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Public health and national security proxies: Case of European countries

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Abstract. The COVID-19 pandemic has spurred transformations aimed at ensuring the effectiveness of the public health system and highlighted the need for a deeper study of the causal relationships between the parameters of healthcare system effectiveness and the national security. The aim of this study is to identify causal and temporal patterns in the impact of various types of healthcare expenditures on the components of national security. The study was conducted on a sample of 34 European countries for 2000-2021. In order to achieve the research objectives, integral indicators of economic, social, and environmental security were developed based on a complex combination of principal component analysis, Fishburn formula and additive convolution. Panel data regression modelling was employed to identify causal relationships between health care expenditures and those integral indicators. Finally, distributional-lag modelling (testing for the

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presence of a lag of up to 3 years) identified temporal patterns of the relationship between the indicators. Causal and temporal patterns of the relationship between health care expenditures and components of national security of the state were determined according to the modelling results.

Keywords: public health, national security, economic growth, social security, environmental security, coronavirus disease, European countries.

JEL Classification: C23, F52, H51, I18

1. INTRODUCTION

COVID-19 pandemic revealed several systemic problems both in the public health system and in other areas of public life. With the aim of avoiding such large-scale destructive consequences in the future, the most critical bottlenecks of the health care system should be identified and eliminated in order to increase the health care system's efficiency and resistance to familiar shocks. s. The effectiveness of the public health system depends on a number of determinants like the adequacy of medical personnel and their qualifications, the quality of the facilities and equipment, the quality of treatment protocols, etc. At the same time, financing of the health care system directly or indirectly affects all the above-mentioned parameters. Thus, within the scope of this study, one of the basic assumptions is that the effectiveness of the public health system is determined by the adequacy of funding, as well as the efficiency of spending.

However, the pandemic also made it quite clear that not only do such strong destructive processes have a great impact on the medical system, they also constitute a burden for related fields. Moreover, the scale of the pandemic's impact varied significantly across countries, so a more in-depth study of this issue is still required. The most adversely affected fields have experienced economic, social, and environmental consequences. Thus, identification of causal and temporal patterns of the relationship between different groups of health care expenditures and the parameters of economic, social, and environmental security of the state is of special scientific interest. It will make it possible to determine the areas most vulnerable to such threats and develop more effective measures to eliminate such threats in the future, as well as to create effective post-pandemic recovery programs.

2. LITERATURE REVIEW

The theoretical basis of the research combines the existing work of scientists in several meaningful blocks: definition of the essence, quantitative measurement indicators and factors of the ecological, economic and social security of the state, including the influence made by public health factors in terms of ensuring these components of the state's national security.

Flessa et al. (2023), Vasilyeva et al. (2021), Aliyev (2022), Remeikienė et al. (2023), Rózsa et al. (2022), Grenčíková et al. (2022), Mishchuk et al. (2023) note great importance of a balanced policy at the macro and micro levels of population's employment in ensuring the social security of the state, especially in confronting and leveling the threats caused by the COVID-19 pandemic. An important vector of employment policy is to balance the market for educational services of medical workers and the labor market for specialists in the relevant field since the COVID-19 pandemic highlighted the insufficient provision of the medical system with specific medical personnel for its effective work (Ginevičius et al., 2022; Smiianov et al., 2020). Lyeonov et al. (2021), Saman (2022), Hrybinenko, Bulatova, & Zakharova, (2020), Bhandari (2023), Dotsenko & Kolomiiets (2022) define the social perspective of ensuring national security in terms

of life expectancy, unemployment rate, human development index, etc. Şerban & Jianu (2023), Kryshtanovych et al. (2020) suppose that social security is characterized by the number of years of schooling, the employment rate of the population, the income of the population, as well as the total domestic government expenditures on health care. Thus, the researchers note that the state's social security is based on the level of population's health. Androniceanu, Georgescu, Mirică (Dumitrescu) (2022), in turn, note that the social perspective of the state's development depends on the adequacy of state financing in the social sphere. Instead, Belas, Kmecová, Cepel (2020), Caballero-Morales et al. (2020) define educational factors (coverage of the population at different levels of education) as one of the important determinants in the country's social development. It is proved by Oliinyk et al. (2021) that the appropriate knowledge management measures have significant positive impact on economic growth.

Vasilyeva et al. (2021) emphasize that in the quantitative assessment of the state's economic security, GDP is one of the key indicators. However, it is also advisable to consider indicators of investment activity and foreign trade efficiency (trade turnover). Nguyen (2022), Němečková & Hayat (2022) also note that in ensuring the state's national security , foreign trade development contributes to the GDP growth . Thus, trade is a determinant of the economic security of the state. Lyeonov et al. (2021), Vasilyeva et al. (2013) consider GDP per capita and GDP growth, the inflation level as important parameters of the state's economic security. Kuzior et al. (2022) note that one of the important determinants for ensuring economic well-being is a high level of population income. Şerban & Jianu (2023) characterize the economic security of the state through GDP per capita, trade balance, level of public debt and inflation rate. Ben Amor (2023) defines GDP growth and unemployment rate reduction as the key determinants of the state's economic well-being. Singh (2022) notes that the economic growth is based on attracting investment resources to the country. Innovative activity, technological development and improvement of organizational and business processes with the transition to digital technologies are also identified by some researchers as determinants ensuring the economic security of the state (Arivazhagan et al., 2022; Dias et al., 2023; Khalifa et al., 2023; Kliuchnikava, 2022; Houfaf Khoufaf, & Nouiri, 2023; Mayimele, Demana, & Keele, 2023; AL-Hashimi, AL-Toobi, Ahmed, 2023). Some researchers also define the food provision and sufficiency as an important component of the economic security of the state (Irtyshcheva et al., 2023; Čermák and Ligocká, 2022).

At the same time, Nguyen (2022), Saitkamolov (2022) note that GDP growth also depends on energy factors, especially on the consumption of energy resources. In this context, it is worth noting that excessive energy dependence of the state on external suppliers of energy resources can significantly threaten the state's national security. Thus, in terms of leveling these threats, it is expedient to use maximum of internal capabilities to produce electrical energy and its supply. If there is no such potential, it is necessary to apply a diversified approach to the import of energy resources. Renewable energy development is an important vector in building a balanced energy policy of the state. It will contribute to ensuring the energy and economic security of the state, and to leveling environmental risks. Letunovska et al. (2021) also determine the importance of energy factors in the context of ensuring the national security of the state. Besides, the authors note that in countries with a higher level of economic well-being, environmental consequences are significantly higher due to increased needs for energy resources. At the same time, the increase in the consumption of energy resources, especially from non-renewable sources, negatively impacts the population health. Samusevych et al. (2021), Spirkova et al. (2022), Ojaghlou & Uğurlu (2023) characterising the environmental and energy determinants of state's national security, note the importance of such factors as emissions of various types of greenhouse gases, consumption of chemical fertilizers, volumes of electricity production, volumes of electricity consumption, energy intensity of GDP, etc. Habib, Khan, & Oláh (2023), Li (2023), Zhang (2023), Richterová, Richter & Sojková, (2021) note that environmental determinants, in particular, investments using financial instruments in environmentally friendly investment projects, positively affect economic parameters. Zhichen, Dayong (2023), Sedliačiková et al. (2023), Szczepańczyk

(2022) point out that the country's environmental sustainability can be ensured by private support for eco-investments and by providing state subsidies to support eco-innovations.

Lyeonov et al. (2021) determine the current health care expenditures and domestic government health care expenditures among the most impactful public health determinants, which contribute to volatility of the national security. . Kuzior et al. (2022), Gentle (2023), Awojobi & Adeniji (2023) note that the state of public health depends on the economic well-being and population's income. Researchers note that the intensification of the health insurance development depends significantly on the population's income growth . At the same time, expansion the network of coverage by medical policies will allow to reduce the burden on the state budget due to the reduction of domestic government expenditures on health care. Thus, the authors confirm the connection between health care expenditures and parameters of state's economic security (Jayasundera, 2023; Pakhnenko, Brychko, and Shalda, 2022; Koibichuk & Dotsenko, 2023). Several researchers also noted the existence of a relationship between the parameters of the public health system development and indicators of the state's social security (Mrabet, Benachenhou, Khalil, 2022; Louis, 2022).

In general, according to the literature review results, it was established that researchers have no unified approach to determining the indicators of quantitative assessment of the environmental, economic, and social security of the state. At the same time, scientists emphasize a relationship between public health factors and indicators of the state's national security, but the results of the considered studies are sometimes contradictory and fragmentary. All this determines the need for further scientific research in this direction.

3. METHODOLOGY

This study aims to determine the causal and temporal patterns of the impact made by various health care expenditures on the components of the state's national security. Implementation of the research goal involves several stages.

3.1. Formation of integral indicators of the national security components

A review of the existing literature on the topic revealed that the most important and relevant components of the state's national security are environmental, economic, and social security. So the study focuses attention on these components of national security. It is worth noting that each of the defined components of the state's national security cannot be clearly formalized and measured by only one quantitative indicator. Thus, it is necessary to form integral indicators for measuring the environmental, economic, and social security of the state.

Thus, based on the results of the scientific approaches to the quantification of the state's environmental security, it was established that scientists most often use the following indicators:

- Annual freshwater withdrawals, total (% of internal resources) (*Water*);
- CO2 emissions (metric tons per capita) (*CO2*);
- Nitrous oxide emissions (thousand metric tons of CO2 equivalent) (*NO2*);
- Electric power consumption (kWh per capita) (*Cons*);
- Electricity production from renewable sources, excluding hydroelectric (% of total) (*Ren_prod*);
- Electric power transmission and distribution losses (% of output) (*Loss*).

In turn, among the most common indicators of the characteristics of the level of social security of the state, the following indicators were determined:

- Employment to population ratio, 15+, total (%) (modeled ILO estimate) (*Empl*);
- Gini index (*Gini*);
- School enrollment, secondary (% gross) (*School*).

At the same time, the economic security of the state is most often characterized through the prism of the following indicators:

- GDP per capita (current US$) (*GDP_pc*);
- General government final consumption expenditure (% of GDP) (*GGFC*);
- Gross capital formation (% of GDP) (*GCF*);
- Trade (% of GDP) (*Trade*);
- Total reserves in months of imports (*Res*);
- Military expenditure (% of GDP) (*Mil_exp*).

Given that most indicators have different units of measurement, it is impossible to form integral indicators of the state's environmental, economic, and social security without bringing all the indicators to a comparable form.. It is worth noting that before normalization, all indicators were divided into stimulators (the growth of which has a positive effect on the level of the integral indicator) and inhibitors (the growth of which leads to a decrease in the level of the integral indicator). Inhibitors are almost all indicators of quantitative assessment of the state's environmental security (except electricity production from renewable sources, excluding hydroelectric), Gini index, General government final consumption expenditure. The remaining indicators are classified as stimulants. Inhibitors were converted to a comparable form using formula (1), and drivers – using formula (2).

$$x_n = \frac{x_{min}}{x_i} \tag{1}$$

where x_n– the normalized value of the indicator;
x_i– the value of the indicator in a curtain period;
x_{min}– the minimum value of the indicator within the sample.

$$x_n = \frac{x_i}{x_{max}} \tag{2}$$

where x_n– the normalized value of the indicator;
x_i– the value of the indicator in a curtain period;
x_{max}– the maximum value of the indicator within the sample.

After bringing to a comparable form, the values of the indicators range from 0 to 1, where a higher value of the indicator corresponds to a better influence on the relevant integral indicator of the national security component.

At the stage of forming integral indicators of the state's environmental, economic, and social security, it is also necessary to find out the importance of the contribution of individual indicators to the formation of the integral. It is proposed to use a combination of methods such as principal component analysis, the Fishburn formula, and ranking to ensure the fulfilment of this task. Therefore, applying the principal component analysis will allow preliminary determining the scale of the influence of indicators on the integral indicator. In particular, the importance of the parameters is determined based on a comparison of the averaged eigenvalues of the corresponding individual indicators. The averaged eigenvalue is determined not by the entire set of principal components but only by those that explain more than 70% of the total variation of the selected parameters. At the next stage, all the calculated averaged eigenvalues of individual indicators of the formation of integral indicators of environmental, economic, and social security of the state must be ranked. The highest rank will be given to the indicator for which the calculated averaged eigenvalue is the

largest. It is also worth noting that if the averaged eigenvalues of some indicators are close or identical, they can be assigned the same rank. In the next step, the weighting factors for each indicator are determined based on the Fishburn formula. Weighting coefficients are determined by dividing the rank of the corresponding individual indicator by the total sum of rank estimates for all indicators characterizing the relevant component of the state's national security. The effectiveness of using the algorithm described above for the formation of integral indicators was confirmed in the works of Brody & Smith (2022), Nardo et al. (2005), Vyas, Kumaranayake (2006).

3.2. Determination of causal and temporal patterns of the impact made by health care expenditures on the national security components

To determine general patterns of influence on the national security components , a sample of the following health care expenditures (independent variables) was formed:

- Hospital beds (per 1,000 people) (*Beds*);
- Capital health expenditure (% of GDP) (*CapHE*);
- Current health expenditure (% of GDP) (*CurHE*);
- Domestic general government health expenditure (% of current health expenditure) (*GGHE-D*);
- Domestic private health expenditure (% of current health expenditure) (*PVT-D*);
- Out-of-pocket expenditure (% of current health expenditure) (*OoP*);
- External health expenditure (% of current health expenditure) (*Ext*).

Dependent variables are integral indicators of the state's ecological, economic, and social security, which are constructed on the previous stage of the research.

General causal relationships between the above-mentioned variables will be identified based on the panel data regression modeling using the Stata/SE 14.2 software product. The type of model will be identified based on the Hausman test (choosing between a fixed or random effects model). In turn, the identification of temporal patterns between variables are carried out based on distributional-lag modeling (testing for the presence of a lag from 1 to 3 years).

All stages of the research are carried out for a sample of 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 2000-2021.

It is also worth noting that all indicators were compiled from public sources of statistical information, namely "World Development Indicators" and "Health Nutrition and Population Statistics" collections are developed by the World Bank Group (World Bank DataBank, 2023).

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Formation of integral indicators of the components of national security of the state

The next step after bringing all the individual indicators of the state's economic, environmental, and social security to a comparable form is to implement principal component analysis. The results are presented in Table 1.

Given that the next stage might consider only those principal components that explain at least 70% of the total indicators' variation, it is selected three principal components for the formation of the integral

indicator of environmental security, two principal components – for the integral indicator of social security, three principal components – for the integral indicator economic security.

Table 1

Matrix of principal components

Component	Eigenvalue	Difference	Proportion	Cumulative
Environmental security				
Comp1	2.2592	0.4978	0.3765	0.3765
Comp2	1.7614	0.9132	0.2936	0.6701
Comp3	0.8481	0.1879	0.1414	0.8115
Comp4	0.6602	0.3943	0.1100	0.9215
Comp5	0.2659	0.0608	0.0443	0.9658
Comp6	0.2051	.	0.0342	1.0000
Social security				
Comp1	1.7039	1.0082	0.5680	0.5680
Comp2	0.6957	0.0953	0.2319	0.7999
Comp3	0.6004	.	0.2001	1.0000
Economic security				
Comp1	1.7775	0.3113	0.2962	0.2962
Comp2	1.4662	0.4442	0.2444	0.5406
Comp3	1.0220	0.3135	0.1703	0.7109
Comp4	0.7085	0.1447	0.1181	0.8290
Comp5	0.5638	0.1017	0.0940	0.9230
Comp6	0.4620	.	0.0770	1.0000

*Sourc*e: Authors' results.

The vectors of the eigenvalues of the specified components used to determine the weighting coefficients are presented in Table 2.

Table 2

Matrix of principal components ' eigenvalue vectors

Variable	Comp1	Comp2	Comp3	Average	Rank	Weight
Environmental security						
Water	0.3728	0.5453	0.1158	0.3446	3	0.1765
CO2	0.4222	0.4336	0.3830	0.4129	4	0.2353
NO2	0.1486	0.6704	0.2018	0.3403	3	0.1765
Cons	0.5617	0.2486	0.1812	0.3305	2	0.1176
Ren_prod	0.3651	0.0169	0.8746	0.4189	4	0.2353
Loss	0.4603	0.0563	0.0378	0.1848	1	0.0588
Social security						
Empl	0.6017	0.7978	-	0.6998	2	0.5
Ginny	0.5673	0.4606	-	0.5140	1	0.25
School	0.5623	0.4695	-	0.5159	1	0.25
Economic security						
GDP_pc	0.1343	0.5375	0.5834	0.4184	5	0.2500
GGFC	0.4418	0.4680	0.0439	0.3179	2	0.1000
GCF	0.5150	0.1611	0.2357	0.3039	1	0.0500
Mil_exp	0.5252	0.3367	0.2729	0.3783	3	0.1500
Trade	0.4661	0.2777	0.4604	0.4014	4	0.2000
Res	0.1689	0.5250	0.5620	0.4186	5	0.2500

Source: Authors' results.

The dynamics of the calculated integral indicators of the state's environmental, social, and economic security are presented in Figures A.1-A.3 of Appendix A. General descriptive statistics for these indicators are shown in Table 3.

Table 3

Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Env_sec	748	0.1464	0.0771	0.0589	0.4865
Soc_sec	748	0.688	0.0807	0.4713	0.8864
Econ_sec	748	0.4255	0.0608	0.3078	0.7284

Notes: Env_sec – integral indicators of environmental security, units; *Soc_sec* – integral indicators of social security, units; *Econ_sec* – integral indicators of economic security, units.
Source: Authors' results.

It is worth noting that for most of the 34 studied countries, the growth of the integral indicator of environmental security during the observation period is inherent. However, this indicator is characterized by a downward trend for Albania and Bosnia and Herzegovina. It is also worth noting that among the three researched components of the state's national security, environmental security is characterized by the worst existing potential realization, because even the maximum value of this indicator is only about 50% of the possible maximum. The countries with the highest level of environmental security include Iceland, Denmark and Portugal, while the lowest level is in Ukraine and Serbia.Characterizing the dynamics of social security in the studied countries, we note that this component of the state's national security is the highest in using the existing potential. So, on average, the country uses the available reserve to ensure social security by 68.8%, while the maximum value of the indicator reaches almost 90%. Iceland, Sweden, Finland, and Belgium have the highest level of social security. The lowest level of social security is in North Macedonia and Bosnia and Herzegovina..

The level of economic security in the 34 studied countries ranges from 0.31 to 0.73 units, indicating a moderate use of the available economic potential in the country. On average, in the studied countries, the existing potential is used by 42.6%. The state's highest level of economic security is typical for Switzerland, Norway, and Denmark and the lowest for Moldova, Bosnia, and Herzegovina.

4.2. Identification of causal and temporal patterns of the impact of health care expenditures on the components of the national security

The Hausman test proved that a model with random effects would be more effective for this country and data sample. Based on the application of panel data regression modeling and distributional-lag modeling, the following results were obtained, which are presented in Tables 4-6.

Table 4

Results on identifying the impact of healthcare expenditures on environmental security

Variables	Without lag	1-year lag	2-years lag	3-years lag
Beds	-0.0164***	-0.0169***	-0.0172***	-0.017***
	(0.0015)	(0.0015)	(0.0016)	(0.0017)
CapHE	0.0002	0.0016	0.0032	0.0044
	(0.0038)	(0.0038)	(0.0038)	(0.0039)
CurHE	0.0093***	0.0076***	0.0061***	0.0043***
	(0.0012)	(0.0013)	(0.0013)	(0.0014)
GGHE-D	-0.0026***	-0.0026***	-0.0026***	-0.0025***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
PVT-D	0.0026***	0.0027***	0.0026***	0.0025***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
OoP	0.0018***	0.0020***	0.0021***	0.0021***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Ext	0.0051***	0.0044***	0.0039**	0.0037**
	(0.0015)	(0.0016)	(0.0015)	(0.0015)

Notes: standard deviation is provided in parentheses; ** - significance level at 0.05, *** - significance level at 0.01; the most relevant modeling results are shadowed

Source: Authors ' results.

So, based on the modelling results from Table 4, the following conclusions can be drawn:

– the most relevant relationship between the number of hospital beds and the index of the state's environmental security was with a lag of 1 year, that is, an increase in the number of hospital beds per 1,000 population per unit with a lag of 1 year will lead to a reduction of the integral indicator of environmental security by 0.0169 units; the revealed causal patterns can be justified by the increase in medical waste and other accompanying environmental pollutants due to the increase in the potential number of patients;

– the impact of changes in capital expenditures for health care on the level of environmental security of the state has not been confirmed by any of the models;

– the growth of current expenditures on health care has the most statistically significant effect on the level of environmental security of the state without a time lag, namely: a 1% increase in the independent variable leads to an increase in the dependent variable by 0.0093 units; with an increase in the time lag, the strength of the connection between the investigated indicators weakens;

– an increase in the specific weight of government expenditures on financing the public health system negatively affects the state's environmental security. However, the strength and statistical significance of this effect are identical in models without a time lag, with lags of 1 and 2 years, and only in the model with a lag of three years the relationship between the studied parameters becomes weaker, although it remains statistically significant; according to the most relevant results of modelling the growth of this type of expenditure in the structure of current health care expenditures by 1% leads to a decrease in the level of environmental security by 0.0026 units immediately, and this effect also persists with a lag of 1 and 2 years;

– in contrast to the previous indicator, an increase in the specific weight of private expenditures on health care in the structure of current expenditures on health care by 1% with a scale almost identical to the previous indicator leads to an increase in the level of environmental security of the state, namely: an increase of 1 unit of the independent variable with a time lag of 1 year causes the growth of the dependent variable by 0.0027 units; in fact, it can be noted that the positive effect from the growth of private expenditures on health care is offset by the negative effect from the reduction of public expenditures on health care;

– the level of environmental security of the state also increases with a lag of 2 and 3 years by 0.0021 units with an increase in the specific weight of out-of-pocket expenditures on health care in the structure of current expenditures in this area;

– at the same time, a 1% increase in the specific weight of external expenditures on health care in the structure of current expenditures on health care contributes to strengthening the environmental security of the state without a time lag by 0.0051 units;

– according to the results of modelling for this component of the national security of the state, it can be noted that the strong destructive factor is the increase in the number of beds, while the most significant positive factor is the increase in current expenditures on health care.

Table 5

Results on identification the impact of healthcare expenditures on social security

Variables	Without lag	1-year lag	2-years lag	3-years lag
Beds	-0.0090***	-0.0084***	-0.0083***	-0.0080***
	(0.0014)	(0.0015)	(0.0015)	(0.0016)
CapHE	0.0027	-0.0002	-0.0027	-0.0037
	(0.0035)	(0.0036)	(0.0037)	(0.0033)
CurHE	-0.004***	-0.002*	0.0004	0.0015
	(0.0012)	(0.0012)	(0.0013)	(0.0013)
GGHE-D	0.0011***	0.0013***	0.0015***	0.0015***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
PVT-D	-0.0009***	-0.001***	-0.0012***	-0.0013***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
OoP	-0.0015***	-0.0016***	-0.0017***	-0.0016***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Ext	-0.0062***	-0.0068***	-0.0068***	-0.0065***
	(0.0012)	(0.0013)	(0.0013)	(0.0013)

Notes: standard deviation is provided in parentheses; *** - significance level at 0.01, * - significance level at 0.1; the most relevant modelling results are shadowed

Source: Authors' results.

In turn, based on the modelling results from Table 5, the following conclusions can be drawn:

– an increase in the number of hospital beds per 1,000 population by 1 unit without a time lag reduces the level of the state's social security by 0.009 units, while over time the strength of this relationship decreases, although it remains statistically significant;

– as in the case of the state's environmental security , the impact of changes in capital expenditures for health care on the level of social security of the state is not confirmed by any of the models;

– in turn, an increase in current expenditures on health care by 1% causes a decrease in the level of social security of the state by 0.004 units without a delay in time;

– in contrast to the environmental security of the state, there is a positive effect of the increase in public spending on health care on the social security of the state, while the increase in private spending on health care acts as an inhibitor for the studied performance indicator, the influence of both variables, as in the previous case, is quite similar. Thus, a 1% increase in public spending on health care in the structure of current health care expenditures leads to an increase in the integral level of social security of the state by 0.0015 units with a lag of 2 and 3 years, while an increase in private spending on health care in the structure

of current expenditures on health care by 1% causes a decrease in the dependent variable by 0.0013 units with a lag of 3 years;

– in turn, a 1% increase of the ratio of out-of-pocket expenses in the structure of current health care expenditures causes a decrease in the level of the state social security by 0.0017 units; it is notable that the negative impact of an increase in out-of-pocket expenditures and private expenditures on health care on the performance indicator can be explained by an increase in the expenditure burden on households, which might lead to a decrease in the well-being of the population; instead, transferring the expenditure burden from private individuals to state institutions (increasing the share of public spending on health care) will allow households to preserve their financial resources, positively affecting their well-being;

– negative for the state's social security is also the increase in the specific weight of external health care expenditures in the structure of current expenditures in this area: a 1% increase in the independent variable with a lag of 1 and 2 years will cause a decrease in the dependent variable by 0.0068 units.

Table 6

Results on identification the impact of healthcare expenditures on economic security

Variables	Without lag	1-year lag	2-years lag	3-years lag
Beds	-0.0212***	-0.0205***	-0.0213***	-0.0212***
	(0.0014)	(0.0015)	(0.0015)	(0.0016)
CapHE	0.0105***	0.0101***	0.0086**	0.0085**
	(0.0037)	(0.0037)	(0.0037)	(0.0037)
CurHE	0.0023*	0.0040***	0.0062***	0.0081*
	(0.0012)	(0.0012)	(0.0013)	(0.0013)
GGHE-D	-0.0008**	-0.0006**	-0.0005	-0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
PVT-D	0.001***	0.0007**	0.0007**	0.0005
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
OoP	-0.0003	-0.0004	-0.0004	-0.0004
	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Ext	-0.0018	-0.0012	-0.002	-0.0018
	(0.0015)	(0.0016)	(0.0016)	(0.0015)

Notes: standard deviation is provided in parentheses; *** - significance level at 0.01, ** - significance level at 0.05, * - significance level at 0.1; the most relevant modelling results are shadowed

Source: Authors' results.

At the same time, according to the data from Table 6, the change in the weight of out-of-pocket expenditures on health care and external expenditures on health care in the structure of current expenditures in this area does not have a statistically significant impact on the level of economic security. Among other conclusions regarding this component of the state's national security, the following aspects can be noted:

– an increase in the number of hospital beds per 1,000 population by 1 unit without a time lag reduces the economic security of the state by 0.0212 units. It indicates the importance of optimizing state funding for the maintenance of medical institutions;

– in addition, the growth of capital expenditures on health care positively affects the state's economic security , namely, a 1% increase in the independent variable causes an increase in the dependent indicator by 0.0105 without a time lag; on the other hand, a 1% increase in current expenditures causes an increase in the economic security of the state by 0.0081 units with a lag of 3 years; the obtained results confirm the importance of providing adequate funding for both the operational needs of the public health system and

active investment in the development of medical infrastructure, since supporting public health system is actually an investment in the quality and productivity of the workforce and contributes to the development of the country's human potential;

– the modelling results, which proved that an increase in the weight of public expenditures on health care is an inhibitor of the economic security of the state are of great interest. However, an increase in the share of private expenditures in the structure of current expenditures in this area is a driver of its growth (a 1% increase in the independent variable leads in the first case to a reduction of the performance indicator by 0.0008 units, and in the second case to its growth by 0.001 units); such a situation can be explained by the need to relocate state financial resources to more priority areas of ensuring economic growth and sustainable development, while shifting the expenditure burden in the field of financing the public health system from state donors to private individuals will allow achieving this goal.

Thus, the obtained results in their integral form confirm the existence of a connection between various types of expenditures on health care and components of national security of the state.

5. CONCLUSION

According to the study results, the main task of which was to determine the causal and temporal patterns of the influence made by different health care expenditures on the integral indicators of environmental, economic, and social security of the state for 34 European countries for 2000-2021, a statistically significant relationship was confirmed between these parameters. It is worth noting that the highest level of economic security among the studied countries can be observed in Switzerland, Norway and Denmark, social security – in Sweden, Iceland, Norway and Belgium, and environmental security – in Iceland, Denmark, and Portugal. In terms of the impact of various groups of health care expenditures on the state's environmental security, it can be concluded that capital expenditures for health care do not have a statistically significant impact on this indicator. At the same time, current expenditures and external expenditures are immediate (without lag) drivers of the growth of the environmental security , and public expenditures on health care are an immediate inhibitor. With a lag of one year, the environmental security of the state increases due to the growth of private expenditures on health care and decreases due to the increase in the number of hospital beds. With a lag of two and three years, the increase in environmental security of the state is ensured due to the increase in out-of-pocket expenditures for health care.

The change in capital expenditure on health care is also not a relevant factor in the change in the state's social security level. On the other hand, the increase in the number of hospital beds and current expenditures on health care immediately (without lag) leads to a decrease in the state's social security level. With a lag of 1-2 years, the growth of external expenditures on health care acts as an inhibitor to the state's social security. The 2-year time lag is also the most relevant in characterizing the negative impact of out-of-pocket health care expenditures on the state's social security and the positive impact of public health care expenditures on the performance indicator. With a lag of 3 years, a statistically significant negative impact of the growth of private health care expenditures on the state's social security was confirmed..

For economic security, the impact of different groups of expenditures on health care without a lag is more typical. In particular, the drivers of ensuring economic security are the growth of capital expenditures and private expenditures on health care. The inhibitors are the growth of the number of hospital beds and public expenditures on health care. With a lag of 3 years, the state's economic security is positively affected by the growth of private expenditures on health care. The impact of out-of-pocket and external expenditures on health care is not statistically significant.

Thus, from the obtained modelling results, different groups of health care expenditures can simultaneously act as a driver of ensuring one of the considered components of the state's national security

and an inhibitor of the other. Therefore, these interrelationships should be considered when building the appropriate vector of state policy and during the implementation of post-pandemic recovery measures.

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APPENDIX A

Figure A.1

Dynamics of integral indicator of environmental security in 34 European countries in 2000-2021, units

Figure A.2

Dynamics of integral indicator of social security in 34 European countries in 2000-2021, units

Figure A.3

Dynamics of integral indicator of economic security in 34 European countries in 2000-2021, units