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

Journal of International Studies

Centre of Sociological Research

Scientific Papers

Economic growth and national security: Patterns of European countries' resistance to global turbulences

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Abstract. Macroeconomic stability and national security are core measurement indicators of country performance. Historical, economic, social and other prerequisites contribute to the formation of country-specific patterns of these performance indicators resistance to global turbulences such as COVID-19 pandemic. Pandemic proved that considering of public health issues in promoting economic prosperity, social welfare and environmental security is crucially important. The aim of the research is to identify country-specific (for 34 European countries) patterns of socio-economic (internal) and public health (external) drivers and inhibitors of ensuring economic growth, macroeconomic stability and national security resistance to global turbulences similar to COVID-19 pandemic. Realization of the research objectives involves the implementation

Received: October, 2023
1st Revision: July, 2024
Accepted: September, 2024

DOI: 10.14254/2071-8330.2024/17-3/10

of the following stages: 1) identification of the general and country-specific the most influential internal impetus indicators fostering volatility socio-economic development and national security based on multivariate analysis; 2) formation of general and country-specific matrix of influential determinants of ensuring macroeconomic stability and national security resistance to global turbulences similar to COVID-19 pandemic; 3) formalization general and country-specific external drivers and inhibitors of macroeconomic stability and national security volatility within public health determinants. The study is carried out on a sample of 34 European countries for 2000-2022.

Keywords: macroeconomic stability, economic growth, national security, coronavirus disease, COVID-19, global turbulence, European countries.

JEL Classification: C23, E60, F52, I18

1. INTRODUCTION

In the conditions of intensification of globalization and integration processes inherent in the current stage of world economic relations, there is an increase in interdependence between the economies of the countries of the world, a convergence of trends in their socio-economic development is observed. At the same time, despite the undeniable advantages of globalization, including close cooperation between countries, the possibility of practically unhindered movement of labour resources and capital between countries, which allows saving due to the use of relative advantages, there are a number of risks that accompany these processes. In particular, increasing the openness of economic systems contributes to the increase of their vulnerability due to the rapid transmission of destructive processes both from one economic system to another and between sectors of the national economy within the borders of one country. Characteristic of the current stage of the development of world economic relations is not only an increase in the speed of shocks, but also an increase in the scale of the negative impact of these crisis processes. All these effects were quite clearly manifested both during the global financial crisis and during the development of the COVID-19 pandemic. That is why, in modern conditions, an important task facing the governments is to identify the drivers and inhibitors that determine the resistance of the socio-economic system to global turbulence of various origins. It is fair to note that the high integration of economic systems leads to the formation of certain generalized patterns of relevance of influence on the main macroeconomic parameters, especially among groups of countries characterized by common historical prerequisites or the current vector of economic policy development (for example, European countries). At the same time, it is important to understand that historical, economic, social and other prerequisites contribute to the formation of specific models of determinism of these performance indicators for each country, which, despite general convergent trends, can vary significantly. Taking into account the above, the main task of this study is to identify internal and external drivers and inhibitors of the resistance of indicators of economic growth, macroeconomic stability and national security to global turbulences (on the example of a sample of 34 European countries).

2. LITERATURE REVIEW

The last of the global turbulences - the pandemic of the coronavirus infection - proved the vulnerability not only of the health care system to absorb destructive processes and leveling risks and threats to the life of the population (Lima, 2024), but also the vulnerability of the socio-economic system of the world countries in the context of resilience to this kind of crisis. In these conditions, the need to identify country-

specific patterns of relevance of the internal mechanisms of the socio-economic system in the context of ensuring its resilience to overcoming turbulences that are gaining a global scale becomes urgent. Taking into account the need for a comprehensive characterization of the state of the socio-economic system within the scope of this study, it is proposed to choose such three performance parameters as key performance characteristics: economic growth, macroeconomic stability and national security. Considering the results of previous studies on this issue (Vysochyna et al., 2024; Vysochyna et al., 2023a; Vysochyna et al., 2023b; Firstová & Vysochyna, 2024), it can be noted that the concept of "national security" is the most complex and contains determinants that make it possible to quantitatively assess both the rates of economic growth and the level of macroeconomic stability.

Summarizing the scientific output of scientists regarding the formalization of indicators for quantitative measurement of economic growth rates, the level of macroeconomic stability and national security of the state, one of the most common indicators is the rate of GDP growth (Dobrovolska et al., 2024b; Tvaronavičienė et al., 2024; Mahfoudh et al., 2024; Djouadi et al., 2024; Tkacova et al., 2023; Andrei, et al., 2023; Mathur & Ray, 2022; Andrei, et al., 2021; Mec & Cermakova, 2024), as well as variations of this indicator - GDP per capita, GDP in comparative prices, etc. The next most popular indicator for assessing the economic dynamics and stability of the socio-economic system is the inflation rate (Mahfoudh et al., 2024; Tkacova et al., 2023). Scientists emphasize that a small level of inflation is even useful for stimulating business activity, but excessively fast price growth activates significant negative processes, spinning up an inflationary spiral. Thus, maintaining price stability and the stability of the national monetary unit are the priority goals of economic policy and a guarantee of the resilience of the socio-economic system.

Determinants related to the development of human capital occupy a special place in ensuring positive economic dynamics, national security and macroeconomic stability. Thus, an important vector of developed economic policy is balancing the state of the labour market, increasing opportunities for employment of the population, etc. (Ahmed & Akaak, 2024; Akinyemi, 2024; Tu et al., 2024; Kuzior et al., 2023; Lyeonov et al., 2021; Kuzior et al., 2020; Yehorova & Drozd, 2024; Bhandari, 2023; Fawaiq, 2024; Alishli et al., 2024; Kaczorowska-Spychalska et al., 2024). In addition, an important role in the development of human capital and the resilience of the socio-economic system is played by a decent wage and promotion of the even distribution of the population's income (Melnyk et al., 2024).

The transition to Industry 5.0 contributes to the growing importance of innovative technologies and digitalization in ensuring the sustainability of socio-economic dynamics (Vasylieva & Kasyanenko, 2013). An equally important place is given by researchers to the issue of cyber security Yarovenko et al., 2023; Dobrovolska & Rozhkova, 2024; Dobrovolska et al., 2024a; Zámek & Zakharkina, 2024; Chao & Di, 2024; Popescu et al., 2023; Slingerland et al., 2024; Novotná, 2023). Along with the need to protect against cyber threats and fraud in the digital sector, the important foundations of building a "healthy" and resilient socio-economic system are the development of mechanisms to counter the shadowing of the economy (Asare & Samusevych, 2023; Leonov et al., 2022; Tiutiunyk et al., 2022).

In the conditions of strengthening cross-border cooperation and intensification of integration processes, economic growth, macroeconomic stability and national security are impossible without the development of trade relations (Čermák & Ligocká, 2022; Djouadi et al., 2024; Aleksandravičienė et al., 2024; Němečková & Hayat, 2022; Akhtar et al., 2024; Hasan et al., 2022).

A significant group of scientists emphasize the impossibility of achieving resilience of the socio-economic system without taking into account environmental determinants. Thus, the main priorities in the field of taking into account the importance of environmental factors in ensuring economic growth and national security are the reduction of negative anthropogenic impact on the environment, reduction of greenhouse gas emissions, rational use of natural resources, stimulation of the development of environmental innovations, etc. (Didenko et al., 2021; Yin et al., 2023; Szczepańczyk, 2022; Saman & Pauna,

2023; Li, 2024; Fu & Chang, 2024; Streimikiene, 2023; Streimikiene & Kyriakopoulos, 2024; Bucur & Rus, 2024; Liu & Rumánková, 2022).

Related to environmental determinants is a group of energy security indicators, without achieving which the smooth functioning of industrial facilities and critical infrastructure facilities is impossible. At the same time, researchers note that ensuring sustainable economic growth is impossible without a gradual transition from traditional sources of energy generation in favor of renewable ones (hydroelectric power plants, solar power plants, wind power plants, etc.), and ensuring national security and macroeconomic stability is at risk when the country largely depends on the import of electricity. Thus, ensuring the resilience of the socio-economic system will contribute to the expansion of own electricity production mainly due to renewable sources, optimization of the production cycle due to the reduction of losses during electricity production, as well as the introduction of innovative technologies (Letunovska et al., 2021; Tapang, 2023).

Among the factors of ensuring economic growth rates, the level of macroeconomic stability and national security of the state, scientists also identify the quality of general management and proper governance, the absence of corruption (Vysochyna et al., 2023c; Katkova et al., 2022; Dobrovolska, et al., 2022; Acar & Kara, 2023).

Researching the general impact of crisis processes on socio-economic dynamics is in the focus of such scientists as Richardson (2024), Takemoto et al. (2024), Kornyliuk et al. (2022), Melnyk et al. (2023), Shevchuk et al. (2021), Shevchuk and Omelchuk (2023), Činčikaitė et al. (2023), Danylyshyn and Bohdan (2022), El Fallahi et al. (2023), Zohaib and Ismail (2024), Issam et al. (2024), Letunovska and Boliukh (2023), Iwu et al. (2023).

3. METHODOLOGY

So, the basic assumption of this study is the following: despite the common trends of socio-economic policy in the studied 34 European countries, the patterns of internal and external determinism of the resistance of performance indicators (economic growth, macroeconomic stability and national security) to the influence of global turbulences have national specificity. To test this hypothesis, the following procedures will be employed:

1) formation of a sample of indicators for quantification of performance indicators – economic growth, macroeconomic stability and national security;

2) clarification of the patterns of internal determinism of the resistance of performance indicators to the influence of global turbulences for the entire sample;

3) clarification of specific for each of the 34 countries patterns of the internal determinism of the resistance of performance indicators to the influence of global turbulence;

4) determination of the general pattern of external determinism (due to public health factors) of the resistance of performance indicators to the influence of global turbulence;

5) determination of the country-specific patterns of external determinism (due to public health factors) of the resistance of performance indicators to the influence of global turbulence;

6). formation of general and specific recommendations considering internal and external drivers and inhibitors to strengthen the resistance of performance indicators to the influence of global turbulence.

It should be noted that the geographic structure of the sample covers 34 European countries, including: Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Moldova, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom. The observation period is 2000-2022, which includes both the period of the global financial crisis of 2007-2009 and the period of the active spread of

the coronavirus pandemic – 2019-2022, and therefore we believe that taking into account this particular time horizon will reveal patterns of resistance of socio-economic systems of the studied countries to global turbulences.

In previous studies (Vysochyna et al., 2024; Vysochyna et al., 2023a; Vysochyna et al., 2023b) the selection of indicators for the quantitative assessment of sustainable economic growth, macroeconomic stability, and national security is comprehensively substantiated. It is considered 16 indicators that characterise:

- the ecological perspective of ensuring sustainable economic growth, macroeconomic stability and national security (loss of water resources, greenhouse gas emissions);
- energy perspective (indicators of energy consumption, production and loss);
- social perspective (population employment, Gini index, coverage of school education);
- economic perspective (GDP growth, government expenditures, gross capital formjetion, inflation, trade, reserves in months of imports);
- military component (military expenditures).

The last indicator becomes particularly relevant in the context of the worsening security situation in the European region from February 2022.

All these indicators are selected from the public collection of the World Bank (World Bank DataBank, 2024).

The following approach was used to determine both general for the entire sample of countries and country-specific patterns of internal and external determinism of the resistance of performance indicators to the impact of global turbulence on economic growth, macroeconomic stability, and national security:

1) bringing the indicators to a comparable form, taking into account the nature of their influence on the resulting parameters using the methods of natural normalization and Savage normalization (as in Szczepańska-Woszczyna et al., 2024);

2) application of the multivariate analysis toolkit (principal components analysis) using Stata 14.2/SE software (Stata, 2024) to determine the relevance of internal determinants in ensuring the change of effective parameters and the formation of an integral indicator of socio-economic development and national security using the principal component analysis, the Fishburne approach and additive-multiplicative convolution.

As noted in Nardo et al. (2005) principal component analysis is one of the tools of multivariate analysis, which allows reducing the dimensionality of indicators, eliminating multicollinearity between them, as well as forming an integral indicator taking into account the significance of the influence of individual parameters. Brody and Smith (2022) also note that the principal component analysis is a promising tool for forming integral indicators that is widely used in financial and economic research. In particular, the integration algorithm using this approach involves the following sequence of steps: 1) determination of the number of principal components that will be used for further stages of index formation (the authors note that for further stages of modelling it is advisable to choose the number of principal components according to the scree plot – it is chosen and the number of principal components at which the graph goes from steep to flat; as a rule, the sum of the principal components that cumulatively explain more than 70-75% of the total variation of the indicators is chosen); 2) at the next stage, the significance and importance of individual indicators when forming an integral indicator is determined. Thus, Nardo et al. (2005) note that it is necessary to use varimax rotation technology, which provides for the determination of the most important individual indicators based on the comparison of eigenvalues within the principal components selected at the previous stage. Instead, Brody and Smith (2022) add that the determination of the weighting factors for the formation of an integral indicator is carried out by the ratio of the eigenvalues selected at the previous stage to the sum of the eigenvalues for all indicators. Brody and Smith (2022) also note that this stage of

index formation is a kind of factor analysis, since the ratio of the maximum eigenvalues determined by varimax rotation technology, to the total sum of these eigenvalues for all individual indicators indicate the factor load of the individual indicator in the formation of the integral. Instead, Nardo et al. (2005) compare the performance of two multivariate analysis tools, principal components analysis and actual factor analysis, and note that the factor loading results for both approaches are almost identical. The final procedure within this stage is the ranking of indicators - the higher the weight coefficient of an individual indicator, the higher its rank. Further, using the Fishburn formula and additive-multiplicative convolution, an integral indicator of socio-economic development and national security is formed. The methodology of forming integrated socio-economic indicators using the above algorithm is described in more detail in a previous study (Vysochyna et al., 2024).

3) determination of the impact of public health factors on the integrated indicator of socio-economic development and national security using regression modelling on panel data and regression modelling based on time series in the Stata 14.2/SE software (Stata, 2024), which will allow to identify common and country-specific drivers and inhibitors among public health factors. This stage of research will reveal general and national patterns of external determinism of resistance to economic growth, macroeconomic stability, and national security to the impact of global turbulence. The choice of the determinants within public health indicators was made based on the strength and scale of the impact of the last of the global turbulences - the COVID-19 pandemic. At the same time, testing the impact of other determinants, particularly the parameters of good governance, digital development, environmental sustainability, etc., can be a promising vector for further research.

Previously, based on the generalization of publicly available performance data indicators of public health system, the following factor indicators were selected:

- Capital health expenditure to GDP ratio, % (Cap);
- Current health expenditure to GDP ratio, % (Cur);
- Domestic general government health expenditure per capita (current US$) (Dom_gov);
- Domestic general government health expenditure to current health expenditure ratio, % (Dom_gov_2);
- Domestic private health expenditure per capita (current US$) (Dom_prv);
- Domestic private health expenditure to current health expenditure ratio, % (Dom_prv_2);
- External health expenditure per capita (current US$) (Ext);
- External health expenditure to current health expenditure ratio, % (Ext_2);
- Out-of-pocket expenditure per capita (current US$) (Oop);
- Out-of-pocket expenditure to current health expenditure ratio, % (Oop_2);
- Number of infant deaths (Infand_d);
- Number of maternal deaths (Maternal_d);
- Incidence of tuberculosis (per 100,000 people) (Tuberc);
- Immunization, DPT (% of children ages 12-23 months) (Immun_1);
- Immunization, measles (% of children ages 12-23 months) (Immun_2);
- Physicians (per 1,000 people) (Physicians);
- Hospital beds (per 1,000 people) (Beds).

In the next step, a correlation analysis was carried out with an effective indicator - an integral indicator of socio-economic development and national security. A set of simple regression models for each of the 34 European countries will be built with the factor variables that have a high and noticeable correlation with the performance index;

5) qualitative characteristics of simulation results.

4. EMPIRICAL RESULTS AND DISCUSSION

The first stage of this study is bringing to a comparable form of 16 indicators of quantitative assessment of economic growth, macroeconomic stability and national security by using two normalization approaches. According to the results of this block of analysis, all variables are in the range [0;1], while a larger value of the parameter indicates its better positive influence on the performance indicators. Summative statistics by variables are given in Table 1.

Table 1

Summative statistics for normalized measurement indicators of economic growth, macroeconomic stability and national security in 34 European countries

Variable	Obs	Mean	Std. Dev.	Min	Max
water	782	.818	.212	0	1
co2	782	.606	.184	0	1
no2	782	.83	.217	0	1
cons	782	.919	.116	0	1
ren prod	782	.129	.162	0	1
loss	782	.881	.092	0	1
empl	782	.489	.172	0	1
gini	782	.672	.157	0	1
school	782	.37	.179	0	1
gdpg	782	.25	.207	0	1
ggfc	782	.543	.194	0	1
gcf	782	.321	.106	0	1
infl	782	.918	.062	0	1
mil exp	782	.045	.04	0	1
trade	782	.343	.163	0	1
res	782	.153	.125	0	1

Water – Annual freshwater withdrawals, total (% of internal resources); CO2 – CO2 emissions (metric tons per capita); NO2 – Nitrous oxide emissions (thousand metric tons of CO2 equivalent); Cons – Electric power consumption (kWh per capita); Ren_prod – Electricity production from renewable sources, excluding hydroelectric (% of total); Loss – Electric power transmission and distribution losses (% of output); Empl – Employment to population ratio, 15+, total (%); Gini – Gini index; School – School enrollment, secondary (% gross); GDPg – GDP growth, %; GGFC – General government final consumption expenditure (% of GDP); GCF – Gross capital formation (% of GDP); Infl –Inflation, consumer prices (annual %); Mil_exp – Military expenditure (% of GDP); Trade – Trade (% of GDP); Res – Total reserves in months of imports

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Data (World Bank DataBank, 2024)

According to summative statistics, indicators such as inflation and electricity consumption have the highest average value among other measurement indicators, while the indicator of military spending is the lowest.

The next stage of the research is to identify the general pattern of the internal determinism of the resistance of performance indicators to the influence of global turbulence using multivariate analysis in Stata 14.2/SE software (Stata software, 2024). The results are presented in Table 2.

Table 2

Results of identifying relevance of internal determination of economic growth, macroeconomic stability and national security resistance to global turbulence for the whole country sample

Variable	Maximum eigenvalue	Factor loading	Rank	Weights
water	0.437	0.0656	10	0.0735
co2	0.359	0.0539	4	0.0294
no2	0.49	0.0736	14	0.1029
cons	0.367	0.0551	6	0.0441
ren prod	0.485	0.0728	13	0.0956
loss	0.365	0.0548	5	0.0368
empl	0.388	0.0583	8	0.0588
gini	0.289	0.0434	1	0.0074
school	0.353	0.0530	2	0.0147
gdpg	0.384	0.0577	7	0.0515
ggfc	0.453	0.0680	11	0.0809
gcf	0.455	0.0683	12	0.0882
infl	0.587	0.0882	16	0.1176
mil exp	0.354	0.0532	3	0.0221
trade	0.498	0.0748	15	0.1103
res	0.394	0.0592	9	0.0662
Total	6.658	**X**	**136**	**X**

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Data (World Bank DataBank, 2024)

First of all, it is worth noting that the combination of the graphic method (building of the scree plot) and the analytical method made it possible to establish that for further research it is necessary to select 6 principal components that cumulatively explain 69.7% of the total variation of individual indicators. In the next step, it is necessary to determine the maximum eigenvalue of each of the individual indicators using the varimax rotation method ("Maximum eigenvalue" column in Table 2). Factor loadings show the significance of the contribution of each of the determinants to the formation of the integral indicator of socio-economic development and national security (ISEDNS). According to the data of factor loadings, each of the indicators is assigned a rank, which is the basis for calculating the weighting coefficients.

Therefore, according to the results presented in Table 2, it can be noted that, in general, for a sample of 34 European countries, special attention should be paid to curbing inflation, stimulating trade relations and increasing the general trade turnover and reducing greenhouse gas emissions, while the least relevant is the impact of variations in such factors as inequality in income distribution (Gini index), school enrolment of the population, and military spending. It is fair to note that the irrelevance of the influence of these factors is largely due to the specifics of the countries included in the sample, while for less developed countries, their influence can be significant.

However, the model generalized for 34 European countries may not be equally relevant for each of the studied countries, so there is a need to identify country-specific patterns summarized in Table 3.

Table 3

Country-specific results (ranks) of identifying relevance of internal determinations of economic growth, macroeconomic stability and national security resistance to global turbulence

Country	water	co2	no2	cons	ren_prod	loss	empl	gini	school	gdpg	ggfc	gcf	infl	mil_exp	trade	res
Albania	10	7	4	5	1	14	6	12	8	2	16	9	3	15	11	13
Austria	1	16	12	6	2	10	13	14	4	9	5	15	3	11	7	8
Belgium	8	1	2	14	11	3	6	10	15	12	16	5	13	4	9	7
Bosnia and Herzegovina	1	7	4	11	1	10	14	3	8	6	15	9	13	5	12	16
Bulgaria	14	6	2	9	8	1	7	3	13	10	12	4	11	5	15	16
Croatia	16	2	15	7	8	3	6	1	9	5	11	14	4	12	10	13
Czechia	2	1	4	10	5	16	15	9	3	6	11	8	12	7	14	13
Denmark	5	6	8	1	7	3	16	10	11	9	13	14	4	2	12	15
Estonia	8	14	1	4	2	6	13	7	3	12	16	11	5	10	15	9
Finland	2	9	7	14	5	1	3	8	15	12	6	10	13	4	11	16
France	5	3	9	2	1	11	8	6	7	16	14	15	12	4	13	10
Germany	5	12	3	10	1	6	4	9	16	11	7	8	15	2	13	14
Greece	16	3	10	11	1	7	12	13	8	6	15	14	5	2	9	4
Hungary	5	7	16	15	2	10	4	1	13	11	3	12	14	9	6	8
Iceland	1	7	1	4	5	10	16	11	6	14	13	8	15	1	9	12
Ireland	3	4	14	8	2	9	11	1	5	6	13	12	7	10	16	15
Italy	4	2	14	5	3	15	6	1	8	7	12	16	10	11	9	13
Latvia	3	14	15	6	10	4	7	2	5	1	8	13	11	16	9	12
Lithuania	6	11	14	2	7	12	16	3	15	10	13	1	5	9	8	4
Moldova	10	7	2	14	1	8	15	13	4	9	5	16	12	11	6	3
Netherlands	16	8	2	11	4	9	12	5	3	1	15	6	10	7	13	14
North Macedonia	9	16	6	2	13	4	11	8	3	15	10	5	7	14	1	12
Norway	1	12	5	2	6	16	14	3	11	15	13	10	4	7	9	8
Poland	8	6	11	16	4	7	12	14	2	15	1	9	3	13	10	5
Portugal	2	1	11	16	15	5	4	6	12	13	8	3	9	10	7	14
Romania	11	6	13	14	1	8	12	5	3	7	15	16	2	9	10	4
Serbia	16	14	5	6	15	3	2	8	12	7	9	1	10	11	4	13
Slovak Republic	7	4	9	2	1	13	11	8	14	5	16	12	6	10	3	15
Slovenia	3	4	16	1	2	14	13	10	11	12	8	9	7	5	15	6
Spain	2	13	1	8	3	7	6	12	14	4	9	5	10	15	16	11
Sweden	11	5	14	9	4	3	15	2	12	6	13	8	7	1	16	10
Switzerland	1	4	3	5	2	13	7	9	10	6	16	15	12	14	11	8
Ukraine	10	8	9	4	3	11	2	12	6	7	13	1	15	14	16	5
UK	14	3	1	6	4	2	16	9	5	8	12	10	7	11	15	13

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Data (World Bank DataBank, 2024)

The obtained results confirmed the proposed hypothesis that, despite the commonality of socio-economic policy trends in the studied 34 European countries, the patterns of internal determinism of the resistance of performance indicators to the influence of global turbulences have national specificity. At the

same time, in the sample of 34 countries, no identical coincidence was recorded in terms of the relevance of the role of internal determinants in ensuring the resistance of economic growth, macroeconomic stability and national security to global fluctuations.

In turn, Table 4 demonstrates the frequency of relevance of the influence of the relevant determinants for the studied countries.

Table 4

Ranking of relevance of internal determinations of economic growth, macroeconomic stability and national security resistance to global turbulence

Variable	Frequency	Countries
ggfc	10	Albania, Belgium, Bosnia and Herzegovina, Estonia, France, Greece, Netherlands, Romania, Slovak Republic, Switzerland
empl	9	Bosnia and Herzegovina, Czechia, Denmark, Iceland, Lithuania, Moldova, Norway, Sweden, UK
gcf	9	Austria, Croatia, Denmark, France, Greece, Italy, Moldova, Romania, Switzerland
trade	9	Bulgaria, Czechia, Estonia, Ireland, Slovenia, Spain, Sweden, Ukraine, UK
res	9	Bosnia and Herzegovina, Bulgaria, Denmark, Finland, Germany, Ireland, Netherlands, Portugal, Slovak Republic
no2	8	Croatia, Hungary, Ireland, Italy, Latvia, Lithuania, Slovenia, Sweden
water	6	Bulgaria, Croatia, Greece, Netherlands, Serbia, UK
cons	6	Belgium, Hungary, Moldova, Poland, Portugal, Romania
school	6	Belgium, Finland, Germany, Lithuania, Slovak Republic, Spain
mil exp	6	Albania, Latvia, North Macedonia, Spain, Switzerland, Ukraine
gdpg	5	France, Iceland, North Macedonia, Norway, Poland
loss	5	Albania, Czechia, Italy, Norway, Slovenia
co2	5	Austria, Estonia, Latvia, North Macedonia, Serbia
infl	4	Germany, Hungary, Iceland, Ukraine
ren prod	3	Finland, Portugal, Serbia
gini	2	Austria, Poland

Frequency demonstrates number of countries, for which the determinant is crucially important (have the highest relevance)

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Data (World Bank DataBank, 2024)

Thus, despite the fact that, for the whole country sample the resilience of the socio-economic system is determined to be most dependent on the optimization of the total volume of NO2 emissions, the stimulation of trade relationships and reduction of inflation, for the totality of the countries in the sample, the list of the most common determinants ensuring this resilience is somewhat different for specific countries. In particular, the key determinants of this approach are the optimization of the government's total current expenditures, the growth of turnover, the growth of employment and the increase of gross capital accumulation.

At the next stage of the research, using the weighting coefficients presented in the "Weights" column of Table 2, an integrated indicator of socio-economic development and national security (ISEDNS) was formed, the dynamics of which is presented in Figure 1.

Graph 1. Dynamics of Index of Socio-Economic Development and National Security (ISEDNS) for 34 European countries in 2000-2022

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Data (World Bank DataBank, 2024)

Based on the results of the analysis, it was established that the level of the calculated integral indicator fluctuates in the range [0.36; 0.70]. Austria, Belgium, Denmark, Finland, Iceland, Ireland, Norway, Switzerland, Sweden are the flagship countries in terms of the calculated performance indicator. The lowest values of the indicator are typical for Albania, France, Greece, Italy, Moldova, Poland, Romania, Serbia, Spain and Ukraine. For the rest of the countries, the values of the performance indicator are average.

The next stage of this research involves the identification of relevant external determinants of public health, which determine the resistance of indicators of socio-economic development and national security to the influence of global turbulence. First of all, it is necessary to determine the most relevant determinants based on the calculation of correlation coefficients (Table 5).

Table 5

Correlation coefficients between Index of Socio-Economic Development and National Security (ISEDNS) and public health determinants for 34 European countries in 2000-2022

Variables	**Cap**	**Cur**	**Dom_gov**	**Dom_gov_2**	**Dom_prv**
ISEDNS	0.21	0.474	0.493	0.3	0.422
	Dom_prv_2	**Ext**	**Ext_2**	**Oops**	**Oop_2**
ISEDNS	-0.29	-0.162	-0.195	0.409	-0.291
	Infant_d	**Maternal_d**	**Tuberc**	**Immun_1**	**Immun_2**
ISEDNS	-0. 3 17	-0. 2 47	-0.32	0.006	0.058
	Physicians	**Beds**			
ISEDNS	0.421	-0.41			

From among the 17 preliminary selected public health factors, 6 most relevant indicators were selected based on the results of the correlation analysis (marked with green fill in Table 5). These indicators will be involved in testing for the presence of cause-and-effect relationships with the ISEDNS based on the regression modelling.

Thus, Table 6 summarizes the statistically significant (with 95% confidence level) relationships between Current health expenditure to GDP ratio, % (Cur) and the Index of Socio-Economic Development and National Security (ISEDNS).

Despite the fact that, for the whole group of 34 European countries an increase in the share of current health care expenditures in GDP is accompanied by an increase in ISEDNS by 0.015 units, the national patterns of these causal relationships are markedly differentiated. Thus, a statistically significant relationship between the studied variables was not confirmed for such countries as Bulgaria, Croatia, Greece, Ireland, Latvia. Otherwise, in Albania, Bosnia and Herzegovina, Hungary, Iceland, and North Macedonia the relationship between the variables, unlike the pattern for the whole panel, is reversed, that is, the growth of current expenditures on health care is an inhibitor of the resilience of socio-economic development and national security.

According to the results of the conducted research (Table 7), it can be noted that there is no confirmed statistically significant impact of the increase in domestic public spending on health care per capita on socio-economic development and national security in such countries as Albania, Austria, Belgium, France, Greece, Iceland, Ireland, Latvia, Moldova, Netherlands, Poland, Portugal, Romania, Serbia, Slovak Republic, Ukraine, and the United Kingdom. It is worth noting that for the entire panel of countries, the growth of this group of expenditures per capita is a driver of resistance to turbulence of the performance indicator, as well as for Bulgaria, the Czech Republic, Estonia, Hungary, North Macedonia, Norway, Slovenia, and Switzerland, but for the rest of the countries from the Table 7 this relationship is reversed.

Table 6

Generalization of the statistically significant regression modelling result on identifying relationships between Index of Socio-Economic Development and National Security (ISEDNS) and Current health expenditure to GDP ratio (Cur) in European countries in 2000-2022 (country-specific results, simple regression)

Country	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Albania	-.006	.002	-3.11	.006
Austria	.035	.003	12.30	0
Belgium	.039	.002	16.44	0
Bosnia and Herzegovina	-.011	.002	-5.09	0
Czechia	.029	.003	9.21	0
Denmark	.031	.003	9.48	0
Estonia	.029	.003	8.41	0
Finland	.027	.002	10.89	0
France	.029	.001	20.63	0
Germany	.067	.005	12.39	0
Hungary	-.033	.011	-3.06	.006
Iceland	-.021	.006	-3.34	.003
Italy	.061	.005	11.47	0
Lithuania	.025	.008	2.99	.007
Moldova	.006	.002	3.08	.006
Netherlands	.032	.004	7.93	0
North Macedonia	-.02	.004	-5.00	0
Norway	.017	.002	7.15	0
Poland	.067	.009	7.85	0
Portugal	.035	.011	3.05	.006
Romania	.04	.012	3.26	.004
Serbia	.02	.007	3.00	.007
Slovak Republic	.013	.005	2.51	.021
Slovenia	.012	.005	2.42	.025
Spain	.028	.002	12.25	0
Sweden	.011	.001	12.99	0
Switzerland	.03	.003	9.03	0
Ukraine	.011	.004	3.04	.006
UK	.032	.001	22.21	0
General	**.015**	**.001**	**16.09**	**0**

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Dana (Word Bank DataBank, 2024)

Table 7

Generalization of the statistically significant regression modelling result on identifying relationships between Index of Socio-Economic Development and National Security (ISEDNS) and Domestic general government health expenditure per capita (Dom_gov) in European countries in 2000-2022 (country-specific results, simple regression)

Country	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Bosnia and Herzegovina	-.000034	.000012	-2.83	.01
Bulgaria	.000175	.000029	6.03	0
Croatia	-.000045	.000019	-2.33	.03
Czechia	.000024	2.000e-06	9.61	0
Denmark	-.000011	2.000e-06	-4.36	.0002
Estonia	.000024	2.000e-06	9.69	0
Finland	-.000013	6.000e-06	-2.31	.03
Germany	-.000024	5.000e-06	-5.03	.00
Hungary	.000017	3.000e-06	5.78	.00
Italy	-.000027	6.000e-06	-4.81	.00
Lithuania	-.000037	.000015	-2.42	.02
North Macedonia	9.000e-06	1.000e-06	7.26	0
Norway	.000097	8.000e-06	12.78	0
Slovenia	.00002	4.000e-06	4.52	.00
Spain	-8.000e-06	3.000e-06	-2.82	.01
Sweden	-.000012	2.000e-06	-5.77	.00
Switzerland	.000024	3.000e-06	8.49	0
General	.0000237	1.02e-06	23.36	0

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Dana (Word Bank DataBank, 2024)

Table 8

Generalization of the statistically significant regression modelling result on identifying relationships between Index of Socio-Economic Development and National Security (ISEDNS) and Domestic private health expenditure per capita (Dom_prv) in European countries in 2000-2022 (country-specific results, simple regression)

Country	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Bosnia and Herzegovina	-.000095	.000032	-3.00	.01
Croatia	-.00019	.000074	-2.56	.02
Czechia	.000129	.000012	10.95	0
Denmark	-.000057	.000014	-4.18	.00
Estonia	.000096	9.000e-06	10.26	0
France	-.000041	.000015	-2.80	.01
Germany	-.00009	.000027	-3.28	.003
Hungary	.000099	.000015	6.40	0
Iceland	.000039	.00001	3.84	.001
Ireland	-.000054	.000021	-2.56	.02
Italy	-.000077	.000022	-3.52	.002
North Macedonia	.000055	.00001	5.69	.00
Norway	.000241	.000017	13.86	0
Serbia	.000256	.000065	3.94	.001
Spain	.000019	2.000e-06	7.65	0
Sweden	-6.000e-06	1.000e-06	-5.68	0
Switzerland	.000118	.000012	9.68	0
General	.0000375	2.28e-06	16.45	0

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Dana (Word Bank DataBank, 2024)

The simulation results, presented in Table 8, demonstrate the absence of a statistically significant impact of the growth of private spending on health care per capita on socio-economic development and national security in such countries as Albania, Austria, Belgium, Bulgaria, Finland, Greece, Latvia, Lithuania, Moldova, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Ukraine, United Kingdom. At the same time, the general pattern of the relationship between variables can be presented as follows: an increase in current private expenditures on health care per capita by 1 USD leads to an increase in the performance indicator by 0.0000375 units. Despite the existence of a positive relationship for the entire sample of countries, this relationship is manifested negatively for such countries as Bosnia and Herzegovina, Croatia, Denmark, France, Germany, Ireland, Italy, Sweden.

According to the simulation results (Table 9), it was also established that an increase of 1 USD in out-of-pocket health care expenditures per capita contributes to the growth of the socio-economic development and national security index by 0.0000954 units. However, the modelling results did not allow to confirm the existence of a statistically significant relationship between this pair of variables for such countries as Albania, Austria, Belgium, Bulgaria, France, Germany, Greece, Iceland, Ireland, Latvia, Lithuania, Moldova, Netherlands, Poland, Portugal, Romania, Serbia, Slovenia, United Kingdom. In addition, for countries such as Bosnia and Herzegovina, Croatia, Denmark, Finland, Italy, Sweden, it has been empirically confirmed that the growth of out-of-pocket expenditures for health care per capita negatively affects the dynamics of socio-economic development and national security.

Table 9

Generalization of the statistically significant regression modelling result on identifying relationships between Index of Socio-Economic Development and National Security (ISEDNS) and Out-of-pocket expenditure per capita (Oop) in European countries in 2000-2022 (country-specific results, simple regression)

Country	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Bosnia and Herzegovina	-.000095	.000032	-3.02	.007
Croatia	-.000314	.000096	-3.26	.004
Czechia	.000137	.000013	10.39	0
Denmark	-.000068	.000016	-4.38	0
Estonia	.00011	.000011	10.15	0
Finland	-.000056	.000013	-4.48	0
Hungary	.000103	.000016	6.33	0
Italy	-.000083	.000025	-3.29	.004
North Macedonia	.000056	.00001	5.57	0
Norway	.000328	.000037	8.87	0
Slovak Republic	.00023	.000045	5.14	0
Spain	.000081	9.000e-06	8.63	0
Sweden	-.000015	3.000e-06	-5.71	0
Switzerland	.000164	.000016	9.96	0
Ukraine	.00008	.000035	2.29	.05
General	.0000954	4.23e-06	22.55	0

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Dana (Word Bank DataBank, 2024)

The simulation results (Table 10) confirmed the statistical significance of the increase in the number of Physicians (per 1,000 people) for most of the countries in the sample, except for the following countries: Bosnia and Herzegovina, Bulgaria, Moldova. In general, for all 34 countries, the growth of the factor variable is accompanied by an increase in the performance indicator by 0.042 units. However, in countries such as France and Serbia, the relationship between the variables is reversed, that is, the increase in the number of

Physicians per 1,000 people is a statistically significant inhibitor of the resistance of socio-economic development and national security to turbulence.

Table 10

Generalization of the statistically significant regression modelling result on identifying relationships between Index of Socio-Economic Development and National Security (ISEDNS) and Physicians (per 1,000 people) (Physicians) in European countries in 2000-2022 (country-specific results, simple regression)

Country	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Albania	.033	.011	2.93	.012
Austria	.033	.002	17.73	0
Belgium	.332	.042	7.89	0
Croatia	.05	.003	14.87	0
Czechia	.077	.005	15.22	0
Denmark	.057	.004	15.59	0
Estonia	.089	.016	5.40	0
Finland	.028	.005	5.39	0
France	-.132	.027	-4.94	0
Germany	.106	.004	28.99	0
Greece	.015	.006	2.61	.021
Hungary	.066	.018	3.61	.002
Iceland	.058	.014	4.12	.001
Ireland	.026	.009	2.86	.01
Italy	.171	.013	13.17	0
Latvia	.056	.012	4.73	0
Lithuania	.046	.005	9.73	0
Netherlands	.063	.005	12.85	0
North Macedonia	.071	.014	4.99	0
Norway	.03	.003	10.36	0
Poland	.087	.063	1.39	.183
Portugal	.024	.003	8.85	0
Romania	.074	.015	4.77	0
Serbia	-.122	.034	-3.57	.004
Slovak Republic	.101	.016	6.20	0
Slovenia	.012	.003	3.60	.002
Spain	.068	.006	12.22	0
Sweden	.034	.003	10.87	0
Switzerland	.083	.008	9.95	0
Ukraine	.045	.013	3.50	.004
UK	.111	.004	25.13	0
General	.042	.002	22.27	0

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Dana (Word Bank DataBank, 2024)

Table 11

Generalization of the statistically significant regression modelling result on identifying relationships between Index of Socio-Economic Development and National Security (ISEDNS) and Hospital beds (per 1,000 people) (Beds) in European countries in 2000-2022 (country-specific results, simple regression)

Country	**Coefficient**	**Standard Error**	**t-value**	**p-value**
Albania	-.046	.01	-4.58	0
Austria	-.069	.008	-8.17	0
Belgium	-.102	.004	-25.26	0
Bulgaria	.01	.004	2.37	.028
Croatia	-.05	.023	-2.20	.04
Czechia	-.041	.004	-9.34	0
Denmark	-.038	.002	-16.13	0
Estonia	-.03	.005	-5.91	0
Finland	-.016	.001	-14.65	0
France	-.027	.001	-20.20	0
Germany	-.101	.014	-7.23	0
Greece	-.027	.01	-2.76	.012
Hungary	-.048	.008	-6.08	0
Iceland	-.007	.001	-4.96	0
Ireland	-.016	.003	-6.22	0
Italy	-.054	.003	-16.16	0
Latvia	-.01	.002	-5.44	0
Lithuania	-.021	.005	-4.40	0
Netherlands	-.052	.003	-15.46	0
North Macedonia	-.09	.013	-7.03	0
Norway	-.022	.005	-4.69	0
Poland	.033	.01	3.14	.005
Portugal	-.142	.04	-3.55	.002
Romania	-.042	.013	-3.25	.004
Slovak Republic	-.023	.004	-6.65	0
Slovenia	-.026	.004	-6.18	0
Spain	-.111	.009	-12.29	0
Sweden	-.037	.003	-11.50	0
Switzerland	-.043	.004	-9.58	0
UK	-.052	.004	-14.81	0
General	-.02	.001	-18.82	0

Source: Authors' calculations in Stata 14.2/SE software (Stata software, 2024) based on World Bank Dana (Word Bank DataBank, 2024)

According to the data presented in Table 11, it can be noted that in such countries as Bosnia and Herzegovina, Moldova, Serbia, and Ukraine there is no statistically significant relationship between the Index of Socio-Economic Development and National Security (ISEDNS) and Hospital beds (per 1,000 people) (Beds). It is worth noting that the following relationships are relevant for the entire group of countries: the growth of Hospital beds (per 1,000 people) for 1 unit leads to the reduction of the ISEDNS by 0.02 units. The revealed peculiarities may indicate the need for more optimal use of the existing capacities of the public health system due to the improvement of treatment protocols, rather than the increase of hospital beds. In addition, the cause-and-effect relationships presented in Table 10 indicate that it is more reasonable and economically feasible to increase the number of doctors instead of increasing the number of hospital beds. Bulgaria and Poland are the countries in which the increase in the number of hospital beds has a positive effect on socio-economic development and national security.

5. CONCLUSION

The analysis of literary sources proved that the key parameters of the quantitative assessment of the resilience of the socio-economic system are GDP growth, indicators of inflationary expectations and employment of the population, energy and environmental determinants, indicators of government expenditures, turnover, etc. Taking into account the identified theoretical regularities, 16 indicators were selected, which in their integral form characterize the state of economic dynamics, macroeconomic stability and national security. The study of the general regularities of the internal determinism of the performance parameters for all 34 European countries proved that the most relevant internal impulses for the improvement of the performance indicators are the reduction of NO2 emissions, inflation and the growth of trade turnover. And therefore, it is precisely these directions of economic policy that should be in the special focus of the influence of the state administration bodies of the countries under study, because it is precisely to their volatility that the performance indicators are most sensitive. At the same time, despite the formalization of the general regularities of the internal relationships of the selected determinants, similar patterns specific to each country proved the existence of certain discrepancies with the general regularities. In addition, it was established that despite the convergence of the general trends of socio-economic development among the studied European countries, according to the research results, no identical national pattern of internal conditioning of the resilience of socio-economic development and national security was found. Thus, the generalization of the country-specific part of the study confirmed the overriding importance of optimizing the structure of current government expenditures for 10 studied countries, increasing the level of employment of the population, gross capital accumulation, turnover, reserves in months of import - for 9 countries, reducing NO2 emissions - for 8 countries, rational use of water resources, electricity consumption, coverage of school education and increasing military spending - for 6 countries, increase in GDP growth rates, reduction of electricity losses during its production and transportation, as well as reduction of CO2 emissions - for 5 countries, reduction of inflation - for 4 countries, the development of renewable energy - for 3 countries, and the reduction of inflation - for 2 countries. The identified general and country-specific patterns are the basis for developing a system of practical measures to ensure the resilience of the socio-economic system to global turbulences.

The modelling results obtained within the second block of this study, aimed at determining the general and country-specific patterns of influence of public health factors on the Index of Socio-Economic Development and National Security (ISEDNS) in their integral form, confirmed the research hypothesis that despite the commonality of socio-economic policy trends in the studied 34 European countries, the patterns of external determinism of the resistance of socio-economic indicators and national security to the influence of global turbulence due to the influence of public health factors also have national specificity, and in some cases, the relationships that are true for a panel of countries, lose their relevance, or are the opposite for a specific country in the sample.

ACKNOWLEDGMENT

This research was funded by the Ministry of Education and Science of Ukraine, grant number 0122U000778 ("Socio-economic recovery after COVID-19: modeling the implications for macroeconomic stability, national security and local community resilience"), grant number 0122U000777 ("De-shadowing and Regulatory Efficiency of Environmental Taxation: Optimization Modeling to Ensure National Security and Rational Nature Management").

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