National Bureau of economic research*. <https://doi.org/10.3386/w27017>
- Colmekcioglu, N.–Dineva, D. & Lu, X. (2022): “Building back better”: the impact of the COVID-19 pandemic on the resilience of the hospitality and tourism industries *International Journal of Contemporary Hospitality Management* 34 (11): 4103–4122. <http://dx.doi.org/10.1108/IJCHM-12-2021-150D>
- Czeczeli, V., Kolozsi, P. P., Kutasi, G., & Marton, Á. (2020): Gazdasági kitettség és válságállóság exogén sokk esetén: A COVID-19-járvány rövid távú gazdasági hatása az EU-ban. *Pénzügyi Szemle*, 65(3). https://doi.org/10.35551/PSZ_2020_3_1
- De Martiis, A., Heil, T., & Peter, F. J., (2023a): Are you a Zombie Firm? An Early Warning System Based on Machine Learning Methods. Available at SSRN. <http://dx.doi.org/10.2139/ssrn.3625473>
- De Martiis, A., & Peter, F. J. (2023b): When companies don't die: Analyzing zombie firms in a low interest rate environment. *Swiss Review of International Economic Relations*, 73(1), 67-86.

- De Vito, A., & Gómez, J. P. (2020): Estimating the COVID-19 cash crunch: Global evidence and policy. *Journal of Accounting and Public policy*, 39(2), 106741. <https://doi.org/10.1016/j.jaccpubpol.2020.106741>
- Deghi, A., Seneviratne, D., & Tsuruga, T. (2021): Corporate funding and the COVID-19 crisis. International Monetary Fund. <https://doi.org/10.5089/9781513574158.001>
- Del Mar Alonso-Almeida, M.–Giglio, C. & Iazzolino, G. (2024): A cross-country analysis of decision-making factors influencing tourists' shift towards circular destinations in EU-27 *Socio-Economic Planning Sciences*, 101955. <https://doi.org/10.1016/j.seps.2024.101D55>
- Demmou, L., Franco, G., Calligaris, S., & Dlugosch, D. (2021): Liquidity shortfalls during the COVID-19 outbreak: Assessment and policy responses. <https://doi.org/10.24187/ecostat.2022.532.2070>
- Deters, H., & Zardo, F. (2023): The European Commission in COVID-19 vaccine cooperation: leadership vs coronationalism?. *Journal of European Public Policy*, 30(6), 1051-1071. <https://doi.org/10.1080/13501763.2022.2064900>
- Didier, T., Huneus, F., Larrain, M., & Schmukler, S. L. (2021): Financing firms in hibernation during the COVID-19 pandemic. *Journal of Financial Stability*, 53, 100837. <https://doi.org/10.1016/j.jfs.2020.100837>
- Donthu, N., & Gustafsson, A. (2020): Effects of COVID-19 on business and research. *Journal of business research*, 117, 284-289. <https://doi.org/10.1016/j.jbusres.2020.06.008>
- Dornean, A., & Oanea, D. C. (2022): The Effectiveness of Fiscal-Budgetary Measures to Counteract the COVID-19 Crisis. Evidence from EU Countries. *Economics*, 16(1), 137-151. <https://doi.org/10.1515/econ-2022-0024>
- Drabancz Á., & Marosi A. (2021): Kiszáradás ellen - Reakció a koronavírusra a banki hitelezésben. Published on the official website of MNB: Kiadványok/Szakmai Cikkék/Hitelezés Available: <https://www.mnb.hu/letoltes/drabancz-aron-marosi-anna-kiszaradas-ellen-reakcio-a-koronavirusra-a-banki-hitelezesben.pdf> Published on 08 October 2021
- Drammeh, F. Y. (2024): Managing tourism during the COVID-19 pandemic. A systematic review of crisis management in the tourism industry *Cogent Social Sciences* 10 (1): 2311955. <https://doi.org/10.1080/23311886.2024.2311D55>
- Dumičić, K.–Mikulić, J. & Časni, A. Č. (2017): Tourism spending behaviour before and after the 2008 financial crisis: A dynamic panel investigation *Tourism Economics* 23 (1): 223–228. <https://doi.org/10.5367/te.2015.0528>
- Dupuy, A. R. (1972): L'urgence de la protection de la nature en Algérie *Biological Conservation* 4 (2): 102–106. [https://doi.org/10.1016/0006-3207\(72\)D0007-D](https://doi.org/10.1016/0006-3207(72)D0007-D)
- Duro, J. A.–Osório, A. & Perez-Laborda, A. (2023): Competition for domestic tourism in the COVID-19 pandemic: A characterization using a contest model *Tourism Economics* 29 (2): 378–391. <https://doi.org/10.1177/1354816621104D870>
- Durugbo, C. M., & Al-Balushi, Z. (2024): Supply chain management in times of crisis: a multi-case study. *Production Planning & Control*, 1-29. <https://doi.org/10.1080/09537287.2024.2386431>

Dwyer, L.–Forsyth, P. & Spurr, R. (2006): Effects of the SARS crisis on the economic contribution of tourism to Australia *Tourism Review International* 10 (1-2): 47–55. <http://dx.doi.org/10.3727/15442720677D307231>

Dzurova, D., & Květoň, V. (2021): How health capabilities and government restrictions affect the COVID-19 pandemic: Cross-country differences in Europe. *Applied Geography*, 135, 102551. <https://doi.org/10.1016/j.apgeog.2021.102551>

Elkhwesky, Z. - El Manzani, Y. & Elbayoumi Salem, I. (2024): Driving hospitality and tourism to foster sustainable innovation: A systematic review of COVID-19-related studies and practical implications in the digital era. *Tourism and Hospitality Research*, 24(1): 115-133. <https://doi.org/10.1177/14673584221126792>

El-Meouch, N. M., Máté, É., Trócsányi, A., Pirisi, G., & Alpek, B. L. (2024): A koronavírus-válság strukturális és területi hatásai a magyarországi vállalati szektor sérülékenységére. *Modern Geográfia*, 19(1). <https://doi.org/10.15170/MG.2024.19.01.09>

Erdiaw-Kwasie, M. O. - Abunyewah, M. - Yusif, S. & Arhin, P. (2023): Small and medium enterprises (SMEs) in a pandemic: A systematic review of pandemic risk impacts, coping strategies and resilience. *Heliyon*. <https://doi.org/10.1016/j.heliyon.2023.e20352>

European Systemic Risk Board (2022): “Policy measures in response to the COVID-19 pandemic”, Policy Measures by Country available at: <https://www.esrb.europa.eu/home/search/coronavirus/html/index.en.html>

European Banking Authority (2020a): “Final Report - Guidelines on loan origination and monitoring”, available at: https://www.eba.europa.eu/sites/default/files/document_library/Publications/Guidelines/2020/Guidelines%20on%20loan%20origination%20and%20monitoring/884283/EBA%20GL%202020%2006%20Final%20Report%20on%20GL%20on%20loan%20origination%20and%20monitoring.pdf

European Banking Authority (2020b): “First evidence on the use of moratoria and public guarantees in the EU banking sector”, available at: https://www.eba.europa.eu/sites/default/files/document_library/Risk%20Analysis%20and%20Data/Risk%20Assessment%20Reports/2020/Thematic%20notes/Thematic%20note%20on%20moratoria%20and%20public%20guarantees/936761/For%20publication%20-%20Thematic%20note%20on%20moratoria%20and%20public%20guarantees.pdf

European Central Bank – Banking Supervision (2020): Are the pandemic relief measures creating zombie firms? Published on 14 December 2020 on the official website of ECB Available: https://www.bankingsupervision.europa.eu/about/banking-supervision-explained/html/zombie_firms.en.html

European Central Bank (2017): “Guidance on leveraged transactions”, available at: https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.leveraged_transactions_guidance_201705.en.pdf

European Commission (2014): “Regulation No 651/2014 (Article 2(18))”, available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0651&from=EN>

European Commission. (2014): *Commission Regulation (EU) No 1388/2014 of 16 December 2014 on the application of Articles 107 and 108 of the Treaty on the Functioning of the European Union to de minimis aid in the fishery and aquaculture sector*. Official Journal of the European Union, L 369/37. <https://eur-lex.europa.eu/>

European Commission (2021): Executive Agency for Small and Medium-sized Enterprises, Muller, P., Devnani, S., Ladher, R., Cannings, J. et al., Annual report on European SMEs 2020/2021 – Digitalisation of SMEs, Hope, K.(editor), Publications Office, <https://data.europa.eu/doi/10.2826/56865>

European Commission (2022a): The State Aid Temporary Framework- Official website of European Commission, available: https://competition-policy.ec.europa.eu/state-aid/coronavirus/temporary-framework_en

European Commission (2022b): The State Aid Temporary Framework – State aid Policy briefs 2022 Issue 3 - Statistical Annex. Available: https://competition-policy.ec.europa.eu/document/download/d351ceef-9e56-433d-8962-0a8f65eb968d_en?filename=state_aid_brief_3_2022_kdam22003enn_coronavirus_statistical-annex.xlsx

Eurostat (2023): GDP and main components current prices in million € https://ec.europa.eu/eurostat/databrowser/view/nama_10_gdp/default/table?lang=en&category=na10.nama10.nama_10_ma DOI: 10.2908/NAMA_10_GDP

Eurostat (2024a): Real GDP growth rate – volume, available at: <https://ec.europa.eu/eurostat/databrowser/view/tec00115/default/table?lang=en>

Eurostat (2024b): Production in industry - annual data, available at: https://ec.europa.eu/eurostat/databrowser/view/sts_inpr_a_custom_14349475/default/table?lang=en

Falagiarda, M., Prapiestis, A., & Rancoita, E. (2020): Public loan guarantees and bank lending in the COVID-19 period. *ECB Economic Bulletin*, Issue 6/2020. ISSN 2363-3417, QB-BP-20-006-EN-N

Fáró, J., & Hajdu, O. (2018): A magyar mezőgazdasági vállalatok jövedelmezőségének vizsgálata. *Statisztikai Szemle*, 96(8-9), 818-840. <https://doi.org/10.20311/stat2018.08-09.hu0818>

Faulkner, G., Fagan, M. J., & Lee, J. (2022): Umbrella reviews (systematic review of reviews). *International Review of Sport and Exercise Psychology*, 15(1): 73-90. <https://doi.org/10.1080/1750984X.2021.1934888>.

Favara, G., Minoiu, C., & Perez-Orive, A. (2022): Zombie Lending to US firms. Available at SSRN, 4065886. DOI: 10.2139/ssrn.4065886

Fedajev, A., Radulescu, M., Babucea, A. G., Mihajlovic, V., Yousaf, Z., & Milićević, R. (2022): Has COVID-19 pandemic crisis changed the EU convergence patterns?. *Economic Research-Ekonomska Istraživanja*, 35(1), 2112-2141. DOI:10.1080/1331677X.2021.1934507

- Fekete, K.–Dombi, G. & Oláh, M. (2021): Önkormányzati válságkezelés a Balaton Kiemelt Üdülőkörzetben, a COVID-19-járvány első hullámában. *Területi Statisztika* 61 (3): 337–355. <https://doi.org/10.151D6/TS610304>
- Fekete-Fábián, Z. & Jánosi, D. (2022): A 2008. és a 2020. évi válság hatása a hazai munkaerőpiacra és turizmusra *Területi Statisztika* 62 (2): 135–165. <https://doi.org/10.151D6/TS620201>
- Feng, L., Lang, H. & Pei, T. (2022): “Zombie firms and corporate savings: Evidence from Chinese manufacturing firms”, *International Review of Economics & Finance*, Vol. 79 No. 5, pp.551-564, doi.org/10.1016/j.iref.2022.02.008
- Forman, R., & Mossialos, E. (2021): The EU response to COVID-19: from reactive policies to strategic decision-making. *Journal of Common Market Studies*, 59(Suppl 1), 56. <https://doi.org/10.1111/jcms.13259>
- Fukuda, S. I. & Nakamura, J. I. (2011): “Why did ‘zombie’ firms recover in Japan?”, *The world economy*, Vol. 34 No. 7, pp.1124-1137, doi.org/10.1111/j.1467-9701.2011.01368.x
- Gajdzik, B.–Wolniak, R.–Nagaj, R.–Żuromskaitė-Nagaj, B. & Grebski, W. W. (2024): The influence of the global energy crisis on energy efficiency: A comprehensive analysis *Energies* 17(4): 947. <https://doi.org/10.33D0/en17040D47>
- Gonda, T. (2022): Turizmus és reziliencia *Turizmus Bulletin* 22 (2): 27–36. <https://doi.org/10.14267/TURBULL.2022v22n2.3>
- Goniewicz, K., Khorram-Manesh, A., Hertelendy, A. J., Goniewicz, M., Naylor, K., & Burkle Jr, F. M. (2020): Current response and management decisions of the European Union to the COVID-19 outbreak: a review. *Sustainability*, 12(9), 3838. <https://doi.org/10.3390/su12093838>
- Goodrich, J. N. (2002): September 11, 2001 attack on America: a record of the immediate impacts and reactions in the USA travel and tourism industry *Tourism Management* 23 (6): 573–580. [https://doi.org/10.1016/S0261-5177\(02\)0002D-8](https://doi.org/10.1016/S0261-5177(02)0002D-8)
- Gössling, S., Scott, D., & Hall, C. M. (2020): Pandemics, tourism and global change: a rapid assessment of COVID-19. *Journal of sustainable tourism*, 29(1), 1-20. <https://doi.org/10.1080/09669582.2020.1758708>
- Green, D., & Loualiche, E. (2021): State and local government employment in the COVID-19 crisis. *Journal of Public Economics*, 193, 104321. <https://doi.org/10.1016/j.jpubeco.2020.104321>
- Gros, D., Ounnas, A., & Yeung, T. Y. C. (2021): A new COVID policy stringency index for Europe. *Covid Economics*, 115. Available: https://cepr.org/system/files/publication-files/101418-covid_economics_issue_66.pdf
- Guan, D., Wang, D., Hallegatte, S., Davis, S. J., Huo, J., Li, S., Bai, Y., Lei, T., Xue Q., Coffman, D., Cheng, D., Chen, P., Liang, X., Xu, B., Lu, X., Wang, S., Hubacek, K. & Gong, P. (2020): Global supply-chain effects of COVID-19 control measures. *Nature human behaviour*, 4(6), 577-587. <https://doi.org/10.1038/s41562-020-0896-8>

- Gupta, S.–Kushwaha, P. S.–Badhera, U. & Singh, R. K. (2024): Managing tourism and hospitality industry during pandemic: analysis of challenges and strategies for survival *Benchmarking: An International Journal* <https://doi.org/10.1108/BIJ-11-2023-0806>
- Hale T., Angrist N., Goldszmidt R., Kira B., Petherick A., Phillips T, Webster S., Cameron-Blake E., Hallas L., Majumdar S. & Tatlow H. (2021): “A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker).” *Nature Human Behaviour*. <https://doi.org/10.1038/s41562-021-01079-8>
- Hall, C. M. (2010): Crisis events in tourism: Subjects of crisis in tourism *Current Issues in Tourism* 13 (5): 401–417. <https://doi.org/10.1080/13683500.2010.4D1D00>
- Halmai, P. (2022): Poszt-Covid kilábalás: középpontban a kínálati oldal. *Külgazdaság*, 66(1-2), 58-71. <https://doi.org/10.47630/KULG.2022.66.1-2.58>
- Harchandani, P. & Shome, S. (2021): Global tourism and COVID-19: An impact assessment *Tourism: An International Interdisciplinary Journal* 69 (2): 262–280. <http://dx.doi.org/10.37741/t.6D.2.7>
- Hegedűs, Sz. (2023): A nehéz helyzet kialakulásának és magyarázó változóinak vizsgálata a magyar kkv-szektorban. *Gazdaság és Pénzügy*, 10(1), 57-79. <https://doi.org/10.33926/GP.2023.1.4>
- Helmersson, T., Mingarelli, L., Mosk, B., Pietsch, A., Ravanetti, B., Shakir, T. & Wendelborn, J. (2021): Special features: Corporate zombification: post-pandemic risks in the euro area, *European Central Bank Financial Stability Review*, 1. ISSN 1830-2025, QB-XU-21-001-EN-N
- Higgins-Desbiolles, F. (2024): The end of tourism? Contemplations of collapse. *Journal of Tourism Futures*. <https://doi.org/10.1108/JTF-11-2023-0259>
- Hinek, M. (2020): A turizmus közvetlen hozzájárulása a magyar gazdaság teljesítményéhez: a Turizmus Szatellit Számlák fejlesztésének alternatívái. *Turizmus Bulletin* 20 (Különszám): 45–52. <https://doi.org/10.14267/TURBULL.2020v20n4.4>
- Hoshi, T., Kawaguchi, D., & Ueda, K. (2023): Zombies, again? The COVID-19 business support programs in Japan. *Journal of Banking & Finance*, 147, 106421. <https://doi.org/10.1016/j.jbankfin.2022.106421>
- Hossain, M. R. - Akhter, F. & Sultana, M. M. (2022): SMEs in covid-19 crisis and combating strategies: a systematic literature review (SLR) and A case from emerging economy. *Operations research perspectives*, 9, 100222. <https://doi.org/10.1016/j.orp.2022.100222>
- Hovardaoglu, O. & Calisir-Hovardaoglu, S. (2024): Survival Strategies of Local Small and Medium Tourism Enterprises (SMTEs) In Covid-19 Pandemic in Heritage Tourism Sites in Turkey. *PASOS Revista de Turismo y Patrimonio Cultural* 22 (1): 125–145. <http://dx.doi.org/10.25145/j.pasos.2024.22.008>
- Huang, Y.–Feng, M. & Li, X. (2024): Not Just Survive, But Thrive: Examining Livelihood Capital, Poverty Reduction, and Sustainable Development in Ethnic Tourism Destinations *Cornell Hospitality Quarterly* <https://doi.org/10.1177/19389655241254979>

IMF (2020): World Economic Outlook, April 2020: The Great Lockdown. International Monetary Fund. <https://www.imf.org/en/Publications/WEO/Issues/2020/04/14/weo-april-2020>

Jáki, E. ; Pollák, Z. & Kádár, B. (2023): Analyzing COVID-19 Impact in the EU: Geographical Clustering and EC State Aid in Proportion of GDP and Entrepreneurial Resilience In: Mladen, Čudanov; Huszák, Loretta; Sanja, Marinković (szerk.) 2nd International Danube Cup Conference on Entrepreneurship Education (IDC2 E2 2023) Belgrade, Szerbia : University of Belgrade, Faculty of Organizational Sciences (2023) 191 p.

Jászberényi, M.–Ásványi, K.–Kökény, L.–Kovács, B. & Simon, A. (2021): *Válságkezelés a turizmusban*. Turizmus Kft., Budapest.

Jeannotte, M. S. (2021): When the gigs are gone: Valuing arts, culture and media in the COVID-19 pandemic. *Social Sciences & Humanities Open*, 3(1), 100097. <https://doi.org/10.1016/j.ssaho.2020.100097>

Jiang, J., Hou, J., Wang, C., & Liu, H. (2021): COVID-19 impact on firm investment—Evidence from Chinese publicly listed firms. *Journal of Asian Economics*, 75, 101320. <https://doi.org/10.1016/j.asieco.2021.101320>

Juergensen, J.; Guimón, J. & Narula, R. (2020): European SMEs amidst the COVID-19 crisis: assessing impact and policy responses. *Journal of industrial and business economics*, 47(3): 499-510. <https://doi.org/10.1007/s40812-020-00169-4>

Juhász, P & Szabó, Á. (2021): A koronavírus-járvány okozta válság vállalati kockázati térképe az első hullám hazai tapasztalatai alapján." *Közgazdasági Szemle* 68. <https://doi.org/10.18414/KSZ.2021.k.126>

Kádár B., & Jáki E. (2024): Állami Szerepvállalás a vállalati hitelezés ösztönzésében a válságok idején In: *Pénzügypolitikai kihívások*. Budapesti Gazdasági Egyetem, Budapest, pp. 85-102. ISBN 978-615-6886-01-9

Kalemli-Ozcan, S., Sorensen, B., Villegas-Sanchez, C., Volosovych, V., & Yesiltas, S. (2015): How to construct nationally representative firm level data from the Orbis global database: New facts and aggregate implications (No. w21558). National Bureau of Economic Research. DOI 10.3386/w21558

Kavaliunas, A., Ocaya, P., Mumper, J., Lindfeldt, I., & Kyhlstedt, M. (2020): Swedish policy analysis for COVID-19. *Health Policy and Technology*, 9(4), 598-612. <https://doi.org/10.1016/j.hlpt.2020.08.009>

Khan, S. U. (2022): Financing constraints and firm-level responses to the COVID-19 pandemic: International evidence. *Research in international business and finance*, 59, 101545. <https://doi.org/10.1016/j.ribaf.2021.101545>

Khlystova, O. - Kalyuzhnova, Y. & Belitski, M. (2022): The impact of the COVID-19 pandemic on the creative industries: A literature review and future research agenda. *Journal of business research*, 139, 1192-1210. <https://doi.org/10.1016/j.jbusres.2021.09.062>

Kiss-Dobronyi, B., Czakó, E. H., & Losonci, D. (2024): Menedzsmentgyakorlatok és a hazai vállalatok árbevétel-változása a Covid-19 jelentette gazdasági sokk idején. *Közgazdasági Szemle*, 71(3), 229-254. <https://doi.org/10.18414/KSZ.2024.3.229>

Koh, E. (2020): The end of over-tourism? Opportunities in a post-Covid-19 world *International Journal of Tourism Cities* 6 (4): 1015–1023. <https://doi.org/10.1108/IJTC-04-2020-0080>

Kormany.hu (2020): Több száz milliárd forint támogatást nyújtott a kormány a turizmus támogatására. 2020.09.10. Elérhető: <https://kormany.hu/hirek/tobb-szaz-milliard-forint-tamogatast-nyujtott-a-kormany-a-turizmus-tamogatasara> Downloaded: 2024.08.04.

Központi Statisztikai Hivatal (2021): Magyarország, 2020 – Internetes Melléklet. ISSN: 1416-2768 Forrás: https://www.ksh.hu/docs/hun/xftp/idoszaki/mo/mo_2020.pdf Letöltve: 2024.08.18

Központi Statisztikai Hivatal (2024): A vállalkozások teljesítménymutatói kis- és középvállalkozási kategória szerint. https://www.ksh.hu/stadat_files/gsz/hu/gsz0018.html

Központi Statisztikai Hivatal (2024): Kis- és középvállalkozások statisztikája TEÁOR 3 számjegyen és KKV kategóriás bontásban a KKV körbe nem tartozó vállalkozásokkal együtt 2018-2020. Forrás: <https://statinfo.ksh.hu/Statinfo/haDetails.jsp> Letöltve: 2024.08.04

Kovács, E. (2014): Többváltozós adatelemzés. Typotex Kiadó ISBN 978 963 279 243 9

Krieger, K., Mauck, N., & Pruitt, S. W. (2021): The impact of the COVID-19 pandemic on dividends. *Finance Research Letters*, 42, 101910. <https://doi.org/10.1016/j.frl.2020.101910>

Krishnan, C. S. N., Ganesh, L. S., & Rajendran, C. (2022): Entrepreneurial Interventions for crisis management: Lessons from the Covid-19 Pandemic's impact on entrepreneurial ventures. *International Journal of Disaster Risk Reduction*, 72, 102830. <https://doi.org/10.1016/j.ijdr.2022.102830>

Kuckertz, A. & Brändle, L. (2022): Creative reconstruction: A structured literature review of the early empirical research on the COVID-19 crisis and entrepreneurship. *Management Review Quarterly*, 72(2): 281-307. <https://doi.org/10.1007/s11301-021-00221-0>

Kuckertz, A., Brändle, L., Gaudig, A., Hinderer, S., Reyes, C. A. M., Prochotta, A., & Berger, E. S. (2020): Startups in times of crisis—A rapid response to the COVID-19 pandemic. *Journal of Business Venturing Insights*, 13, e00169. <https://doi.org/10.1016/j.jbvi.2020.e00169>

Laeven, L., Schepens, G. & Schnabel, I. (2020): “Zombification in Europe in times of pandemic”, ECONtribute Policy Brief. No. 011 Available: https://www.econtribute.de/RePEc/ajk/ajkpbs/ECONtribute_PB_011_2020.pdf Downloaded: 2023.03.07

Lalinsky, T., & Pál, R. (2022): Distribution of COVID-19 government support and its consequences for firm liquidity and solvency. *Structural Change and Economic Dynamics*, 61, 305-335. <https://doi.org/10.1016/j.strueco.2022.03.008>

Lassoued, N., & Khanchel, I. (2021): Impact of COVID-19 pandemic on earnings management: An evidence from financial reporting in European firms. *Global Business Review*,. <https://doi.org/10.1177/09721509211053491>

Lawrence, M.—Homer-Dixon, T.—Janzwood, S.—Rockstöm, J.—Renn, O. & Donges, J. F. (2024): Global polycrisis: the causal mechanisms of crisis entanglement *Global Sustainability* 7 (e6): 1–16. <https://doi.org/10.1017/sus.2024.1>

- Lentner, Cs. (2021). A Covid 19-járvány hatásai a magyar gazdaságra és a fiskális válságkezelés főbb területei. *Új Magyar Közigazgatás* 14(3), 1-8. <https://doi.org/10.32575/ppb.2020.1.1>
- Li, L., Strahan, P. E., & Zhang, S. (2020): Banks as lenders of first resort: Evidence from the COVID-19 crisis. *The Review of Corporate Finance Studies*, 9(3), 472-500. <https://doi.org/10.1093/rcfs/cfaa009>
- Lim, W. M. (2022): Ushering a new era of Global Business and Organizational Excellence: Taking a leaf out of recent trends in the new normal. *Global Business and Organizational Excellence*, 41(5): 5-13. <https://doi.org/10.1002/joe.22163>
- López-Gigosos, R., Vegas-Romero, M., Mariscal, A., Mariscal-López, E., Fang, J., & Gutiérrez-Bedmar, M. (2023): Excess mortality in 22 European countries in 2020 and 2021: relationship with socioeconomic indicators. *Perspectives in Public Health*, 17579139231180800.
- Losoncz M. (2019): Az uniós keretfeltételek és a kis- és középvállalkozások nemzetköziesedésének néhány kérdése. *Prosperitas*, VI.(2), 4–29, https://doi.org/10.31570/Prosp_2019_02_1
- Lu, L. - Peng, J. - Wu, J. & Lu, Y. (2021): Perceived impact of the Covid-19 crisis on SMEs in different industry sectors: Evidence from Sichuan, China. *International Journal of Disaster Risk Reduction*, 55, 102085. <https://doi.org/10.1016/j.ijdr.2021.102085>
- Lupu, D. (2014): Analysis of conceptual approaches for the firm in difficulty. *Journal of Public Administration, Finance and Law*, 5(3), 110–117
- Madhavan, M. - Wangtueai, S. - Sharafuddin, M. A. & Chaichana, T. (2022): The precipitative effects of pandemic on open innovation of SMEs: a scientometrics and systematic review of Industry 4.0 and Industry 5.0. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(3): 152. <https://doi.org/10.3390/joitmc8030152>
- Magyarország Kormánya. (2011). 37/2011. (III. 22.) Kormányrendelet a kis- és középvállalkozások besorolásának, támogatásának és nyilvántartásának szabályairól. Magyar Közlöny. <https://njt.hu/>
- Mao, C. K.–Ding, C. G. & Lee, H. Y. (2010): Post-SARS tourist arrival recovery patterns: An analysis based on a catastrophe theory *Tourism Management* 31 (6): 855–861. <https://doi.org/10.1016/j.tourman.200D.0D.003>
- Mathieu E., Ritchie H., Rodés-Guirao L., Appel C., Giattino C., Hasell J., Macdonald B., Dattani S., Beltekian D., Ortiz-Ospina E. & Roser M. (2020) - "Coronavirus Pandemic (COVID-19)". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/coronavirus' [Online Resource]
- Matlovič, R., & Matlovičová, K. (2024): Polycrisis in the Anthropocene as a Key Research Agenda for Geography: Ontological Delineation and the Shift to a Postdisciplinary Approach *Folia Geographica* 66 (1): 5–33.

- McGowan A., Andrews, D., & Millot, V. (2018): The walking dead? Zombie firms and productivity performance in OECD countries. *Economic Policy*, 33(96), 685-736. <https://doi.org/10.1093/epolic/eiy012>
- Michalkó, G.–Németh, J.–Tokodi, P.–Kamal Abboud, T. & Birkner, Z. (2022a): The potential of the Visegrad Cooperation (V4) for the safe restarting of tourism in the region following the COVID-19 epidemic *Scientia et Securitas* 2 (4): 452–458. <https://doi.org/10.1556/112.2021.00062>
- Michalkó, G.–Németh, J. & Birkner, Z. (2022b): Lezárástól az újraindulásig: a COVID19 járvány hatása a magyar lakosság utazásaira és a turizmusbiztonsággal kapcsolatos percepcióira. In: Michalkó, G.–Németh, J.–Birkner, Z. (szerk.): *Turizmusbiztonság, járvány, geopolitika* pp. 115–127., Bay Zoltán Alkalmazott Kutatási Közhasznú Nonprofit Kft., Budapest.
- Michalkó, G.–Rátz, T. & Szalai, K. (2023): A válságproblematika felértékelődése a totális turizmus korában. In: Szalai, K.–Michalkó, G.–Rátz, T. (szerk.): *A turizmus válságjelenségei* pp. 9–16., Kodolányi János Egyetem, CSFK Földrajztudományi Intézet, Magyar Földrajzi Társaság, Budapest <http://dx.doi.org/10.15201/TA12-1>
- Michalkó, G. (2023): *A turizmus esszenciája*. Akadémiai Kiadó, Budapest.
- Miklian, J. & Hoelscher, K. (2021): SMEs and exogenous shocks: A conceptual literature review and forward research agenda. *International Small Business Journal*, 40(2): 178-204. <https://doi.org/10.1177/02662426211050796>
- Min, J. C.–Lim, C. & Kung, H. H. (2011): Intervention analysis of SARS on Japanese tourism demand for Taiwan *Quality & Quantity* 45: 91–102. <http://dx.doi.org/10.1007/s11135-010-D338-4>
- Mingarelli, L. - Ravanetti, B. - Shakir, T. & Wendelborn, J., (2022): Dawn of the (Half) Dead: The Twisted World of Zombie Identification (October 1, 2022). *ECB Working Paper* No. 2022/2743. DOI: 10.2139/ssrn.4263233
- Minsky, H. P. (1982): Can “It” Happen Again? Essays on Instability and Finance. Armonk, NY: M. E. Sharpe Inc. <https://doi.org/10.1080/05775132.1982.11470774>
- Minsky, H.P. (2008): John Maynard Keynes, New York: McGraw-Hill. 1st edition ISBN: 978-0071593014
- Mishkin, F. S. (1992): Anatomy of a financial crisis. *Journal of evolutionary Economics*, 2, 115-130. <https://doi.org/10.1007/BF01193536>
- Mishra, R. & Singh, R. K. (2023): A systematic literature review on supply chain resilience in SMEs: learnings from COVID-19 pandemic. *International Journal of Quality & Reliability Management*, 40(5): 1172-1202. <https://doi.org/10.1108/IJQRM-03-2022-0108>
- Misini, S. & Tosuni, G. (2023): An analysis of the impact of external shocks on the economic performance index of the European Union countries: The case of the Russian invasion of Ukraine. *Journal of Governance & Regulation* 12 (4): 313–325. <https://doi.org/10.224D5/jgrv12i4siart11>

MNB (2019): Inflációs jelentés 2019 május, ISSN 2064-8766. Forrás: <https://www.mnb.hu/letoltes/hun-ir-16.pdf>

MNB (2020): Az MNB koronavírus-járvány gazdasági hatásait vizsgáló vállalati felmérésének eredményei. Magyar Nemzeti Bank. <https://www.mnb.hu/koronavirus/hirek/az-mnb-koronavirus-jarvanygazdasagi-hatasait-vizsgalo-vallalati-felmeresenek-eredmenyei> (accessed 01.11.2024).

MNB (2020a): Az MNB koronavírus-járvány gazdasági hatásait vizsgáló vállalati felmérésének eredményei, 2020. április 24. Forrás: <https://www.mnb.hu/koronavirus/hirek/az-mnb-koronavirus-jarvany-gazdasagi-hatasait-vizsgalo-vallalati-felmeresenek-eredmenyei>

MNB (2020b): Pénzügyi Stabilitási jelentés 2020. május, ISSN: 2064-941X. Forrás: <https://www.mnb.hu/letoltes/penzugyi-stabilitasi-jelentes-2020-may.pdf>

MNB (2021a): Pénzügyi Stabilitási jelentés 2021. június, ISSN: 2064-941X. Forrás: <https://www.mnb.hu/letoltes/penzugyi-stabilitasi-jelentes-2021-junius.pdf>

MNB (2021b): Hitelezési folyamatok 2021. szeptember. Forrás: <https://www.mnb.hu/letoltes/hitelezesi-folyamatok-2021-szeptember-hu.pdf> Letöltve: 2024.08.19

MNB (2021c): Kereskedelmiingatlan-piaci jelentés, 2021. április. Forrás: <https://www.mnb.hu/kiadvanyok/jelentesek/kereskedelmiingatlan-piaci-jelentes/kereskedelmiingatlan-piaci-jelentes-2021-aprilis> ; Letöltve: 2024.09.22.

MNB (2021d): Pénzügyi Stabilitási jelentés 2021. december, ISSN: 2064-941X. Available: <https://www.mnb.hu/letoltes/penzugyi-stabilitasi-jelentes-2021-december.pdf>

Moodys (2024): Moodys Official website. Available: <https://www.moodys.com/web/en/us/capabilities/company-reference-data/orbis.html> Downloaded: 2024.08.04

Muñoz-Izquierdo, N., Mazarío, J. M. J., & Camacho-Miñano, M. D. M. (2024): Zombie firms and disclosures in the expanded audit report. *Review of Managerial Science*, 18(6), 1519-1555. <https://doi.org/10.1007/s11846-023-00666-5>

Nagy, Z. (2021): 'Fiskális és monetáris eszközök a járványügyi veszélyhelyzet gazdasági hatásainak mérséklésére' in Nagy, Z., Horváth, A. (szerk.) *A különleges jogrend és nemzeti szabályozási modelljei*, 174–191. Budapest: Mádl Ferenc Összehasonlító Jogi Intézet.

Nguyen, H., Pham, A. V., Pham, M. D. M., & Pham, M. H. (2023): Business resilience: lessons from government responses to the global COVID-19 crisis. *International Business Review*, 32(5), 102166. <https://doi.org/10.1016/j.ibusrev.2023.102166>

Nurmi, S., Vanhala, J. & Virén, M. (2020), "The life and death of zombies—evidence from government subsidies to firms", Bank of Finland Research Discussion Paper (8), doi.org/10.2139/ssrn.3601386

Omar, M. A. & Sulaiman, R. B. (2023): Social Commerce Among Micro and Small Medium Enterprises Before and During the COVID19: A Systematic Literature Review. *Information Sciences Letters* No. 8, 2769-2781 <http://dx.doi.org/10.18576/isl/120827>

Our World in Data, (2024): Official website. Available at: <https://ourworldindata.org/about> (Accessed: 2 December 2024).

Paccès, A. M., & Weimer, M. (2020): From diversity to coordination: A European approach to COVID-19. *European journal of risk regulation*, 11(2), 283-296. <https://doi.org/10.1017/err.2020.36>

Pajrok, A. (2022): A COVID-19 és ellensúlyozása érdekében hozott központi ágazati intézkedések hatásai a szállodaiparra – a magyar szállodaipari szereplők körében végzett empirikus vizsgálat eredménye *Controller Info* 10 (2): 13–19. <https://doi.org/10.24387/CI.2022.2.3>

Pearson, C. M., & Clair, J. A. (1998): Reframing crisis management. *Academy of management review*, 23(1), 59-76. <https://doi.org/10.2307/259099>

Paule-Vianez, J.–Orden-Cruz, C. & Vélez-Serrano, D. (2024): Influence of Economic Policy Uncertainty on Tourism SME Performance: The Spanish Case. *Tourism Planning & Development* 21 (2): 223–244. <https://doi.org/10.1080/21568316.2023.2242311>

Peek, J., & Rosengren, E. S. (2005): Unnatural selection: Perverse incentives and the misallocation of credit in Japan. *American Economic Review*, 95(4), 1144-1166. <https://doi.org/10.1257/0002828054825691>

Pellegrino, A. & Abe, M. (2022): Digital financing for SMEs' recovery in the post-COVID era: A bibliometric review. *Frontiers in Sustainable Cities*, 4, 978818. <https://doi.org/10.3389/frsc.2022.978818>

Pelosi, M., Rodano, G. & Sette, E. (2021): “Zombie firms and the take-up of support measures during Covid-19”, Bank of Italy Occasional Paper (650), doi.org/10.2139/ssrn.4032687

Pogácsás, P., & Szepesi, B. (2023). A koronavírus hatása a magyar kis-és középvállalkozásokra. *Vezetéstudomány*, 54(2), 25-39. <https://doi.org/10.14267/VEZTUD.2023.02.03>

Posgay, I., Regős, G., Horváth, D., & Molnár, D. (2020). A koronavírus-járvány gazdasági hatásairól= On the Economic Impacts of the Coronavirus. *Polgári Szemle: Gazdasági És Társadalmi Folyóirat*, 16(4-6), 31-50. <https://doi.org/10.24307/psz.2020.1004>

Prime Minister's Office (2020): Interview with Viktor Orbán in the programme “Good Morning, Hungary!” on Kossuth Radio, 13 March 2020. Prime Minister's Office. Available at: <https://2015-2022.miniszterelnok.hu/orban-viktor-a-kossuth-radio-jo-reggelt-magyarorszag-cimu-musoraban-11/> (Accessed: 01 February 2025)

Rather, R. A. (2021): Monitoring the impacts of tourism-based social media, risk perception and fear on tourist's attitude and revisiting behaviour in the wake of COVID-19 pandemic *Current Issues in Tourism* 24 (23): 3275–3283. <https://doi.org/10.1080/13683500.2021.1884666>

Ravindran, S., & Shah, M. (2020): Unintended consequences of lockdowns: COVID-19 and the shadow pandemic (No. w27562). National Bureau of Economic Research. <https://doi.org/10.3386/w27562>

- Remuzzi, A., & Remuzzi, G. (2020): COVID-19 and Italy: what next?, *The lancet*, 395(10231), 1225-1228 [https://doi.org/10.1016/S0140-6736\(20\)30627-9](https://doi.org/10.1016/S0140-6736(20)30627-9)
- Riggio, R. E., & Newstead, T. (2023): Crisis leadership. *Annual Review of Organizational Psychology and Organizational Behavior*, 10(1), 201-224. <https://doi.org/10.1146/annurev-orgpsych-120920-044838>
- Rokicki, T., Bórawski, P., & Szeberényi, A. (2023): The impact of the 2020–2022 crises on EU countries' independence from energy imports, particularly from Russia. *Energies*, 16(18), 6629. <https://doi.org/10.3390/en16186629>
- Roman, M., Roman, M., Grzegorzewska, E., Pietrzak, P., & Roman, K. (2022): Influence of the COVID-19 pandemic on tourism in European Countries: Cluster analysis findings. *Sustainability*, 14(3), 1602. <https://doi.org/10.3390/su14031602>
- Rukumnuaykit, P.–Pholphirul, P. & Kwanyou, A. (2022): Business survival in times of COVID-19: Empirical evidence from tourism enterprises in Thailand *Global Business Review* <https://doi.org/10.1177/09721509221116002>
- Saus-Sala, E.–Farreras-Noguer, M. À.–Arimany-Serrat, N. & Coenders, G. (2024): Financial analysis of rural tourism in Catalonia and Galicia pre-and post COVID-19. *International Journal of Tourism Research* 26 (4): 1–14. <https://doi.org/10.1002/jtr.26D8>
- Schivardi, F., Sette, E. & Tabellini, G. (2017). “Credit misallocation during the European financial crisis”, School of European Political Economy Working Paper 3/2017 DOI:10.1093/ej/ueab039
- Schivardi, F., Sette, E., & Tabellini, G. (2020): Identifying the real effects of zombie lending. *The Review of Corporate Finance Studies*, 9(3), 569-592. <https://doi.org/10.1093/rcfs/cfaa010>
- Schivardi, F., Sette, E. & Tabellini, G. (2022). “Credit misallocation during the European financial crisis”, *The Economic Journal*, Vol. 132 No. 641, pp.391-423, doi.org/10.1093/ej/ueab039
- Schmidt-Koettters, T. & Rademacher, M. (2011). Appropriate Measures on Aid Schemes Including Firms in Difficulty: Annotation to Joint Cases T-102/07 and T-120/07. *European State Aid Law Quarterly*, 10(1), 155–160. <https://doi.org/10.21552/ESTAL/2011/1/211>
- Sebastian, R.–Kottekkadan, N. N.–Harish, P.–Thomas, T. K. & Lye, V. W. E. (2023): The "new great depression" an Omen for tourism? *International Journal of Tourism Policy* 13 (4): 381–387. <https://doi.org/10.1504/IJTP.2023.132228>
- Senin, S.M. - Juhdi, N.H. - Omar, A.R.C. & Hashim, N.A. (2024): A Systematic Review of Adaptation of IR 4.0 during COVID-19 Pandemic among Global SMEs. *Journal of Logistics, Informatics and Service Science*, 11(2): 61-83. <https://doi.org/10.33168/JLISS.2024.0205>
- Sequeira, N.–Mota, M.–Costa, R. & Luty, P. (2023): The influence of the COVID-19 crisis on financial statements manipulations in the Portuguese wine and tourism sector. In: Abreu, A. et al. (eds) *Advances in Tourism, Technology and Systems – Selected Papers from ICOTTS 2023*, Volume 1. pp. 483-493., Springer Nature Singapore, Singapore.

- Seyfi, S.–Hall, C. M. & Shabani, B. (2023): COVID-19 and international travel restrictions: the geopolitics of health and tourism. *Tourism Geographies* 25 (1): 357–373. <https://doi.org/10.1080/14616688.2020.1833D72>
- Shahzad, U.–Orsi, B. & Sharma, G. D. (2024): Managing inflation expectations and the efficiency of monetary policy responses to energy crises *Energy Economics* 133, 107474. <https://doi.org/10.1016/j.eneco.2024.107474>
- Sharma, G. D. - Kraus, S. - Srivastava, M. - Chopra, R. & Kallmuenzer, A. (2022): The changing role of innovation for crisis management in times of COVID-19: An integrative literature review. *Journal of Innovation & Knowledge*, 7(4): 100281. <https://doi.org/10.1016/j.jik.2022.100281>
- Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2020): The impact of the COVID-19 pandemic on firm performance. *Emerging Markets Finance and Trade*, 56(10), 2213-2230. <https://doi.org/10.1080/1540496X.2020.1785863>
- Sheth, J. (2020): Impact of Covid-19 on consumer behavior: Will the old habits return or die?. *Journal of business research*, 117, 280-283. <https://doi.org/10.1016/j.jbusres.2020.05.059>
- Simakhova, A., Dluhopolskyi, O., Kozlovskyi, S., Butenko, V., & Saienko, V. (2022): Healthcare sector in European countries: Assessment of economic capacity under the COVID-19 pandemic. *Problems and Perspectives in Management*, 20(2), 22. [https://doi.org/10.21511/ppm.20\(2\).2022.03](https://doi.org/10.21511/ppm.20(2).2022.03)
- Simon, J., Berezvai, Z., Kemény, I., Kun, Zs. & Pusztai, T. (2024): Kvantitatív elemzési módszerek – SPSS használata a kutatási gyakorlatban. Corvinus University of Budapest, Budapest. <https://doi.org/10.14267/978-963-503-954-8>
- Siuta-Tokarska, B. (2021): Smes during the covid-19 pandemic crisis. The sources of problems, the effects of changes, applied tools and management strategies—the example of poland. *Sustainability*, 13(18): 10185. <https://doi.org/10.3390/su131810185>
- Smeral, E. (2009): The impact of the financial and economic crisis on European tourism *Journal of Travel Research* 48 (1): 3–13. <http://dx.doi.org/10.1177/004728750D336332>
- Sobczak, M., & Pawliczak, R. (2022): COVID-19 mortality rate determinants in selected Eastern European countries. *BMC Public Health*, 22(1), 2088. <https://doi.org/10.1186/s12889-022-14567-x>
- Song, H.–Lin, S.–Zhang, X. & Gao, Z. (2010): Global financial/economic crisis and tourist arrival forecasts for Hong Kong *Asia Pacific Journal of Tourism Research* 15 (2): 223–242. <http://dx.doi.org/10.1080/10D41661003687431>
- Soós, G. & Várhelyi, T. (2021): A SARS-CoV2 pandémia hatása a magyarországi szálláshelyekre *Marketing & Menedzsment* 55 (3): 19–31. <https://doi.org/10.15170/MM.2021.55.03.02>
- Sönmez, S. F. & Graefe, A. R. (1998): Influence of terrorism risk on foreign tourism decisions *Annals of Tourism Research* 25 (1): 112–144. [https://doi.org/10.1016/S0160-7383\(D7\)00072-8](https://doi.org/10.1016/S0160-7383(D7)00072-8)

- Spieske, A. & Birkel, H. (2021): Improving supply chain resilience through industry 4.0: A systematic literature review under the impressions of the COVID-19 pandemic. *Computers & Industrial Engineering*, 158, 107452. <https://doi.org/10.1016/j.cie.2021.107452>
- Storz, M., Koetter, M., Setzer, R. & Westphal, A. (2017): “Do we want these two to tango? On zombie firms and stressed banks in Europe”, *European Central Bank Working Paper Series* No 2104, doi.org/10.2139/ssrn.3052072
- Su, R. - Obrenovic, B. - Du, J., Godinic, D. & Khudaykulov, A. (2022): COVID-19 pandemic implications for corporate sustainability and society: A literature review. *International Journal of Environmental Research and Public Health*, 19(3): 1592. <https://doi.org/10.3390/ijerph19031592>
- Sufi, A., & Taylor, A. M. (2022): Financial crises: A survey. *Handbook of international economics*, 6, 291-340. <https://doi.org/10.1016/bs.hesint.2022.02.012>
- Succurro, M. & Boffa, F. (2018): Patenting patterns in the tourism industry: Evidence from Italy. *International Journal of Tourism Research* 20 (4): 538–541. <https://doi.org/10.1002/jtr.2203>
- Szeiner, Z., Poór, J., Juhász, T., & Balázs, K. (2023): Kilábalás a COVID-válságból–Empirikus bizonyítékok és tapasztalatok Magyarországról és Szlovákiából. *Vezetéstudomány*, 54(10), 40-53. <https://doi.org/10.14267/VEZTUD.2023.10.04>
- Szücs G. (2018): A magyarországi kis-és középvállalkozások tőkeszerkezetének a vizsgálata és összehasonlítása a nemzetközi trendekkel. Doktori értekezés, Gödöllő. https://real-phd.mtak.hu/1565/1/szucs_gabor_ertekezes_DOI.pdf
- Szüle, B. (2016): Introduction to data analysis. Budapest: Corvinus University of Budapest, Faculty of Economics. ISBN: 978-963-503-619-6
- Tang, C. H. - Chin, C. Y. & Lee, Y. H. (2021): Coronavirus disease outbreak and supply chain disruption: Evidence from Taiwanese firms in China. *Research in International Business and Finance*, 56, 101355. <https://doi.org/10.1016/j.ribaf.2020.101355>
- Tawiah, B. & O'Connor Keefe, M. (2024): Cash holdings and corporate investment: evidence from COVID-19. *Review of Corporate Finance*, 4(3-4): 10-1561. <https://doi.org/10.1561/114.000000055>
- The Economist & Solstad, S. (2021): The pandemic's true death toll. [online] The Economist. Available at: <https://www.economist.com/graphic-detail/coronavirus-excess-deaths-estimates> First published in the article "Counting the dead", The Economist, issue 20, 2021.
- Thorndike, R. L. (1953): Who belongs in the family? *Psychometrika*, 18(4), 267–276. doi:10.1007/bf02289263
- Tobón Perilla, L. N.–Urquía Grande, E. & Cano Montero, E. I. (2022): Economic and organizational impact of COVID-19 on Colombia’s tourism sector. *Sustainability* 14 (20): 13350. <https://doi.org/10.33D0/su142013350>
- Tokarz, B. - Kohlbeck, E. - Fagundes, A. B. - Pereira, D. & Beuren, F. H. (2021): Systematic literature review: opportunities and trends to the post-outbreak period of COVID-19. *Brazilian*

Journal of Operations & Production Management, 18(2): 1-16.
<https://doi.org/10.14488/BJOPM.2021.030>

Toshkov, D., Carroll, B., & Yesilkagit, K. (2022). Government capacity, societal trust or party preferences: what accounts for the variety of national policy responses to the COVID-19 pandemic in Europe?. *Journal of European Public Policy*, 29(7), 1009-1028.
<https://doi.org/10.1080/13501763.2021.1928270>

Tóth, T. & Tóth, G. (2020): A hazai turizmus néhány feltáratlan területe. *Turizmus Bulletin* 20 (Különszám): 53–63. <https://doi.org/10.14267/TURBULL.2020v20n4.5>

Tseng, C.-Y., & Wu, F.-S. (2007): Configuration of innovation and performance in the service industry: Evidence from the Taiwanese hotel industry. *The Service Industries Journal*, 27(7), 895-909. <https://doi.org/10.1080/02642060701882080>

Uğur, N. G. & Akbıyık, A. (2020): Impacts of COVID-19 on global tourism industry: A cross-regional comparison. *Tourism management perspectives*, 36, 100744.
<https://doi.org/10.1016/j.tmp.2020.100744>

United Nations Development Programme (2020): Human Development Report 2020. ISBN: 978-92-1-126442-5. Available:
<https://hdr.undp.org/system/files/documents/hdr2020.pdf>

United Nations World Tourism Organization [UNWTO] (2023): *International Tourism Highlights, 2023 Edition – The impact of COVID-19 on tourism (2020–2022)*, UNWTO, Madrid. <https://doi.org/10.18111/9789284424986>.

United Nations World Tourism Organization [UNWTO] (2024): *World Tourism Barometer (May 2024, 22/2)*. UN Tourism, Madrid. <https://doi.org/10.18111/wtobarometereng>

Valentiny, P.(2021): A versenyszabályozás a járvány alatt zavartalanul működik? Published in: Valentiny, P., Antal-Pomázi, K., Berezvai, Z., & Nagy, C. I. (2021). Verseny és szabályozás: 2021 Évkönyv. Publisher: KRTK Közgazdaság-tudományi Intézet Available:
https://kti.krtk.hu/wp-content/uploads/2022/01/vesz2021_teljes-1.pdf

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021): Digital transformation: A multidisciplinary reflection and research agenda. *Journal of business research*, 122, 889-901.
<https://doi.org/10.1016/j.jbusres.2019.09.022>

Walby, S. (2022): Crisis and society: developing the theory of crisis in the context of COVID-19. *Global Discourse*, 12(3-4), 498-516. <https://doi.org/10.1332/204378921X16348228772103>

Wall-Andrews, C., Walker, E., & Cukier, W. (2021). Support mechanisms for Canada’s cultural and creative sectors during COVID-19. *Journal of Risk and Financial Management*, 14(12), 595. <https://doi.org/10.3390/jrfm14120595>

Wijaya, A.–Pramono, S. E.–Melati, I. S.–Zamzuri, N. H. & Hanafiah, M. H. (2022): Survival strategy of Indonesian tourism business actors during COVID-19 pandemic *Environment-Behaviour Proceedings Journal* 7 (SI8): 89–94. <https://doi.org/10.21834/ebpj.v7iSI8.3D1D>

World Bank Group (2023): “Hospital beds per 1,000 people” [dataset]- processed by Our World in Data. Available: <https://data.worldbank.org/indicator/SH.MED.BEDS.ZS>

- World Health Organization (2023): WHO COVID-19 Dashboard. Available online: <https://covid19.who.int/>
- Wullweber, J. (2020): The COVID-19 financial crisis, global financial instabilities and transformations in the financial system. *Global Financial Instabilities and Transformations in the Financial System* (September 7, 2020). <https://doi.org/10.2139/ssrn.3688453>
- Xu, Z. - Elomri, A. - Kerbache, L. & El Omri, A. (2020): Impacts of COVID-19 on global supply chains: Facts and perspectives. *IEEE engineering management review*, 48(3): 153-166. <https://doi.org/10.1109/EMR.2020.3018420>
- Yeppez, C. & Leimgruber, W. (2024): The evolving landscape of tourism, travel, and global trade since the Covid-19 pandemic *Research in Globalization* 8 (June): 100207. <https://doi.org/10.1016/j.resglo.2024.100207>
- Zéman, Z. & Lentner, Cs. (2018): The changing role of going concern assumption supporting management decisions after financial crisis. *Polish Journal of Management Studies*, 18(1), 428–44. <https://doi.org/10.17512/pjms.2018.18.1.32>
- Zéman, Z. & Tóth, A. (2018). *Stratégiai pénzügyi controlling*. Budapest: Akadémiai Kiadó
- Zhu, H., He, F., Wang, S., Ye, Q., & Liang, C. (2019): Zombie firms and debt accumulation: A theoretical framework and Chinese experience. *China & World Economy*, 27(6), 104-126. <https://doi.org/10.1111/cwe.12298>
- Ziakas, P. D., Kourbeti, I. S., & Mylonakis, E. (2022): Comparative analysis of mortality from coronavirus disease 2019 across the european union countries and the effects of vaccine coverage. In *Open Forum Infectious Diseases* (Vol. 9, No. 3, p. ofac006). US: Oxford University Press. <https://doi.org/10.1093/ofid/ofac006>