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Analysis of trends in financial and institutional capacity within European public health systems

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Abstract. The financial and institutional capacity of public health systems is an essential determinant of national socio-economic stability and resilience, especially amid fluctuating global conditions. Monitoring the efficiency and structural strength of public health management requires a thorough analysis of the dynamics, structure, and ratio of various kinds of healthcare inputs and outcomes. The aim of the research is to identify and systematise empirical patterns of change in public health indicator`s. The research is based on a comprehensive dataset spanning 2000–2023 across 34 European countries. The analysis employs 18 indicators that characterise the healthcare system across three crucial dimensions: finance, workforce and infrastructure, and health outcomes. The methodology is structured in several stages: 1) evaluating healthcare indicator fluctuations across historical periods of macroeconomic instability; 2) identifying latent system response patterns through cluster

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analysis; 3) generalising statistical and cluster analysis results to pointing out crucial changes in public health management as a response to global socio-economic turbulence. The findings offer an evidence base for policymakers, government executives, and academicians, supporting the development of effective regulatory frameworks aimed at strengthening the long-term financial and institutional resilience of European public health systems against future global challenges.

Keywords: health, expenditure, healthcare financing, healthcare institutional capacity, healthcare workforce, European countries.

JEL Classification: C23, H51, I18, O47, O52

1. INTRODUCTION

The long-term stability and resilience of national socio-economic systems are fundamentally dependent upon the performance and structural integrity of their public health sector. In recent decades, Europe has been confronted with multiple structural shocks, including financial crises, tightening fiscal conditions, geopolitical uncertainty, and most notably the COVID-19 pandemic. These disruptions have exposed persistent disparities in health system funding, workforce sustainability, and institutional capacity across the continent, underscoring the need to assess not only resource levels but also their responsiveness to external stressors. Understanding how financial and institutional indicators adjust during turbulence is essential for identifying vulnerability patterns and informing strategic reforms that strengthen long-term resilience.

Recent large-scale global disruptions, particularly those witnessed over the past two decades, have intensified both academic and governmental scrutiny concerning the prerequisites for mitigating the destructive impacts of such shocks on both the public health system itself and core macroeconomic indicators. Consequently, an in-depth analysis of key performance parameters of the public health system has become critical. Identifying these strengths and bottlenecks allows for a precise understanding of which characteristics amplified a country's resistance to shocks.

The capacity gap in European public health systems is a persistent and multi-faceted challenge. From a financial perspective, data from the Organisation for Economic Co-operation and Development (OECD) indicate that while the average total health expenditure across the EU reached approximately 9.9% of GDP in 2022 (OECD, 2024), there remains significant heterogeneity. For instance, countries in Western Europe often dedicate substantially higher proportions of public funds compared to Eastern European counterparts, creating marked differences in available capital for infrastructure upgrades and long-term planning (European Commission, 2023). Moreover, institutional capacity, particularly concerning workforce sustainability and infrastructure, shows critical gaps. The OECD highlights the shortfall of 1.2 million health workers in EU countries in 2022 (OECD, 2024), a crisis acutely felt across Europe through burnout and maldistribution (WHO, 2021). Furthermore, the disparity in capital expenditure on health (e.g., spending on hospitals, diagnostic equipment) suggests a fundamental difference in institutional ability to adapt to rapid technological change or expand services during peak demand (EC, 2023).

Effective monitoring and strategic reform necessitate not only a qualitative benchmarking analysis but also the determination of empirical patterns of resistance to socio-economic crises. Furthermore, identifying these patterns requires investigating the dynamic transformations of the health system's characteristics under the influence of major historical shocks, such as the global financial and economic

crisis and the subsequent large-scale epidemiological event. Analysing the critical changes that occurred both preceding and following these major economic and health turbulences is thus an urgent research task.

Taking these challenges into account, the urgency of this study lies in determining the patterns of change in the key characteristics of the public health system under the influence of socio-economic shocks. This objective defines the main task of the present research: to analyse trends in the financial and institutional capacity within European Public Health Systems.

2. LITERATURE REVIEW

The formation of the financial and institutional capacity of healthcare systems has been influenced by global turbulences over the last few decades, leading to the reformation of their key characteristics. Existing scholarship shows that public health system responses during crises arise from the interplay of demographic, economic, institutional, and behavioural factors. Evidence indicates that epidemiological shocks, such as COVID-19, produce immediate effects on population health outcomes, particularly mortality and life expectancy, whereas macroeconomic disturbances generate delayed yet substantial fluctuations in system financing and service delivery. Studies also reveal uneven increases in government spending and workforce mobilisation across Europe, reflecting divergent fiscal capacities and institutional efficiency. Meanwhile, persistent structural trends, such as declining hospital bed availability and enduring disparities in workforce distribution, highlight underlying inertia that short-term crises fail to overcome. Consequently, the literature underscores the need to analyse both temporal dynamics and cross-national heterogeneity when assessing the resilience of public health systems.

Building on these overarching patterns, a significant group of researchers emphasises that the COVID-19 pandemic caused a revision of the classical foundations for ensuring system effectiveness, both through direct impacts (where the input and output characteristics of the medical system's capacity underwent changes) and through indirect channels (where the influence on certain economic parameters, with a time lag, led to a deterioration of the public health system's condition).

For example, the authors (Stehlíková et al., 2023) investigate COVID-19 mortality in EU countries. They identify key factors affecting the mortality rate, namely: the incidence of circulatory system diseases, GDP per capita, and others. The results show significant differences between countries and underscore the need for investment in prevention and healthcare. Conversely, the work (Gheorghe & Panazan, 2024) examines the relationship between the effectiveness of national healthcare systems and financial volatility during the COVID-19 pandemic. The study demonstrated that before the pandemic, the link between healthcare system quality and market stability was weak, but it significantly strengthened during the pandemic. The categories 'norms', 'healthcare', and 'prevention' had the greatest impact on volatility. The article (Chapsa, Polychronidou & Athanasenas, 2022) is also an important socio-economic study of the consequences of the pandemic, which directly concerns public health through its psychological and social determinants. The health crisis caused by the pandemic inevitably triggers a socio-economic crisis, which, in turn, leads to significant psychosocial consequences, including panic, fear, anxiety, and depression. The results confirm that women feel more vulnerable and show greater anger and pessimism regarding the consequences of the pandemic than men. This suggests that public health measures and social assistance should be gender-sensitive and specifically aimed at reducing the vulnerability of women during times of crisis. The works (Akinyemi, 2024; Yeremenko et al., 2025) also investigate how job loss and workplace closures caused by COVID-19 containment policies affected public satisfaction with that policy and their propensity for conspiracy theories. Iwu, Sibanda, Makwara (2023) studied the impact of the COVID-19 pandemic on businesses, particularly in developing countries, emphasising the importance of resilience

and the opportunities that arise during a crisis. The study concludes that the governments of developing countries need to implement radical economic transformations to ensure the resilience of the business ecosystem: post-crisis economic policy should aim not just for "recovery", but for creating a more resilient economic ecosystem capable of absorbing future shocks (including health crises) and, thus, ensuring stable social well-being. The work (Valaskova, Gajdosikova & Lazaroiu, 2023) investigates the consequences of the public health crisis (pandemic) on the economy, and these results have important indirect implications for public health. The lesson learned from the study lies in the necessity of developing financial strategies that enhance the long-term financial sustainability of enterprises. Economically resilient enterprises are better able to withstand external shocks (e.g., future pandemics or crises), retain jobs, and support economic activity, thereby ensuring a stable economic environment which is a fundamental condition for supporting public health.

In contrast, the authors (Aliu et al., 2024) analyse the consequences of Russia's war against Ukraine and the COVID-19 pandemic for exchange rates and key commodities in Europe. The results show that geopolitical decisions and dependence on Russian gas had a significantly greater impact on currency dynamics than commodity price fluctuations. Concurrently, economic shocks reduce the fiscal capacity of governments. This can lead to reduced funding for hospitals, prevention programs, or vaccination. Furthermore, the devaluation of national currencies reduces the purchasing power of households. This may limit access to quality medicine, drugs, and healthy food. Another perspective on the war's impact is through the economic effect of government social protection programs for internally displaced persons (Yurchyk, Mishchuk & Bilan, 2023; Oliinyk, et al., 2025). The authors pose the question: can social expenditures be not only a tool for support but also a factor of economic growth and labour market development? Using multiplier calculation methodology, they show that expenditures on social protection for internally displaced persons contribute to GDP growth (a ratio of at least 1:1.23) and the annual preservation of over 13.7 thousand jobs. The study proves that social programs can have a dual effect - social and economic - and are an important instrument of public administration in times of war. At the same time, evidence from humanitarian logistics shows that the effectiveness of crisis-related spending critically depends on the efficiency of supply chains delivering aid and medical resources, as lean and well-coordinated humanitarian supply chains substantially enhance responsiveness and reduce waste (Nyile, 2025). This means they indirectly support hospital funding and healthcare workers' jobs.

The article (Takemoto et al., 2024) proposes a robust framework model for local authorities regarding effective disaster preparedness. The study argues that the key to resilience is a dual strategy: continuous improvement of public services as a manifestation of government support and clear, decisive leadership to ensure the long-term viability of the community. The main conclusion is that active participation and civic engagement are the cornerstone for building resilient communities capable of minimising harm and effectively recovering after natural or other disasters.

The article (Trenta et al., 2025) analyses the increasing influence of right-wing political forces in the European Union and its correlation with public sentiment. The authors examine a range of crises - financial, the COVID-19 pandemic, war, migration, rising prices, and the challenges of digitalisation - that have radically changed the political landscape. Using Google Trends data and ARFIMA models, the study shows long-term patterns of public concerns (immigration, security, corruption, gender issues) and their link to the political messages of right-wing parties. Radicalisation or polarisation of society often reduces trust in state structures, including the healthcare system. This can affect people's willingness to comply with medical recommendations (e.g., during a pandemic). Furthermore, a change in the political balance can influence budget expenditure priorities: whether more funds will be directed to hospitals, prevention, vaccination, or, conversely, to other areas.

The article (Al Assaf & Abdel Halim, 2025) investigates the impact of public debt and financial development on the volatility of economic growth in a market environment. The results show that neither public debt nor financial development has a statistically significant effect on GDP volatility, and past fluctuations do not explain current instability. The study underscores the complexity of macroeconomic dynamics in developing countries and the limitations of traditional forecasting tools. The works (Hamadouche, 2024; Ray, 2024; Filipova, Djakona & Haram, 2025) also examine the impact of public expenditure on inflation levels. The main results confirm the existence of a long-term cointegration relationship between public expenditure and inflation. In the long term, a 1% increase in public expenditure leads to an inflation increase of 0.23%. It was also found that GDP per capita growth is inversely proportional to the inflation rate. Macroeconomic factors such as exchange rate volatility and economic instability directly affect a country's financial sustainability. This, in turn, determines the government's ability to fund the import of vital medicines, vaccines, and medical equipment, which often depend on a stable exchange rate. Instability can lead to higher prices for medical services and reduced access to quality medical care for the population (Ghauri et al., 2024). High levels of public debt and inflation often force governments to cut spending – and healthcare often falls under these cuts. At the same time, even when formal coverage is expanded, evidence from national health insurance schemes shows that expectation gaps between citizens and policy design can undermine perceived system effectiveness and trust in public healthcare financing (Gani, 2024). This can lead to a decrease in the quality of medical services, and shortages of medicines or medical personnel.

The article (Strouhal et al., 2024) investigates the financial consequences of the COVID-19 pandemic for the tourism sector, particularly for travel agencies. The authors found that non-tourism companies had a 19% lower probability of bankruptcy in the post-COVID period compared to the tourism sector. This underscores the uniqueness of the challenges faced by the industry and the importance of developing resilient financial strategies for its recovery. This financial instability has direct consequences for public health, as it leads to mass job losses, reduced incomes, and increased stress and anxiety levels among industry workers. Thus, supporting the financial sustainability of the tourism sector is an indirect but important public health measure.

Ensuring the efficient use of public financial resources, including those invested in the healthcare system, is an important prerequisite not only for optimising public expenditure but also for economic growth. For example, the article (Dudzevičiūtė, 2023) investigates the relationship between economic growth and public expenditure by functional classification in the Baltic countries. The authors analyse data over the last decades and show that investments in education, healthcare, and social protection have the greatest long-term positive effect on economic development. At the same time, expenditures on defence and administrative functions show a weaker or even negative impact on GDP growth.

The article (Yehorova & Drozd, 2024) examines which European countries have the most effective mechanisms to prevent losses of human capital (due to absenteeism, unemployment, and mortality) from hindering the strengthening of six key macroeconomic freedoms (business, labour, trade, investment, monetary, and financial). The study confirms that health problems (absenteeism due to illness and mortality) are direct constraints on economic freedom and development. Strengthening healthcare systems and reducing morbidity are necessary to increase productivity and ensure national security and macroeconomic stability.

In turn, changes in the healthcare system's personnel potential are driven not only by global turbulences but also by local factors. The article is dedicated to the impact of Brexit on Slovak medical professionals in the UK. The survey showed that deteriorating working and living conditions, rising costs, and a sense of discrimination are forcing many to consider returning to Slovakia. The author (Kordoš,

2024) concludes that Brexit significantly affected the migratory moods and professional stability of medics.

The article (Lyeonov et al., 2024) analyses the relationship between economic growth and national security in the context of global upheavals, particularly the COVID-19 pandemic. The authors study 34 European countries during 2000–2022, using multidimensional analysis to identify internal and external resilience factors. The results show that macroeconomic stability and the quality of the healthcare system are key determinants of states' ability to withstand crises. Specifically, countries with higher levels of institutional capacity and financial stability demonstrate greater resilience to external shocks.

The article (Rivero et al., 2025) compares the effectiveness of four types of economic shocks for economic recovery (GDP and employment), particularly under unfavourable external conditions (falling oil prices and declining external GDP). The study found that innovations in public capital investments (e.g., infrastructure investments) have the largest positive impact on economic activity, employment, and social well-being, while fiscal stimulus through current expenditures or transfers has a negative impact on economic activity and social well-being. Concurrently, public capital investments, which are recognised as the most effective growth factor, often include funding for the construction and modernisation of medical facilities, water supply, sewage, and transport networks. These investments are the foundation for improving the quality and accessibility of medical services and the institutional capacity of the public health system.

The research (Dinu et al., 2024; Tayeb et al., 2025) confirms that GDP level and institutional quality are key determinants of environmental indicators. This means that improving public health requires not only medical interventions but also strong state institutions (e.g., effective anti-corruption efforts, compliance with environmental legislation) and economic development, which ensure a clean environment. The revealed effect of spatial contagion and diffusion shows that environmental problems in one country (and associated public health issues) can spread to neighbouring states. This requires public health authorities and governments to enhance international cooperation for joint management of cross-border pollution and risks affecting the health of the entire region. The impact of ecology and energy on public health is twofold: on the one hand, environmental degradation caused by industrialisation (especially in less developed countries) leads to pollution that directly harms the population's health (increasing respiratory and oncological diseases). On the other hand, the transition to sustainable economic models and clean energy (e.g., incorporating environmental criteria into food indices or investing in green infrastructure) is necessary to create a healthy and safe environment, as ecologically clean products and processes usually have a lower impact on the environment, thus contributing not only to the health of the planet but also to human health (Stankevičienė, & Borisova, 2022; Svazas et al., 2023). Complementary time-series evidence from the Democratic Republic of the Congo confirms that life expectancy is tightly linked to macroeconomic development, public investment and structural conditions, underscoring how fragile health outcomes are in the face of persistent socioeconomic constraints (Baharanyi et al., 2024).

The results of the study (Chhetri & Adhikari, 2025) directly confirm the existence of the "health-induced poverty trap" and underscore the key role of financial protection. The article clearly demonstrates that unexpected illnesses (health shocks) are the main cause of "financial catastrophe" for households, as treatment costs significantly exceed their financial capabilities. This is one of the main challenges for global public health. The study offers concrete solutions for breaking this vicious cycle: improving health insurance coverage, strengthening social protection mechanisms, and enhancing the healthcare delivery system. These are the main strategies that public health authorities and governments should implement to achieve sustainable development goals and reduce poverty.

The effectiveness of pharmaceutical companies, studied in the article (Asad, Popesko & Godman, 2024), directly affects the speed and success of research and development (R&D). The more effective the company, the higher the likelihood of new, vital medicines and therapeutic methods for treating infectious, chronic, and rare diseases, which is the main goal of public health.

The results of the study (Radziejowska & Thirakulwanich, 2023) are extremely important for public health, as they offer a new strategic tool for influencing population health through dietary behaviour and the sustainability of food systems.

Bhowmik (2025) examines the non-linear and asymmetric relationship between private healthcare expenditure and life expectancy in the USA during 1960–2023, using the Nonlinear Autoregressive Distributed Lag (NARDL) model. The study found a significant asymmetry. The most important finding is that negative changes (i.e., reductions in private expenditure, for example, during an economic recession) can have an asymmetrically stronger and faster detrimental impact on life expectancy than the positive effect from an equivalent increase in expenditure.

The authors (Baskiewicz, Daroń & Pachura, 2023; Al-Kahtani et al., 2025) analysed audit data conducted in a large hospital complex and then used the Kano methodology to classify patient expectations regarding various hospitalisation attributes. The main findings and recommendations are: three attributes were identified as generating a high level of patient satisfaction: 1) smooth and seamless admission to the ward (SO4); 2) minimisation of bureaucratic paperwork during hospitalisation (SO5); 3) the manner in which doctors treat patients (SO9). Problem area (Doctors): The level of satisfaction with care provided by doctors was rated the lowest among all staff (48% satisfied/moderately satisfied), compared to nurses/midwives (72%). It is recommended to focus on training doctors in effective communication and an individual approach to patients, as well as implementing an information system for standardisation and bureaucracy reduction.

Effective and ethical management of medical data is fundamental for public health in the digital age. The implementation of real-time analytics is crucial for the rapid detection and response to disease outbreaks. This significantly increases the capacity of public health authorities for effective epidemiological surveillance and control. Acknowledging that Western "one-time consent" models do not align with the collective values of Africa has a direct relevance for public health. Without culturally grounded consent mechanisms (eConsent) and ensuring confidentiality, the population may refuse to provide data, which undermines trust in the system and makes it impossible to collect quality data for decision-making (Sidii, 2025).

The article (Saari et al., 2024) focuses on the important topic of the impact of technology on the ethics and quality of care for the elderly, which is a critical public health issue in ageing societies. The effectiveness and ethics of care for the elderly are among the most important challenges for public health in economically developed countries. Population ageing requires not only an increase in the quantity of services but also the maintenance of their quality and humanity. This study emphasises that "quality care" is not just a routine procedure but also an ethical interaction. If technologies designed to increase efficiency lead to moral distress in workers or reduce the quality of relationships with the client, this can negatively affect the mental health and general well-being of both workers and those in care. The results of the study provide critical information for policymakers and healthcare administrators. They caution against the simple implementation of technologies solely for the sake of economic efficiency. To ensure quality public health, it is necessary that technologisation strategies are aligned with the ethics of care, ensuring that new tools support, rather than displace, direct human interaction and the quality of relationships. The articles (Rudawska, Krot & Porada-Rochoń, 2024; Oe & Weeks, 2025) also concern the impact of technology on healthcare, but with a focus on the factor of technology acceptance by patients. Patient acceptance of technology is critically important for the modernisation of the healthcare system and

its ability to respond to public health challenges. Technologies (e-health, monitoring, telemedicine) are key to increasing the accessibility of medical services, especially for remote regions or vulnerable groups. The conclusion that systemic support is the strongest driver of the intention to use ICTs has direct relevance for public health policy. This means that governments and health authorities should invest not only in the technologies themselves (procurement of equipment) but also in public infrastructure, public education, regulatory frameworks, and funding that create a generally favourable environment for digital medicine.

Artificial intelligence (AI) is a transformative technology whose innovative application is likely to improve not only economic but also social progress. In the public health sector, AI can optimise the allocation of medical resources, improve early disease diagnosis, forecast epidemic outbreaks, and enhance the overall efficiency of healthcare systems (Dinu, 2024; Sitnicka et al., 2025; Gayathiri & Prabu 2025). Conversely, Burrell (2025a) investigates how cyberpsychology and health safety interventions can be used to combat mental health challenges among underserved African-American communities. The study underscores the critical importance of technological access and data security in these vulnerable groups. At the same time, in another work (Burrell, 2025b), AI is investigated as a tool to enhance post-marketing surveillance for drugs and medical devices. Improving post-marketing surveillance has a direct and decisive impact on public health, ensuring the safety of the entire medical infrastructure. AI fills critical safety gaps by allowing the quicker detection of rare but dangerous side effects of drugs or devices that were not noticed during clinical trials. This directly prevents harm to health, hospitalisation, and mortality among the general population.

3. METHODOLOGY

The primary objective of this research is to determine the changes in the dynamics of key performance indicators of the public health system (health outcomes, financial and expenditure capacity, workforce and infrastructure capacity) caused by socio-economic shocks. Achieving this objective requires the execution of several distinct stages, each designed to test a specific hypothesis, which together form the overarching architecture of this research.

The time horizon for the analysis is 2000–2023. This period is purposefully selected as it covers two critical events: the Global Financial and Economic Crisis (2007–2009) and the period of the COVID-19 pandemic (2020–2022). This allows for the identification of patterns of change in the public health outcome and capacity indicators under conditions of both general socio-economic turbulence and specific epidemiological threats.

Research Hypotheses

The study is structured around testing three main hypotheses:

Hypothesis 1: Socio-economic turbulence and epidemiological threats fundamentally determine the volatility of public health system outcome and capacity indicators.

Hypothesis 2: There is a common response among public health system outcome and capacity indicators to socio-economic turbulence, allowing for the identification of common patterns.

Hypothesis 3: Socio-economic turbulence and epidemiological threats lead to the transformation of existing public health system patterns.

Section 1. Trends in the Volatility of Public Health System Indicators (Testing Hypothesis 1)

To test **Hypothesis 1** and determine volatility patterns, the mean values of the public health system outcome and capacity indicators were calculated for each of the 34 European countries (Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Moldova, the Netherlands,

North Macedonia, Norway, Poland, Portugal, Romania, Serbia, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom) across five distinct time intervals:

- Period 1 (2000–2006): Pre-crisis stability period;
- Period 2 (2007–2009): Global Financial and Economic Crisis period;
- Period 3 (2010–2019): Post-crisis recovery and stabilisation period;
- Period 4 (2020–2022): COVID-19 Pandemic period;
- Period 5 (2023): Post-pandemic period (for preliminary trend assessment).

Hypothesis 1 will be tested using a statistical analysis of the volatility of public health system indicators and assessing the existence of significant deviations during the transition between these five periods.

Section II: Cluster Analysis (Testing Hypotheses 2 and 3)

To test **Hypothesis 2**, a cluster analysis (specifically the k-means method) will be performed using the Stata 14.2/SE software product (Stata, 2025). Clustering will be carried out based on public health system outcome and capacity indicators averaged over the period 2000–2023 (Appendix A). The optimal number of clusters will be determined using the Calinski-Harabasz test. The relevance of the clustering parameters will be verified by analysing the variation of the input parameters and the p-value for each indicator.

Finally, to test **Hypothesis 3**, the clustering results (including the mean values of indicators within each cluster) will be compared across the different observation periods (Periods 1-5) to identify differences and patterns of change.

Public health system outcome and capacity indicators are considered in the research, presented in Table 1.

Table 1

Research data design

Category	Indicator	Abbreviation
Output Indicators (Health Outcomes)	Death rate, crude (per 1,000 people)	Death
	Life expectancy at birth, total (years)	Life
	Suicide mortality rate (per 100,000 population)	Suicide
	Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)	Mortality
	Number of infant deaths	Infant_d
	Number of maternal deaths	Maternal_d
Input Indicators (Finance & Expenditure Capacity)	Capital health expenditure (% of GDP)	Cap
	Current health expenditure (% of GDP)	Cur
	Domestic general government health expenditure per capita (current US$)	Dom_gov
	Domestic private health expenditure per capita (current US$)	Dom_prv
	External health expenditure per capita (current US$)	Ext
	Out-of-pocket expenditure per capita (current US$)	OoP

Input Indicators (Workforce & Infrastructure Capacity)	Physicians (per 10,000 people)	Physicians
	Medical doctors (per 10,000)	Med_doc
	Density of dentists per 10,000 population	Dentists
	Density of pharmacists per 10,000 population	Pharmacists
	Density of nurses and midwives per 10,000 population	Nurses
	Hospital beds (per 1,000 people)	Beds

Source: World Bank Data (World Bank DataBank, 2025)

4. EMPIRICAL RESULTS AND DISCUSSION

Section 1. Trends in the Volatility of Public Health System Indicators (Testing Hypothesis 1)

To test the hypothesis of this section of the research (**Hypothesis 1:** Socio-economic turbulence and epidemiological threats fundamentally determine the volatility of public health system outcome and capacity indicators), we will analyse the growth rates and mean values of key health system indicators (Table A.1) for the five distinct periods: 2000–2006, 2007–2009, 2010–2019, 2020–2022, and 2023.

The focus is on quantifying changes in average values of public health system indicators across the specified periods and chain growth rates (percentage change of indicators between periods (e.g., Δ Period 2 / Δ Period 1).

Based on the statistical analysis covering the period from 2000 to 2023 for 34 countries, the following key conclusions can be drawn regarding the dynamics of various health system indicators.

1.1. Finance and expenditure capacity of public health system

Overall, the mean value of most health expenditure per capita indicators demonstrated growth throughout the period under review.

Capital Health Expenditure (% of GDP):

– This indicator demonstrates extreme volatility, often displaying maximum/minimum values of +-100% due to many countries having periods with zero expenditure.

– Maximum Total Growth (Period 5 / Period 1): Albania (978.96%).

– Maximum Total Reduction (Period 5 / Period 1): Bulgaria, Latvia, Netherlands, Poland, Romania, Slovak Republic, Slovenia, and Spain all recorded -100.00%.

– Pandemic Period Change (Period 4 / Period 3): During the COVID-19 period (2020–2022), the mean value slightly decreased (-24.71%).

– The maximum growth rate was 48.90% in Estonia, but Croatia's large negative change followed a 0.00% value in Period 2, indicating significant fluctuations.

– Maximum Reduction: Bulgaria, Latvia, Poland, Romania, Slovak Republic, and Slovenia all recorded -100.00%.

Current Health Expenditure (% of GDP):

– The mean indicator exhibited an upward trend, with a particularly notable increase observed in the 2007–2009 period compared to 2000–2006 (a 149.85% growth rate).

– The largest decline in the indicator over the entire period was recorded in Albania (-37.35%), while the largest growth was in Estonia (42.02%).

– Crisis Period (Period 2 / Period 1): The mean growth rate was notably high (7.33%), primarily driven by Moldova (49.43%). Excluding the outliers, the median growth was 7.75%.

– Maximum Reduction: North Macedonia (-21.97%).

– Post-Crisis Period (Period 3 / Period 2): The mean growth slowed significantly (3.38%). Reductions were observed in 10 countries.

– Maximum Reduction: Moldova (-31.20%).

– Pandemic Period (Period 4 / Period 3): The mean growth remained steady (3.98%). Only Ireland (-8.47%) experienced a significant reduction, followed by Moldova (-3.00%) and Albania (-3.09%).

Domestic General Government Health Expenditure per capita (Current US$):

– The mean value grew by 193.58% over the entire period.

– The maximum growth was recorded in Moldova (631.73% for the entire period), again due to a low baseline.

– The minimum growth was observed in Greece (10.78% for the entire period).

– The greatest reduction in the post-crisis period (2010–2019 compared to 2007–2009) was recorded in Greece (-40.46%).

– For most expenditure types, the steepest average growth was characteristic of the Global Financial and Economic Crisis period (2007–2009).

– Crisis Period (Period 2 / Period 1): The average growth rate was 95.52%.

– Maximum growth (excluding France): Latvia (172.58%) and the Slovak Republic (168.35%).

– Post-Crisis Period (Period 3 / Period 2): A reduction in the average growth rate to 7.50% was observed. A reduction in the indicator was recorded in 12 of the 34 countries (e.g., Croatia, Greece, Iceland, Italy, Spain, Ukraine, and the United Kingdom).

– Maximum reduction was recorded in Greece (-40.46%).

– Pandemic Period (Period 4 / Period 3): The average growth rate rose to 28.52%. A further reduction was recorded only in Greece (-1.00%).

– Maximum growth: Moldova (68.67%) and Latvia (59.09%).

Domestic Private Health Expenditure per capita (Current US$):

– The mean value increased by 190.01% over the entire period.

– The most intensive growth over the entire period occurred in Moldova (506.91%).

– The minimum growth was recorded in Greece (42.25% for the entire period).

– The largest reduction in the pandemic period (2020–2022 compared to 2010–2019) was recorded in Albania (-5.19%), which was the minimum among all countries.

– Crisis Period (Period 2 / Period 1): The average growth rate was 96.16%.

– Post-Crisis Period (Period 3 / Period 2): The average growth rate decreased to 8.82%. A reduction in the indicator was recorded in 8 of the 34 countries (including Bosnia and Herzegovina, Croatia, France, and Greece).

– Maximum reduction was recorded in Greece (-21.11%).

– Pandemic Period (Period 4 / Period 3): The average growth rate rose to 24.67%. A reduction was recorded in 6 countries: Finland, France, Ireland, Norway, the Slovak Republic, and the United Kingdom.

– Maximum growth was recorded in Lithuania (52.49%), Estonia (47.94%), and Albania (45.61%).

Out-of-Pocket (OOP) Expenditure per capita (Current US$):

– The mean value increased by 190.05% over the entire period.

– The largest overall growth was recorded in Lithuania (531.43%).

– The minimum overall growth was recorded in Greece (11.31%).

– The maximum increase during the pandemic period (2020–2022 compared to 2010–2019) was recorded in Lithuania (51.86%).

– The largest reduction during the pandemic period was recorded in Sweden (-16.91%).

– Crisis Period (Period 2 / Period 1): The average growth rate was 94.55%.

– Post-Crisis Period (Period 3 / Period 2): The average growth rate decreased to 8.26%. A reduction in the indicator was recorded in 8 countries (Bosnia and Herzegovina, Croatia, Denmark, France, Greece, Italy, the Slovak Republic, and Slovenia).

– Maximum reduction was recorded in Croatia (-30.72%).

– Pandemic Period (Period 4 / Period 3): The average growth rate rose to 23.57%. A reduction was recorded in 7 countries (including Finland, Greece, Norway, and Italy).

– Maximum growth was recorded in Lithuania (51.86%), Estonia (47.89%), and Albania (45.52%).

External Health Expenditure per capita (Current US$):

– Permanent growth across all periods under review is characteristic of Bosnia and Herzegovina, Lithuania, Portugal, Ukraine, and the United Kingdom.

– The remaining countries were characterised by a lack of a clear trend or the irrelevance of this group of expenditures.

– Crisis Period (Period 2 / Period 1): Mean growth was 60.48%. Moldova recorded the highest increase (479.95%).

– Post-Crisis Period (Period 3 / Period 2): Mean growth spiked (271.02%) due to Greece (8803.35%), which had near-zero values prior to Period 3.

– Pandemic Period (Period 4 / Period 3): Mean growth was 17.50%. Croatia recorded the highest growth (198.43%). North Macedonia recorded the most significant decline (-99.65%).

1.2. Health workforce and infrastructure capacity

Physician Density (per 10,000 population):

– The mean value increased by 31.51% over the entire period.

– The largest growth over the entire period was recorded in Finland (79.76%).

– The minimum growth was recorded in Poland (3.41%).

– A reduction in the indicator during the pandemic period (2020–2022 compared to 2010–2019) was recorded in France (-2.31%).

– Crisis Impact (Period 2/Period 1): the median growth of 45% suggests a stable, positive trend in the expansion of physician staff across the sample. Poland recorded the highest reduction -3.82%.

– Post-Crisis Adjustment (Period 3/Period 2): The overall expansion continued, with Portugal recording the maximum growth 25.18%. However, Ireland experienced the most significant reduction (-10.94%), indicating non-uniform recovery.

– Pandemic Period (Period 4/Period 3): Despite the clear need for medical staff, the volatility increased. Albania showed the strongest growth 23.35%, but France recorded a severe decline -26.44%, reflecting significant, non-standard fluctuations during the epidemiological threat.

Medical Doctors (per 10,000 population):

– Crisis Period (Period 2 / Period 1): The mean growth was 8.43%, driven Ireland (41.34%). Italy recorded the highest reduction (-15.19%).

– Post-Crisis Period (Period 3 / Period 2): Mean growth was 8.92%. Ireland recorded the highest reduction (-10.26%).

– Pandemic Period (Period 4 / Period 3): Mean growth was 10.93%. Poland recorded the highest growth (41.93%). Bosnia and Herzegovina recorded the highest reduction (-9.32%).

Density of Dentists (per 10,000 population):

– Crisis Period (Period 2 / Period 1): The mean growth rate was 5.55%, driven by Romania (36.33%). Reductions were seen in 7 countries.

– Maximum Reduction: Albania (-22.58%).

– Post-Crisis Period (Period 3 / Period 2): Mean growth was 10.86%. Reductions were seen in 7 countries.

– Maximum Reduction: Serbia (11.91%).

– Pandemic Period (Period 4 / Period 3): Mean growth was 9.95%. Poland saw the highest growth (131.41%). Reductions were observed in 9 countries, with the maximum in Serbia (-22.44%).

Density of Pharmacists (per 10,000 population):

– Crisis Period (Period 2 / Period 1): The mean growth rate was 10.14%, driven Romania (47.74%). Iceland recorded the highest reduction (-51.91%).

– Post-Crisis Period (Period 3 / Period 2): Mean growth was 17.86%. Albania recorded the highest growth (67.50%). France recorded the highest reduction (-17.68%).

– Pandemic Period (Period 4 / Period 3): Mean growth was 9.09%. Iceland recorded the highest growth (52.72%). Moldova recorded the highest reduction (-78.83%).

Nurse and Midwife Density (per 10,000 population):

– The mean value grew by 110.39% over the entire period.

– The largest growth over the entire period was recorded in Portugal (88.59%).

– The largest reduction over the entire period was recorded in the Slovak Republic (-15.70%).

– Crisis Impact (Period 2/Period 1): The median growth was robust at 7.78%. Reductions were minimal, with the lowest rate observed in the Slovak Republic (-4.43%).

– Post-Crisis Adjustment (Period 3/Period 2): Average growth slightly decelerated 6.69% but remained positive. The greatest reduction was recorded in Latvia -12.72%.

– Pandemic Period (Period 4/Period 3): The average growth rate accelerated to 9.03%. Austria recorded the highest increase 50.71%, likely indicating strong workforce investment or improved data reporting during the period. Conversely, Hungary recorded the largest reduction -10.93%.

Hospital Beds (per 1,000 population):

– The mean value decreased by -25.01% over the entire period.

– Bosnia and Herzegovina (+13.65%) and Bulgaria (+14.72%) are the only countries where an overall increase in the indicator was recorded for the entire period.

– The largest reduction in the indicator was recorded in Iceland (-82.14%).

– The maximum growth during the pandemic period was recorded in Bosnia and Herzegovina (2.27%) and Bulgaria (6.06%).

– Crisis Impact (Period 2/Period 1): The median rate already showed a reduction of -7.43%, indicating that the decline in bed capacity predated the crisis and continued through it. Iceland recorded the maximum reduction (-43.51%).

– Post-Crisis Adjustment (Period 3/Period 2): The trend of reduction continued (mean value -8.97%). Bulgaria was one of the few countries to record growth (6.87%), while Ireland experienced a steep reduction (-34.99%).

– Pandemic Period (Period 4/Period 3): Critically, the mean rate of reduction accelerated to -8.73% during the pandemic period. This strongly indicates that the epidemiological threat did not reverse the long-term trend of decreasing bed capacity. Bulgaria and Bosnia and Herzegovina remained the primary countries showing continued growth, whereas Finland recorded the steepest reduction (-31.23%).

1.3. Health outcomes

Crude Mortality Rate (per 1,000 population):

– The mean value increased by 7.66% over the entire period.

– The largest growth over the entire period was recorded in Albania (60.87%).

– The largest reduction over the entire period was recorded in Ukraine (-17.35%).

– During the pandemic period (2020–2022 compared to 2010–2019), a sharp increase was observed, with the largest growth in North Macedonia (39.22%) and Albania (37.72%).

– The only countries where a reduction in the indicator was recorded during the pandemic period are Norway (-1.13%) and Sweden (-1.83%).

– Crisis Period (Period 2 / Period 1): The Global Financial Crisis (2007–2009) resulted in an increased mortality rate in 14 of the 34 countries sampled.

– Maximum growth was recorded in Lithuania (11.90%) and Bosnia and Herzegovina (8.03%).

– Maximum reductions were recorded in Ireland (-13.58%), the United Kingdom (-6.80%), and Norway (-6.52%).

Life Expectancy at Birth (Years):

– The mean value increased by 5.2% over the entire period.

– The largest growth over the entire period was recorded in Estonia (9.87%).

– The minimum growth was recorded in Iceland (2.26%).

– Crisis Period (Period 2 / Period 1): The Global Financial Crisis (2007–2009) did not lead to a reduction in life expectancy in any of the 34 countries studied.

– Post-Crisis Period (Period 3 / Period 2): Similarly, no reduction in the indicator level was recorded in 2010–2019 compared to 2007–2009.

– Pandemic Period (Period 4 / Period 3): During the pandemic period (2020–2022), a decrease in life expectancy compared to the pre-pandemic period (2010–2019) was recorded in 20 of the 34 countries (including Croatia, Denmark, Estonia, Finland, Germany, Norway, Sweden, and Ukraine).

– The most notable reductions in life expectancy were recorded in Albania (-0.40%), Serbia (-1.47%), and Bulgaria (-1.95%).

Mortality from CVD, Cancer, Diabetes or Chronic Respiratory Diseases (CRD) Aged 30-70 (%):

– The mean value decreased by 16.34% over the entire period.

– The largest growth over the entire period was recorded in Greece (-14.40%).

– The largest reduction over the entire period was recorded in Estonia (-51.75%).

– This indicator generally shows a continuous positive trend of reduction, reflecting improvements in chronic disease management.

– Crisis Period (Period 2 / Period 1): Mean reduction was -8.71. Slovenia recorded the highest reduction (-15.91%).

– Post-Crisis Period (Period 3 / Period 2): Mean reduction was -12.49%. Albania recorded the highest reduction (-31.51%).

– Pandemic Period (Period 4 / Period 3): Mean reduction was -13.79%. Albania was the only country to show an increase (1.45%). Estonia recorded the highest reduction (-23.10%).

Suicide Mortality Rate (per 100,000 population):

– The mean value decreased by -19.32% over the entire period.

– The maximum growth was recorded in Greece (77.01%).

– The largest reduction over the entire period was recorded in Ukraine (-58.16%).

– Crisis Period (Period 2 / Period 1): Mean growth was Slovenia recorded the highest reduction (-24.91%).

– Post-Crisis Period (Period 3 / Period 2): Mean change was a reduction (-6.33%). Greece recorded the highest growth (44.00%). Albania recorded the highest reduction (-33.36%).

– Pandemic Period (Period 4 / Period 3): Mean change was a reduction (-8.51%). Greece recorded the highest growth (16.16%). Estonia recorded the highest reduction (-27.83%).

Infant Deaths:

– The mean value decreased by -51.16% over the entire period.

– The largest reductions were recorded in North Macedonia (-84.68%) and Latvia (-81.33%).

– Crisis Period (Period 2 / Period 1): The median reduction was 16.13%. Albania recorded the highest reduction (-48.04%).

– Post-Crisis Period (Period 3 / Period 2): The mean reduction was -20.90%. Switzerland recorded the only increase (3.19%). Estonia recorded the highest reduction (-45.02%).

– Pandemic Period (Period 4 / Period 3): The mean reduction was -22.30%. Iceland recorded the only increase (1.45%). North Macedonia recorded the highest reduction (-56.10%)

Maternal Deaths:

– The mean value decreased by -47.83% over the entire period.

– North Macedonia recorded a 100% reduction.

– The largest increase was recorded in Portugal (24.66%).

– During the pandemic period, growth was recorded in Belgium (14.58%), Greece (40.74%), Portugal (25.93%), Slovenia (66.67%), the United Kingdom (15.73%), and Moldova (12.50%).

– Volatile Indicator: The indicator is highly volatile, frequently recording zero or low values, resulting in high percentage fluctuations.

– Crisis Period (Period 2 / Period 1): Romania recorded the highest reduction (-42.19%).

– Post-Crisis Period (Period 3 / Period 2): The mean reduction was -20.64%. Greece recorded the only increase (12.50%). Norway recorded the highest reduction (-50.00%).

– Pandemic Period (Period 4 / Period 3): Slovenia recorded the highest increase (66.67%). Romania recorded the highest reduction (-45.12%).

Based on the statistical analysis of the volatility across the five distinct periods, the general conclusion regarding **Hypothesis 1** is as follows. The results of the volatility analysis across the 34 European countries partially confirm Hypothesis 1. The determination of parameter volatility is heavily dependent on the nature of the external threat (socio-economic vs. epidemiological) and the specific indicator being analysed.

Specifically, the analysis confirms that the volatility of key outcome indicators is primarily driven by epidemiological threats, while socio-economic shocks (the Global Financial and Economic Crisis, Period 2) had a limited immediate impact.

Epidemiological Sensitivity (Period 4, 2020–2022): The Crude Mortality Rate and Life Expectancy at Birth were the most sensitive indicators. Mortality rate saw a sharp, widespread increase in nearly all countries during the pandemic period, with maximum growth in North Macedonia (39.22%) and Albania (37.72%). Life expectancy saw the most significant reductions during this period (e.g., Bulgaria, -1.95%; Serbia, -1.47%), though 20 countries still recorded an increase.

Socio-Economic Insensitivity (Period 2, 2007–2009): The financial crisis did not cause the widespread increase in mortality that the pandemic did, and it did not lead to a reduction in life expectancy in any of the 34 countries.

Volatility of Input Indicators (Expenditure). The volatility of expenditure indicators showed a strong but lagged response, suggesting that funding is influenced by the need to stabilise the system post-shock.

Crisis response (Period 2 / Period 1): The steepest average growth for most health expenditure categories (Government, Private, and Out-of-pocket per capita) occurred during the Global Financial and Economic Crisis (Period 2). This surge suggests an immediate, perhaps reactive, increase in spending to counteract the crisis's effects or economic dynamics at the time.

Post-Crisis Volatility (Period 3 / Period 2): This was followed by a noticeable contraction in these expenditure groups for a group of countries (e.g., 12 countries for Government Expenditure) during the post-crisis recovery (Period 3). This pattern suggests a causal link between economic shocks and expenditure volatility, but with a clear time lag3.

Capacity Indicator Trend. The trend in the capacity indicator (Hospital Beds) showed no clear correlation with either type of external threat. The number of Hospital Beds per 1,000 population continued its long-term trend of reduction across all periods, including the pandemic. The median reduction accelerated to -7.64% during the pandemic (Period 4 / Period 3). Deviation: Only Bosnia and Herzegovina and Bulgaria consistently recorded permanent growth in hospital beds capacity.

While the overall hypothesis is only partially confirmed, the analysis successfully demonstrates that the volatility patterns are specific to the type of indicator:

– Outcome Indicators (Mortality/Life Expectancy) are highly sensitive to epidemiological threats.

– Input Indicators (Expenditure) are sensitive to socio-economic shocks, exhibiting initial volatility and subsequent adjustments with a time lag.

– Capacity Indicators (Hospital Beds) are dominated by a long-term structural trend that is largely independent of both external threats.

Section 2. Cluster Analysis

The Kalinski-Harabash test proved the expediency of selecting 6 clusters.

Table 2

Calinski/Harabasz stopping rule results

Number of clusters	Calinski/Harabasz pseudo-F
2	35.12
3	29.36
4	26.36
5	18.73
6	41.81
7	14.68
8	13.79
9	39.80
10	35.53

Source: Authors' calculations in Stata 14.2/SE software (Stata, 2025) based on World Bank Data (World Bank DataBank, 2025)

Table 3

Members of clusters

Cluster	Countries
Cluster 1	Albania (1), Bosnia and Herzegovina (4), Bulgaria (5), Hungary (14), Latvia (18), Moldova (20), North Macedonia (22), Serbia (27)
Cluster 2	Poland (24), Romania (26), Ukraine (33)
Cluster 3	France (11), Germany (12), Italy (17), Spain (30), United Kingdom (34)
Cluster 4	Austria (2), Belgium (3), Denmark (8), Finland (10), Iceland (15), Ireland (16), Netherlands (21), Norway (23), Sweden (31)
Cluster 5	Croatia (6), Czechia (7), Estonia (9), Greece (13), Lithuania (19), Portugal (25), Slovak Republic (28), Slovenia (29)
Cluster 6	Switzerland (32)

Source: Authors' calculations in Stata 14.2/SE software (Stata, 2025) based on World Bank Data (World Bank DataBank, 2025)

Based on the mean value (for 2000-2023) of public health system outcome and capacity indicators for each cluster, we can highlight such specific features.

Cluster 1 (Albania, Bosnia and Herzegovina, Bulgaria, Hungary, Latvia, Moldova, North Macedonia, Serbia). Health Outcomes: The lowest life expectancy (Life: 74.137) across all clusters. Relatively high mortality (e.g., Death: 12.44, Mortality: 23.491, Suicide: 14.649). Very high average number of infant deaths (Infant_d: 427.84). Finance & Expenditure Capacity: The lowest average per capita health expenditure, including government (Dom_gov: 294.522), private (Dom_prv: 183), and out-of-pocket (OoP: 172.809). A relatively high average external health expenditure (Ext: 3.664). Workforce & Infrastructure Capacity: Average indicators for medical staff density and beds.

Cluster 2 (Poland, Romania, Ukraine). Health Outcomes: Low life expectancy (Life: 73.283). Very high infant mortality (Infant_d: 2868.083) and maternal mortality (Maternal_d: 46.863). High suicide rate (Suicide: 17.877). Finance & Expenditure Capacity: Average level of health expenditure (% of GDP) (Cur: 6.087, Cap: 0.203). Low average external expenditure (Ext: 0.8). Workforce & Infrastructure Capacity: The highest average density of nurses (Nurses: 64.78) and the highest average density of beds (Beds: 7.143).

Cluster 3 (France, Germany, Italy, Spain, United Kingdom). Health Outcomes: High life expectancy (Life: 81.06). Low mortality (Death: 9.668, Mortality: 11.688). Low suicide rate (Suicide:

10.632). Finance & Expenditure Capacity: The highest average current health expenditure as a % of GDP (Cur: 9.696). Very high average domestic general government expenditure per capita (Dom_gov: 2737.102). High average out-of-pocket expenditure (OoP: 553.746). The lowest external expenditure (Ext: 0.08). Workforce & Infrastructure Capacity: High average density of nurses (Nurses: 77.88). High density of physicians and pharmacists.

Cluster 4 (Austria, Belgium, Denmark, Finland, Iceland, Ireland, Netherlands, Norway, Sweden). Health Outcomes: Very high life expectancy (Life: 80.693), close to Cluster 3. The lowest death rate (Death: 8.731) and low mortality from major diseases (Mortality: 11.541). The lowest average number of infant deaths (Infant_d: 276.396). Finance & Expenditure Capacity: The highest average domestic general government expenditure per capita (Dom_gov: 3933.66) and domestic private expenditure (Dom_prv: 1060.337). High average out-of-pocket expenditure (OoP: 769.206). Workforce & Infrastructure Capacity: The highest average density of physicians (Physicians: 37.261) and nurses (Nurses: 119.304). High density of dentists and pharmacists.

Cluster 5 (Croatia, Czechia, Estonia, Greece, Lithuania, Portugal, Slovak Republic, Slovenia). Health Outcomes: Average life expectancy (Life: 77.188). Average mortality levels. High suicide rate (Suicide: 17.507). Finance & Expenditure Capacity: Average current expenditure as a % of GDP (Cur: 7.455). High average external health expenditure (Ext: 1.409). Workforce & Infrastructure Capacity: High average density of physicians (Physicians: 37.94). The highest average density of dentists (Dentists: 8.143). High density of pharmacists.

Cluster 6 (Switzerland). Health Outcomes: The highest life expectancy (Life: 82.34). The lowest mortality from major diseases (Mortality: 9.44). Finance & Expenditure Capacity: The highest average current expenditure as a % of GDP (Cur: 10.46). The highest average domestic private expenditure per capita (Dom_prv: 5447.75) and out-of-pocket expenditure (OoP: 2102.33). Average domestic general government expenditure per capita (Dom_gov: 2565.4). Workforce & Infrastructure Capacity: The highest average density of nurses (Nurses: 155.12). High density of physicians.

Table 4

Mean cluster values for the Finance & Expenditure Capacity Indicators of Health System

Period	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
	Capital Health Expenditure (% of GDP)					
2000-2006	.216	.183	.159	.377	.223	0
2007-2009	.366	.3	.227	.327	.211	0
2010-2019	.241	.23	.181	.379	.152	0
2020-2022	.201	.093	.2	.403	.078	0
2023	.221	.093	.198	.411	.09	0
	Current Health Expenditure (% of GDP)					
2000-2006	7.389	5.6	8.701	8.44	6.866	9.746
2007-2009	7.735	5.81	9.494	9.074	7.549	9.637
2010-2019	7.265	6.267	10.05	9.762	7.592	10.775
2020-2022	7.331	6.652	10.723	10.021	8.027	11.513
2023	7.159	6.833	10.666	10.169	8.184	11.69
	Domestic General Government Health Expenditure per capita (Current US$)					
2000-2006	147.261	140.88	1901.897	2539.004	568.866	1467.387
2007-2009	300.043	343.2	2952.272	4063.337	1113.668	2162.24
2010-2019	328.574	377.767	2951.286	4343.772	1049.421	2977.413
2020-2022	459.988	521.571	3468.426	5163.368	1346.885	3704.51
2023	471.875	549.22	3602.2	5516.958	1389.927	3923.39
	Domestic Private Health Expenditure per capita (Current US$)					

2000-2006	93.463	60.539	615.599	692.237	227.204	3319.484
2007-2009	191.905	130.556	944.387	1094.41	446.345	4695.337
2010-2019	205.036	160.947	950.195	1182.676	430.862	6286.013
2020-2022	274.963	213.294	1059.419	1350.32	547.708	7490.153
2023	286.788	227.767	1122.216	1441.463	575.177	8092.91
	Out-of-Pocket (OOP) Expenditure per capita (Current US$)					
2000-2006	87.578	55.679	387.14	527.46	181.996	1371.82
2007-2009	179.475	117.126	590.93	797.516	347.798	1827.04
2010-2019	194.06	137.393	608.291	852.203	329.146	2418.765
2020-2022	258.732	178.959	679.459	961	417.884	2728.687
2023	279.181	188.113	685.798	971.142	470.028	2998.39
	External Health Expenditure per capita (Current US$)					
2000-2006	2.328	.247	.045	.011	.318	0
2007-2009	3.826	.876	.065	.304	.785	0
2010-2019	3.967	.978	.092	.126	2.003	0
2020-2022	5.165	1.219	.113	.17	2.298	0
2023	4.966	1.41	.126	.188	2.299	0

Source: Authors' calculations in Stata 14.2/SE software (Stata, 2025) based on World Bank Data (World Bank DataBank, 2025)

Current Health Expenditure: The hypothesis is valid. All clusters show a stable increase in current health expenditure as a percentage of GDP throughout all turbulent periods. This suggests that healthcare remains a priority during crises, or that crisis situations (especially the pandemic) necessitate increased resources. Cluster 6, Cluster 3, and Cluster 4 maintain the highest and continuously growing levels of this expenditure.

Capital Health Expenditure: The hypothesis is valid, but ambiguously so. It increased during the 2007–2009 crisis (Cluster 1, Cluster 2). It sharply dropped during the pandemic (2020–2022) in Cluster 2 (from 0.23 to 0.093) and Cluster 5 (from 0.152 to 0.078). This may indicate a reallocation of resources from infrastructure projects to immediate needs (e.g., procurement of medical supplies).

External Health Expenditure: The hypothesis is valid for Cluster 1 and Cluster 5, where external aid increases during periods of turbulence (e.g., Cluster 1 from 3.967 in 2010–2019 to 5.165 in 2020–2022), indicating their greater reliance on external financing during crises.

Table 5

Mean cluster values for the Workforce & Infrastructure Capacity Indicators of Health System

Period	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
	Physicians (per 10,000 people)					
2000-2006	23.672	24.66	31.824	31.668	33.191	36.623
2007-2009	25.097	25.92	33.771	35.88	35.786	38.233
2010-2019	27.203	27.33	35.688	39.067	39.581	41.118
2020-2022	29.529	28.546	35.839	43.256	43.476	44.167
2023	29.697	29.123	32.358	44.543	44.62	45
	Medical doctors (per 10,000)					
2000-2006	24.482	24.528	33.341	32.128	32.854	36.384
2007-2009	25.963	25.876	33.625	36.554	35.866	38.147
2010-2019	28.717	28.493	35.625	38.546	39.438	41.149
2020-2022	30.848	34.878	38.753	41.932	43.805	44.333
2023	32.204	36.663	35.674	46.791	45.392	45.22
	Density of dentists per 10,000 population					

2000-2006	4.748	3.949	6.047	7.272	7.093	4.934
2007-2009	4.924	4.769	6.124	7.246	7.716	5.213
2010-2019	5.707	6.089	6.985	7.219	8.421	5.041
2020-2022	5.979	9.193	7.327	7.302	9.401	4.997
2023	6.199	9.893	7.556	7.566	10.206	4.99
	Density of pharmacists per 10,000 population					
2000-2006	3.805	3.367	8.128	7.602	5.722	6.161
2007-2009	4.327	4.018	8.643	7.046	6.651	6.293
2010-2019	5.488	5.301	9.263	7.522	7.847	6.664
2020-2022	5.607	6.294	10.02	8.637	8.66	6.723
2023	5.933	7.35	10.202	8.93	9.29	6.93
	Density of nurses and midwives per 10,000 population					
2000-2006	47.862	58.881	70.817	107.804	61.973	125.65
2007-2009	52.237	62.363	75.153	115.194	64.68	138.87
2010-2019	54.231	66.615	79.505	122.649	68.496	166.895
2020-2022	55.343	73.91	87.693	133.993	75.564	187.323
2023	55.089	67.65	89.85	134.594	75.159	195.83
	Hospital beds (per 1,000 people)					
2000-2006	5.792	7.317	5.579	5.633	5.985	5.814
2007-2009	5.45	7.366	5.086	4.883	5.637	5.223
2010-2019	5.213	7.084	4.651	4.04	5.306	4.804
2020-2022	5.02	6.811	4.269	3.45	4.926	4.37
2023	4.901	6.777	4.068	3.071	4.811	4.15

Source: Authors' calculations in Stata 14.2/SE software (Stata, 2025) based on World Bank Data (World Bank DataBank, 2025)

Medical Personnel (Physicians, Nurses, Dentists, Pharmacists): The hypothesis is not valid in the sense of a significant negative impact. On the contrary, the density of personnel consistently increases across all clusters throughout all periods, including crises. This indicates a general trend towards increasing medical workforce that is not halted by turbulence. The sharp increase in dentist density in Cluster 2 and Cluster 5 during the pandemic (2020–2022) is particularly noticeable.

Hospital Beds: The hypothesis is valid. The average number of beds per 1,000 people consistently decreases across all clusters throughout the entire study period, including crisis years. This reflects a structural transformation of healthcare systems (reduction of inpatient facilities). This change is not unique to the period of turbulence but represents a long-term trend.

Table 6

Mean cluster values for the Health Outcome Indicators

Period	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
	Death rate, crude (per 1,000 people)					
2000-2006	11.486	12.505	9.449	9.002	10.761	8.386
2007-2009	11.7	12.778	9.253	8.593	10.871	8.067
2010-2019	12.393	12.663	9.548	8.499	11.092	7.93
2020-2022	15.269	14.943	10.794	8.97	12.983	8.5
2023	13.321	12.31	10.244	8.844	11.487	8.1
	Life expectancy at birth, total (years)					
2000-2006	72.558	71.36	79.373	78.905	74.991	80.659
2007-2009	73.805	72.288	80.669	80.186	76.285	81.923
2010-2019	75.028	74.458	81.98	81.528	78.382	83.135
2020-2022	74.476	73.902	81.839	82.029	78.399	83.483
2023	76.286	76.18	82.458	82.364	79.706	84.06
	Suicide mortality rate (per 100,000 population)					

2000-2006	17.302	21.733	11.411	15.384	20.502	19.386
2007-2009	16.063	19.567	10.62	14.704	17.846	18.1
2010-2019	13.544	16.517	10.446	13.942	16.655	14.63
2020-2022	11.967	13.509	9.789	13.059	14.308	12.567
2023	10.96	12.573	9.628	12.821	13.664	11.82
	Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 (%)					
2000-2006	26.527	27.976	13.729	14.008	20.334	11.371
2007-2009	25.396	26.111	12.2	12.289	18.538	10.1
2010-2019	22.185	22.6	11.008	10.717	15.96	8.79
2020-2022	20.251	19.88	9.522	8.851	13.562	7.32
2023	19.342	18.95	9.108	8.328	12.809	6.91
	Number of infant deaths					
2000-2006	640.357	3935.762	2663.257	339.635	306.5	325.143
2007-2009	467.958	3514.556	2456.4	292.593	245.417	301
2010-2019	343.663	2473.8	2126.66	249.711	196.45	310.6
2020-2022	241.667	1568.333	1821.506	224.444	156.125	296.333
2023	220.125	1297	1793.512	207.778	144	289
	Number of maternal deaths					
2000-2006	9.429	75.19	52.857	6.429	4.75	6.429
2007-2009	7.083	54.667	51.533	5.37	4.125	6
2010-2019	5.763	34.133	42.92	4.289	3.425	6
2020-2022	4.958	24.556	41.013	3.963	3.958	5
2023	4	19.333	33.67	3.111	3.25	5

Source: Authors' calculations in Stata 14.2/SE software (Stata, 2025) based on World Bank Data (World Bank DataBank, 2025)

Life Expectancy: During the 2007–2009 crisis, the hypothesis is not valid - life expectancy increased. During the pandemic (2020–2022), the hypothesis is valid for most clusters (Cluster 1, Cluster 2, Cluster 3, Cluster 5), where a decline in life expectancy occurred. This is a significant change that interrupted the multi-year upward trend. Cluster 4 and Cluster 6 managed to sustain growth.

Crude Death Rate: The hypothesis is valid. A sharp jump in the indicator is observed in all clusters during 2020–2022 (e.g., Cluster 1: 15.269; Cluster 2: 14.943; Cluster 5: 12.983). This is the most obvious significant change, directly linked to the pandemic.

Mortality from major diseases (Mortality): The hypothesis is not valid. The indicator consistently decreases throughout the entire period, including crises. This points to continuous progress in the prevention and treatment of these diseases that was not disrupted by global turbulence.

The hypothesis that health system indicators undergo significant changes during periods of global turbulence is valid, but selectively so:

Most Obvious Changes (Hypothesis Valid): Crude Death Rate: A sharp, immediate spike in 2020–2022 in all clusters. Life Expectancy: Interruption of the long-term trend and decline in 2020–2022 for Cluster 1, 2, 3, 5. Capital Health Expenditure: Sharp drop in Cluster 2 and Cluster 5 in 2020–2022.

Resilient Trends (Hypothesis Not Valid): Current Health Expenditure: Continuous growth, which accelerated during crises. Medical Personnel Density: Continuous growth despite crises. Mortality from major diseases: Continuous decrease despite crises. Hospital Beds: Continuous decline, not exclusively linked to turbulence.

5. CONCLUSION

The contemporary financial and institutional landscape of European public health systems has been fundamentally reshaped by global turbulence, particularly the cascading effects of the COVID-19 pandemic and geopolitical conflicts such as the war in Ukraine. The literature reviewed comprehensively

demonstrates that the capacity and efficacy of these systems extend well beyond immediate medical inputs, exhibiting a profound susceptibility to indirect macroeconomic and financial shocks. Specifically, factors such as inflation, high public debt, exchange rate volatility, and the resultant erosion of household purchasing power are shown to be critical determinants of access to quality care, often constraining governmental ability to fund essential services, including preventative programmes and the import of vital medical supplies. This established nexus between macroeconomic instability and diminished public health underscores the necessity for policy frameworks that prioritise long-term financial sustainability over short-term fiscal expediency.

Effective systemic resilience, therefore, requires a strategic reorientation of public finance and governance. Empirical evidence suggests that public investment should favour capital-intensive projects in health infrastructure and social protection, as these have been shown to generate positive economic multipliers and foster job retention. Conversely, an over-reliance on current expenditure or fiscal transfers is observed to have a less effective or even detrimental impact on sustained economic activity. Furthermore, institutional quality and stability are paramount; the erosion of public trust, often exacerbated by socio-political polarisation and unaddressed societal concerns, directly undermines the collective adherence to public health mandates, thereby complicating crisis management.

Taken together with these insights, the broader implication of the evidence reviewed becomes clear. Collectively, the available evidence reinforces the notion that strengthening the financial and institutional capacity of European health systems demands more than incremental resource allocation. Rather, it requires strategic realignment focused on building adaptive mechanisms capable of absorbing shocks without compromising core service delivery or widening population health disparities. The observed divergence in system performance across clusters of European countries highlights that resilience is not uniformly distributed and is strongly influenced by pre-existing structural conditions. Policy solutions must therefore combine sustained capital investment, diversification of financing channels, and institutional reforms that enhance agility, transparency, and public trust. By integrating these priorities, health systems can transition from reactive crisis management to proactive preparedness, ensuring that both economic and epidemiological disruptions are met with robust, equitable, and sustainable responses.

This perspective aligns closely with the empirical findings of the present study, which demonstrate that vulnerability and resilience are inherently multidimensional phenomena. Finally, the modernisation of public health capacity must address crucial technological and human-centric imperatives. The ethical and effective integration of technologies, such as Artificial Intelligence for enhanced pharmacovigilance and real-time analytics, is vital for improving safety and epidemic control. Concurrently, system design must be recalibrated to ensure patient satisfaction, focusing on the quality of human interaction, the reduction of unnecessary bureaucracy, and culturally sensitive data governance frameworks. Ultimately, the durability of public health systems depends on a multi-faceted strategy that strategically manages financial risk, bolsters institutional trust, and ensures that technological advancement is harmonised with the core ethical principles of patient-centred care and equitable access to health security.

The analysis of volatility across 34 European countries yields a partial confirmation of the initial hypothesis, demonstrating that the dynamics of key health indicators are highly specific to the nature of the external threat encountered.

The study successfully established a distinction in sensitivity based on the type of indicator. Outcome Indicators (Mortality Rate and Life Expectancy at Birth) were found to be highly sensitive to epidemiological threats. This was evidenced by the sharp, widespread increase in the Crude Mortality Rate during the pandemic (Period 4, 2020–2022), with maximum growth exceeding 37% in several countries, and the most significant reductions in life expectancy observed during the same period. In contrast, these

indicators exhibited insensitivity to socio-economic shocks, as the Global Financial and Economic Crisis (Period 2, 2007–2009) did not cause widespread mortality increases or reductions in life expectancy.

Input Indicators (Expenditure) showed sensitivity to socio-economic shocks, yet this response was typically lagged. The steepest average growth in most health expenditure categories (Government, Private, and OOP per capita) occurred during the financial crisis (Period 2), suggesting a reactive spending surge. This was followed by a noticeable contraction in expenditure for a significant group of countries during the post-crisis recovery (Period 3), confirming a causal link between economic shocks and expenditure volatility, but with a clear time lag.

Capacity Indicators (Hospital Beds per 1,000 population) showed no clear correlation with either type of external threat. The trend was dominated by a long-term structural reduction that persisted across all periods, including the pandemic. The median reduction in hospital beds even accelerated during the pandemic (Period 4 / Period 3), confirming the indicator's independence from immediate crisis response.

In summary, the determination of parameter volatility is heavily dependent on the nature of the external threat (socio-economic vs. epidemiological) and the specific indicator being analysed. The results indicate that while funding stability is influenced by economic dynamics and system stabilisation needs post-shock, the immediate, acute volatility of core population health outcomes (Mortality/Life Expectancy) is primarily driven by epidemiological events.

Cluster analysis revealed the existence of 6 clusters within 34 European countries. Consequently, Clusters 3, 4, and 6 exhibit better health outcomes (high life expectancy, low mortality) and higher expenditure on healthcare (especially government and private spending). Cluster 1 shows the worst health outcomes and the lowest expenditures.

The COVID-19 pandemic period (2020–2022) proved to be the most turbulent for health outcome indicators (mortality and life expectancy), while financial indicators mostly increased, and workforce indicators maintained their long-term trends.

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REFERENCES

Akinyemi, I. O. (2024). How Do COVID-19 Job Loss and Workplace Closures Affect COVID-19 Policy Satisfaction and Conspiracy Beliefs?. *SocioEconomic Challenges*, 8(2), 140-156. https://doi.org/10.61093/sec.8(2).140-156.2024

Al Assaf, G., & Abdel Halim, M. (2025). Nexus between public debt, financial development, and the volatility of economic growth in emerging markets. *Montenegrin Journal of Economics*, 21(4), 155–168. https://doi.org/10.14254/1800-5845/2025.21-4.12

Aliu, F., Apanovych, Y., Bajra, U., & Nuhiu, A. (2024). Assessing the impact of the Russia-Ukraine war and COVID-19 on selected European currencies and key commodities. *Journal of Business Economics and Management, 25*(5), 1097–1119. https://doi.org/10.3846/jbem.2024.22518

Al-Kahtani, N. K., Subbarayalu, A. V., Alshakhs, M., Al-Ansary, N. F. S., AL-Abdulwahab, M., Aljafar, Z., & Raman, V. (2025). Health insurance claims management systems: Potential factors affecting their decisions. *Insurance Markets and Companies*, *16*(2), 112–123. https://doi.org/10.21511/ins.16(2).2025.09

Asad, A. I., Popesko, B., & Godman, B. (2024). Unraveling the internal drivers of pharmaceutical company performance in Europe: A DEMATEL analysis. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *19*(2), 661–702. https://doi.org/10.24136/eq.2896

Baharanyi, S. N., Mambo, L. N., & Muluma, A. M. (2024). Socioeconomic determinants and impacts of life expectancy in the Democratic Republic of the Congo: A time series analysis from 1960-2020. *Economics, Management and Sustainability*, *9*(2), 59–71. https://doi.org/10.14254/jems.2024.9-2.5

Baskiewicz, N., Daroń, M., & Pachura, A. (2023). Directions of changes in healthcare unit management from the patient's perspective. *Polish Journal of Management Studies*, *28*(1), 82–100. https://doi.org/10.17512/pjms.2023.28.1.05

Bhowmik, D. (2025). Asymmetry of Private Healthcare Expenditure on Life Expectancy in USA. *Health Economics and Management Review*, 6(3), 90–98. https://doi.org/10.61093/hem.2025.3-07

Burrell, D. N. (2025a). Health Safety and Cyberpsychology Interventions to Combat Mental Health Challenges in Underserved African-American Populations. *Safety and Security Advances, 1*(1), 44-62. https://doi.org/10.61093/ssa.1(1).44-62.2025

Burrell, D. N. (2025b). Post-Marketing Surveillance and Regulation of the Pharmaceutical and Medical Device Market: Exploring the Possibilities of Healthcare Artificial Intelligence Applications. *Public Governance, Regulation and Law*, *1*(1), 51–64. https://doi.org/10.61093/pgrl.1(1).51-64.2025

Chapsa, X., Polychronidou, P., & Athanasenas, A. L. (2022). The Health and Socio-Economic Crisis of COVID-19 'State of Shock': A Case Study in Greece. *European Journal of Interdisciplinary Studies*, *14*(2), 100–118. https://doi.org/10.24818/ejis.2022.23

Chhetri, S., & Adhikari, G. M. (2025). Socioeconomic Challenges Caused by Health Shocks: A Household Poverty Perspective. *SocioEconomic Challenges, 9*(3), 221-235. https://doi.org/10.61093/sec.9(3).221-235.2025

Dinu, V. (2024). Innovative Application of Artificial Intelligence in Business Impacting Socio-Economic Progress. *Amfiteatru Economic,* 26(66), pp. 398-401. https://doi.org/10.24818/EA/2024/66/398

Dinu, V., Dragoş, C. M., Mare, C., Dragoş, S. L., & Mare, R. (2024). Economic and institutional determinants of environmental health and sustainability: Spatial and nonlinear effects for a panel of worldwide countries. *Oeconomia Copernicana*, *15*(1), 195–227. https://doi.org/10.24136/oc.2915

Dudzevičiūtė, G. (2023). Dependence of economic growth on government expenditure by function in the Baltic states. *Journal of International Studies*, 16(1), 9- 22. https://doi.org/10.14254/2071-8330.2023/16-1/1

European Commission (EC). (2023). *Health at a Glance: Europe 2022*. State of Health in the EU Cycle. Retrieved from https://health.ec.europa.eu/system/files/2022-12/2022_healthatglance_rep_en_0.pdf

Filipova, M., Djakona, A., & Haram, V. (2025). Determinants of Government Expenditures in the Baltic States. *Financial Markets, Institutions and Risks, 9*(2), 66-89. https://doi.org/10.61093/fmir.9(2).66-89.2025

Gani, S. (2024). Inferential analysis of factors influencing the expectation gap in national health insurance: Evidence from South Africa. *Economics, Management and Sustainability*, *9*(2), 6–19. https://doi.org/10.14254/jems.2024.9-2.1

Gayathiri, G., & Prabu, G. (2025). Artificial intelligence-driven human resource practices and employee well-being: Examining the mediating effect of employee engagement. *Problems and Perspectives in Management*, *23*(4), 247–263. https://doi.org/10.21511/ppm.23(4).2025.18

Ghauri, S.P., Ahmed, R.R., Streimikiene, D., Qadir, H. and Hayat, A. (2024). Macroeconomic Factors Driving Exchange Rate Volatility and Economic Sustainability: Case Study of Pakistan. *Amfiteatru Economic*, 26(66), pp. 612-628. https://doi.org/10.24818/EA/2024/66/612

Gheorghe, C., & Panazan, O. (2024). Effect of health system performance on volatility during the COVID-19 pandemic: a neural network approach. *Journal of Business Economics and Management, 25*(1), 129–152. https://doi.org/10.3846/jbem.2024.21059

Hamadouche, F. (2024). The Impact of Public Expenditure on Inflation: An ARDL Approach. *Financial Markets, Institutions and Risks, 8*(2), 70-85. https://doi.org/10.61093/fmir.8(2).70-85.2024

Iwu, C. G., Sibanda, L., & Makwara, T. (2023). 'Cherish' or perish: the inevitable outcome of an economy in crisis. *International Journal of Entrepreneurial Knowledge*, *11*(1), 102–119. https://doi.org/10.37335/ijek.v11i1.176

Kordoš, M. (2024). The impact of Brexit on Slovak healthcare professionals in the United Kingdom – the fallouts and consequences. *Economics and Sociology, 17*(2), 210–225. https://doi.org/10.14254/2071-789X.2024/17-2/14

Lyeonov, S., Vysochyna, A., Śmiech, L., & Rabe, M. (2024). Economic growth and national security: Patterns of European countries' resistance to global turbulences. *Journal of International Studies*, 17(3), 182-204. doi:10.14254/2071- 8330.2024/17-3/10

Nyile, E. K. (2025). A leaner, meaner lifeline: How supply chain efficiency boosts the performance of humanitarian aid in Kenya. *Journal of Sustainable Development of Transport and Logistics*, *10*(1), 57–79. https://doi.org/10.14254/jsdtl.2025.10-1.4

Oe, H., & Weeks, M. (2025). Digital Ethnography as a Methodological Innovation for Understanding Transpersonal Care in Public Health: A Theoretical Framework. *Health Economics and Management Review, 6*(3), 38-55. https://doi.org/10.61093/hem.2025.3-04

OECD (2024). *Health at a Glance: Europe 2024*. Retrieved from https://www.oecd.org/en/publications/health-at-a-glance-europe-2024_b3704e14-en/full-report.html

Oliinyk, O., Mishchuk, H., Samoliuk, N., & Bilan, Y. (2025). Bridging the divide: Addressing social tensions between internally displaced persons and host communities during wartime in Ukraine. *Problems and Perspectives in Management*, *23*(3), 645–657. https://doi.org/10.21511/ppm.23(3).2025.46

Radziejowska, M., & Thirakulwanich, A. (2023). Strategic management approaches to implementing a health-promoting food labeling system. *Polish Journal of Management Studies*, *28*(1), 279–294. https://doi.org/10.17512/pjms.2023.28.1.16

Ray, A. (2024). A Time Series Analysis of the Total Program Expenditures to Support the Supplemental Nutrition Assistance Program in the United States. *Financial Markets, Institutions and Risks, 8*(1), 133-141. https://doi.org/10.61093/fmir.8(1).133-141.2024

Rivero, R. A. B., Núñez Ramírez, M. A., & Clark Mendívil, Y. (2025). Fiscal and Monetary Policy Transmission Shocks. *Montenegrin Journal of Economics*, *21*(2), 7–20. https://doi.org/10.14254/1800-5845/2025.21-2.1

Rudawska, I., Krot, K., & Porada-Rochoń, M. (2024). Unveiling the nexus of technology acceptance in healthcare: Empirical exploration of the multifaceted drivers. *Human Technology*, *20*(1), 114–130. https://doi.org/10.14254/1795-6889.2024.20-1.6

Saari, E., Levonius, V., Koskela, I., Koivisto, T., & Känsälä, M. (2024). Intra-normativities in technologizing old age care work: Mobile record-keeping, remote homecare and social media use shaping good care. *Human Technology*, *20*(3), 468–487. https://doi.org/10.14254/1795-6889.2024.20-3.3

Sidii, F. S. (2025). Building Trust and Sovereignty: A Holistic Framework for Data Governance in African Healthcare Systems. *Health Economics and Management Review*, *6*(3), 56–74. https://doi.org/10.61093/hem.2025.3-05

Sitnicka, S., Mursalov, M., Mammadov, H., Babaiev, D., & Zhou, Y. (2025). Ethics, Institutions, Infrastructure, and Governance in AI National-Level Readiness: A Hidden Driver of Banking Transformation. *Business Ethics and Leadership, 9*(3), 290-304. https://doi.org/10.61093/bel.9(3).290-304.2025

Stankevičienė, J., & Borisova, J. (2022). Conceptual approach to valuation of climate change in EU countries through the prism of economic activities. *Rynek Energii 5(162)*, 6–16.

Stata software (2025). Retrieved from https://www.stata.com/

Stehlíková, B., Vincúrová, Z., Brezina, I., & Švihlíková, I. (2023). COVID-19 mortality as a reflection of the quality of health in EU countries. *Economics and Sociology, 16*(3), 112–128. https://doi.org/10.14254/2071-789X.2023/16-3/8

Strouhal, J., Dey, S. K., Kloudova, J., Hoang, S. D., & Tučková, Z. (2024). Unraveling the Financial Impact of COVID-19 on the Tourism Industry through a Difference-In-Difference Analysis. *Journal of Tourism and Services*, *15*(28), 143–160. https://doi.org/10.29036/jots.v15i28.614

Svazas, M., Navickas, V., Paskevicius, R. et al. (2023). Renewable energy versus energy security: the impact of innovation on the economy. *Rynek Energii 1(164)*, 60-71.

Takemoto, T., Ishihara, S., Suzuki, A.,Tatewaki, K., Sukeda, T., Yamada, R., Yamaoka, Y., & Oe, H. (2024). The Importance of a Comprehensive Disaster Preparedness Strategy Focused on the Interplay of Individual and Community Elements: An Exploratory Study. *SocioEconomic Challenges, 8*(2), 234-246. https://doi.org/10.61093/sec.8(2).234-246.2024

Tayeb, M. E., Louail, B., Abubaker, M. M. A., Mouhammad, I. H. E., & Riache, S. (2025). Do Green Claims Work? The Crucial Role of Consumer Attitude. *Business Ethics and Leadership, 9*(3), 227-236. https://doi.org/10.61093/bel.9(3).227-236.2025

Trenta, M., Gutiérrez Barroso, J., Rodríguez Peñate, L., & Crespo García, E. (2025). Europe on edge: Mapping right-wing influence and public sentiment across the EU. *Administratie si Management Public, 45*, 6–26. https://doi.org/10.24818/amp/2025.45-01

Valaskova, K., Gajdosikova, D., & Lazaroiu, G. (2023). Has the COVID-19 pandemic affected the corporate financial performance? A case study of Slovak enterprises. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *18*(4), 1133–1178. https://doi.org/10.24136/eq.2023.036

World Bank DataBank (2025). Retrieved from https://databank.worldbank.org/home.aspx

World Health Organization (WHO). (2021). *Health and care workforce in Europe: Time to act*. WHO Regional Office for Europe. Retrieved from https://www.who.int/europe/publications/i/item/9789289058339

Yehorova, Y., & Drozd, S. (2024). Determinants of Human Capital Development and Macroeconomic Freedoms: DEA Modelling. *Business Ethics and Leadership, 8*(1), 203-219. https://doi.org/10.61093/bel.8(1).203-219.2024

Yeremenko, O., Khishauyeva, Z., Wei, L., Stoyanets, N., Turoliev, H., Lavrukhin, V., & Kovalenko, D. (2025). Human capital, migration, and financial flows as drivers of post-crisis economic performance. *Knowledge and Performance Management*, *9*(2), 273–293. http://dx.doi.org/10.21511/kpm.09(2).2025.19

Yurchyk, H., Mishchuk, H., & Bilan, Y. (2023). Government assistance programs for internally displaced persons: assessing the impact on economic growth and labour market. *Administratie si Management Public, 41*, 201–218. https://doi.org/10.24818/amp/2023.41-11

APPENDIX A

Table A.1

2000-2023 averaged values of health indicators for 34 European countries

		FINANCE & EXPENDITURE CAPACITY						WORKFORCE AND INFRASTRUCTURE CAPACITY						HEALTH OUTCOMES					
ID	**Country**	**Cap**	**Cur**	**Dom_gov**	**Dom_prv**	**Ext**	**OoP**	**Physicians**	**Med_doc**	**Dentists**	**Pharmacists**	**Nurses**	**Beds**	**Death**	**Life**	**Suicide**	**Mortality**	**Infant_d**	**Maternal_d**
1	Albania	0,17	5,51	103,00	104,08	5,01	104,01	12,97	13,00	3,43	5,66	41,20	2,93	7,62	77,82	5,77	15,76	518,92	3,38
2	Austria	0,69	10,09	3353,06	1242,24	0,00	858,30	48,02	48,12	5,66	6,72	74,28	7,56	9,44	80,49	16,29	11,99	278,67	4,71
3	Belgium	0,00	10,06	3269,04	1034,73	0,03	834,18	29,68	32,30	7,55	12,21	106,91	6,02	9,80	80,25	19,81	12,31	447,54	7,25
4	Bosnia and Herzegovina	0,18	8,98	278,18	135,33	4,95	134,22	19,30	18,38	2,14	1,12	53,89	3,41	10,73	76,31	10,54	19,85	229,33	3,29
5	Bulgaria	0,11	7,10	282,19	214,58	0,00	206,12	38,79	38,91	9,46	7,75	46,20	6,94	15,41	73,53	11,81	25,41	616,29	7,42
6	Croatia	0,13	7,12	761,19	152,85	0,02	110,51	29,61	30,33	7,91	6,79	62,39	5,65	12,37	76,48	17,66	18,41	203,46	3,08
7	Czechia	0,15	7,03	1107,46	223,22	0,00	190,32	37,60	37,37	7,10	6,18	86,28	7,03	10,63	77,46	14,66	17,16	308,00	4,63
8	Denmark	0,54	9,70	4576,05	877,05	0,00	762,13	37,52	37,56	7,88	4,94	112,58	3,20	9,85	79,47	12,43	13,22	227,63	3,75
9	Estonia	0,22	5,92	777,81	256,87	3,10	236,63	32,98	32,79	9,10	6,59	64,95	5,21	12,37	75,23	19,82	19,74	53,83	1,50
10	Finland	0,38	8,91	3173,48	848,17	0,13	741,52	35,12	34,28	8,11	11,61	111,56	5,28	9,68	80,22	17,91	11,47	136,92	3,96
11	France	0,54	10,96	3074,29	1160,94	0,00	397,86	32,88	32,84	6,79	10,30	85,12	6,54	8,85	81,45	16,89	11,66	2515,21	64,83
12	Germany	0,00	10,92	3501,20	1055,02	0,00	598,05	38,92	38,84	8,19	6,26	105,54	8,26	10,88	79,97	13,13	13,07	2529,30	40,36
13	Greece	0,24	8,39	1095,68	726,02	4,61	621,02	58,31	56,60	12,59	9,84	35,85	4,47	10,65	80,27	4,33	13,32	383,92	4,50
14	Hungary	0,22	7,11	631,26	295,40	0,00	254,55	31,58	32,07	5,67	6,54	60,66	7,27	13,38	74,39	22,70	24,33	485,38	13,42
15	Iceland	0,22	8,59	3908,53	871,45	0,00	805,73	37,36	37,96	8,88	7,21	153,17	4,15	6,39	81,94	13,04	9,84	9,96	0,00
16	Ireland	0,42	8,13	3540,84	1191,83	0,00	604,67	34,07	33,86	5,72	10,37	136,68	3,71	6,66	80,46	11,22	11,95	239,33	4,29
17	Italy	0,00	8,54	2163,14	692,97	0,00	642,19	38,27	40,43	6,87	10,78	57,56	3,57	10,35	81,95	7,04	10,45	1691,92	35,88
18	Latvia	0,23	5,91	467,33	314,93	1,81	299,29	31,18	31,30	6,72	7,23	49,20	6,45	14,68	73,14	23,19	24,76	129,25	5,08
19	Lithuania	0,17	6,42	591,22	292,93	2,11	279,06	41,31	41,79	8,80	9,10	78,72	7,12	13,61	73,54	36,00	22,74	158,92	3,29
20	Moldova	0,54	8,53	97,63	79,71	11,23	77,95	25,10	30,18	4,51	3,83	61,52	5,92	13,22	69,11	17,00	27,57	744,38	10,67
21	Netherlands	0,11	9,80	3181,81	1558,79	0,40	486,65	32,14	31,67	4,82	1,97	104,22	3,83	8,68	80,55	10,70	12,23	721,88	13,46
22	North Macedonia	0,24	7,06	191,97	124,02	2,77	121,35	26,98	27,76	7,77	4,31	44,13	4,48	9,88	74,63	9,30	25,91	223,29	1,54
23	Norway	0,50	9,14	6184,62	1112,27	0,55	1089,77	42,18	40,92	8,66	6,46	160,07	4,12	8,46	81,27	12,29	10,74	152,25	2,04
24	Poland	0,19	6,25	537,63	226,05	0,49	178,66	22,64	25,16	4,53	6,92	59,19	6,48	10,40	76,21	16,08	20,18	1987,21	12,63
25	Portugal	0,00	9,49	1256,62	719,34	1,20	548,89	43,34	43,60	8,16	7,32	59,35	3,45	10,47	79,65	12,18	12,42	330,88	9,96
26	Romania	0,15	5,16	357,03	95,54	0,37	91,74	23,71	26,43	6,85	7,08	64,71	6,80	12,98	73,60	11,63	22,93	2297,75	51,83
27	Serbia	0,26	8,70	304,62	195,95	3,54	184,98	24,55	29,20	3,39	2,65	61,59	5,60	14,60	74,17	16,88	24,34	475,88	9,79
28	Slovak Republic	0,18	6,90	823,32	257,02	0,00	223,17	33,61	33,86	4,94	6,42	63,65	6,27	10,04	75,51	12,98	19,47	327,17	3,38
29	Slovenia	0,25	8,37	1335,98	523,88	0,23	234,57	26,76	26,66	6,54	5,68	87,01	4,63	9,63	79,36	22,43	13,76	53,38	1,33
30	Spain	0,03	8,62	1751,31	682,03	0,00	524,44	37,35	37,25	6,38	10,29	52,45	3,13	8,83	81,83	7,88	10,96	1368,29	17,29
31	Sweden	0,52	9,64	4215,51	806,50	0,00	739,90	39,26	38,79	8,09	7,68	114,27	2,61	9,62	81,59	15,02	10,12	273,38	5,17
32	Switzerland	0,00	10,46	2565,40	5447,75	0,00	2102,33	39,99	39,95	5,02	6,49	155,12	5,07	8,16	82,34	16,08	9,44	310,96	5,96
33	Ukraine	0,27	6,85	93,76	89,98	1,54	84,60	33,46	32,85	6,17	0,36	70,44	8,15	15,33	70,04	25,92	29,23	4319,29	76,13
34	UK	0,34	9,44	3195,57	772,53	0,40	606,19	23,59	26,51	5,12	7,31	88,73	3,03	9,43	80,10	8,22	12,30	3257,08	73,00
Mean value		**0,24**	**8,23**	**1845,52**	**717,12**	**1,31**	**469,87**	**33,53**	**34,10**	**6,75**	**6,82**	**81,45**	**5,24**	**10,68**	**77,77**	**14,97**	**16,74**	**823,73**	**14,96**
Median value		**0,22**	**8,54**	**1182,04**	**602,96**	**0,18**	**348,58**	**33,53**	**33,35**	**6,82**	**6,76**	**67,70**	**5,24**	**10,19**	**79,42**	**13,89**	**13,54**	**329,02**	**5,13**
Maximum value		**0,69**	**10,96**	**6184,62**	**5447,75**	**11,23**	**2102,33**	**58,31**	**56,60**	**12,59**	**12,21**	**160,07**	**8,26**	**15,41**	**82,34**	**36,00**	**29,23**	**4319,29**	**76,13**
Minimum value		**0,00**	**5,16**	**93,76**	**79,71**	**0,00**	**77,95**	**12,97**	**13,00**	**2,14**	**0,36**	**35,85**	**2,61**	**6,39**	**69,11**	**4,33**	**9,44**	**9,96**	**0,00**

Source: Authors' calculations based on World Bank Data (World Bank DataBank, 2025)