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Reducing Risk Factors to Face Global Crises and Complex Emergencies: Case Study of the Relation between Public Debt, Health Expenditures and Fatality Rates in COVID 19 Pandemic

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Reducing Risk Factors to Face Global Crises and Complex Emergencies: Case Study of the Relation between Public Debt, Health Expenditures and Fatality Rates in COVID 19 Pandemic

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Abstract: One of the main problems for managing global crises is to clarify and reduces drivers of systemic weaknesses to face complex emergencies. This study here analyzes the relation between public debt, healthcare expenditures and fatality rates in the presence of pandemic crises, such as COVID-19. Statistical evidence, based on a sample of European countries, here shows that high public debt over time reduces health expenditures and increases the vulnerability of countries to face emergencies, such as COVID-19 pandemic crisis. Regression analysis with a log-log model suggests that when European countries experience a 1% increase in healthcare expenditure per capita, in general they have a 1.2% reduction in the COVID-19 fatality rate. Main implications of this study to reduce the systemic risk and vulnerability to environmental threats are that countries must reduce public debt with good governance and institutions without reducing the allocation of economic resources to the healthcare sector in order to improve the preparedness to unforeseen emergencies and crises, such as pandemics, natural disasters, conflicts, and other environmental threats.

1. Introduction

In contemporary economies, more and more countries have high levels of public debt that force to budget constraints with policies of public finance based on fiscal austerity measures (including spending cuts or tax increases), which impact funding for health, education and other public sectors (Alesina et al., 2019; Coccia, 2017; Karanikolos et al., 2022; Levaggi and Menoncin, 2013; Crivelli et al., 2010). Studies suggest that high levels of public debt may restrict government expenditure, especially in critical sectors like healthcare and education (Bacchiocchi et al., 2011; Souliotis et al., 2018). Moreover, high public debt has significative effects on economic system and it can decrease a government's ability to respond to emergencies and social problems (Agoraki et al., 2023; Aizenman and Hito, 2023; Essers and Cassimon, 2022).

1.1. Goal

Research paper here explores the relationship between the public debt and healthcare expenditures for assessing country risk, measured with fatality rates, in the presence of pandemic crises, such as COVID-19. Findings can suggest effective long-run policies to face next emergencies, such as pandemics similar to COVID-19, conflicts, natural disasters, etc., in various European countries.

2. Research Methodology for Statistical Analysis

The literature about COVID1-19 has a lot of studies on manifold topics (Abelk and Gietel-Basten, 2020; Ahmed et al., 2024; Akan and Coccia, 2022, 2023; Allen Douglas, 2022; Amarlou and Coccia, 2023; Angelopoulos et al., 2020; Ardito and Coccia, 2021; Ball, 2021; Banik et al., 2020; Benach et al., 2022; Benati and Coccia, 2022a; Coccia and Benati, 2024, 2024a)[1]. However, how the relationship between the public debt and healthcare expenditures affects fatality rates in the presence of pandemic crises, such as COVID-19, it is hardly known. Our study focuses on a group of 27 European nations characterized by a comparable socioeconomic systems: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden (JHU, 2023).

The study examines variables of the economic and health system in European countries in 2009 and 2019 to assess the level and change before the COVID-19 pandemic crisis and their relationship with case fatality ratio of the COVID-19 in 2020 and 2022. Variables under study are:

- Health expenditures a share of GDP, from 2009 to 2019 (OECD, 2024)
- Government consolidated gross debt, as a share of GDP, from 2009 to 2019 (Eurostat, 2024)
- Case fatality rate (CFR) on 30 December 2020 and 2022 (JHU, 2023)

The average COVID-19 fatality rate in the year 2020, the inception year of the COVID-19 pandemic crisis, is used to categorize the sample of European countries under study into two groups:

- Group 1, Countries with *lower* COVID-19 fatality rates in 2020 than the sample arithmetic mean.
- Group 2, Countries with *higher* COVID-19 fatality rates in 2020 than the sample arithmetic mean.

The arithmetic mean and the change from 2009 to 2019 (ten years) of general government gross debt and of expenditures in health system in countries of group 1 and 2, with a comparative analysis, assess the evolution of public debt and health expenditures before the emergence of COVID-19 pandemic crisis. The rate of change Δ for variable x is given by: x in 2019 minus x in 2009 divided by x in 2009. Statistical analyses are based on descriptive statistics, independent sample T-test to assess the significance of the difference of means between group 1 and 2, correlation analyses of basic relation between health expenditure and COVID-19 fatality rates and simple regression analysis with log-log-model given by the following equation [1]:

COVID-19 fatality rates 2022 (y_i)= α + β healthcare expenditures per capita 2019 (x_i)+ u_i [1]

α = constant

β = coefficient of regression

u_i = error term

i (subscript) = countries

Estimated relationship is with Ordinary Last Squares (OLS) method that determines the unknown parameters. Statistical analyses are performed with the IBM SPSS Statistics 26 ®.

3. Results and Analysis of Findings

Table 1 reveals that Group 1 with a lower COVID-19 fatality rate in 2020 and 202 than group 2 has in the year 2009 and 2019 higher levels of health expenditure per capita (> $3,100 per capita). From 2009 to 2019 this group 1 has a rate of growth of health expenditure per capita of 0.19. Instead,

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[1] Cf. also, Down et al., 2020; Elo et al., 2022; El-Sadr et al., 2023; Fisman, 2022; Flaxman et al., 2020; Galvani et al., 2022; Goolsbee and Syverson, 2021; Götz al., 2024; Haghighi and Takian, 2024; Haldane et al., 2021; Coccia 2023, 2023b, 2024, Coccia and Benati, 2028, 2018°; Kluge et al., 2020; Legido-Quigley et al., 2020; Levin et al., 2020; Magazzino et al., 2022; McKee, 2020, Miranda et al., 2024; Núñez-Delgado et al., 2021, 2023, 2024, 2024a, 2024b; Coccia, 2018b, 2028c, 2022h, 2023c, 2023d, 2024; Kapitsinis, 2020; Kargi et al., 2023, 2023°, 2023b; Khan et al., 2020; Kim et al., 2022; Coccia and Bontempi, 2023, Galvão et al., 2021; Homburg, 2020; Jacques et al., 2023; Penkler et al., 2020; Rađenović et al., 2021; Roche, 2023.

countries with a higher COVID-19 fatality rate in 2020 had in 2009 and 2019 levels of health expenditure per capita lower than previous group 1 (about \$2,530 in 2009 and \$2,600 in 2019). Moreover, this group 2 has a lower rate of growth of health expenditure per capita from 2009 to 2019 and equal to 0.09. If we consider government gross debt as % of GDP, Table 1 reveals that in group 1 is lower both in 2009 (46.80%) and 2019 (50.79%) than group 2, which had 67.22% in 2009 and 81.49% in 2019. In addition, group 1 has from 2009 to 2019 a lower growth of government gross debt (% of GDP) given by 0.12 compared to group 2 that has experienced a high growth of government gross debt (% of GDP) of 0.29, generating a high burden for socioeconomic system and public finance that reduces health expenditures and negatively affects health system.

Table 1. Descriptive statistics.

Variables	Countries with LOWER COVID-19 Fatality in 2020, group 1		Countries with HIGHER COVID-19 Fatality in 2020, group 2	
	Mean	Std. Deviation	Mean	Std. Deviation
COVID-19 Fatality 2020 (%)	1.40	0.44	2.83	0.54
COVID-19 Fatality 2022 (%)	0.57	0.32	1.21	0.89
Healthcare Exp Per Capita $ 2009	$3,119.79	$2,192.71	$2,609.13	$1,828.01
Healthcare Exp Per Capita $ 2019	$3,376.29	$2,014.03	$2,530.77	$1,749.05
Δ Healthcare Exp Per Capita $ 2009-2019	0.19	0.30	0.09	0.31
Government gross debt, % of GDP 2009	46.79	22.21	67.22	37.35
Government gross debt, % of GDP 2019	50.93	27.43	81.51	46.61
ΔGovernment gross debt, % of GDP 2009-2019	0.12	0.31	0.29	0.38

Note: Δ= the rate of change from 2009 to 2019 to assess the dynamics of health expenditures per capita, Government gross debt before the emergence of COVID-19 pandemic crisis

Pearson's coefficient of correlation shows −0.67 which indicates a strong negative correlation (Table 2). The more resources that European nations spend in health sector, the better they are likely to reduce the case fatality rates of COVID-19. The one-tailed significance value – which in this case is p-value < .001, considering that the standard alpha value is .05, means that our correlation is highly significant.

Table 2. Bivariate correlation between health expenditure and COVID-19 fatality rates.

	Log Healthcare Expenditure per Capita $ in 2019
Log COVID-19 fatality rate in 2022	−0.67**

Note: **Correlation is significant at the 0.01 level (1-tailed).

Table 3 presents the results of the regression analysis using the OLS method. The findings clearly indicate that when countries experience a 1% increase in healthcare expenditure per capita in 2019, it leads to a 1.2% reduction in the COVID-19 fatality rate. The R^2 coefficient of determination explains approximately 45% of the variance in the data, whereas the F value is statistically significant (*p*-value < 0.001), indicating that the independent variable reliably predicts the dependent variable, namely the reduction in the COVID-19 fatality rate.

Table 3. Estimated relationship of COVID-19 fatality rate in 2022 on Healthcare Expenditure per Capita $ 2019, log-log model.

	Constant	Coefficient of regression β	Standardized coefficient of regression β	R²	F
COVID-19 case fatality rate 2022	9.04***	−1.17***	−0.67	0.45	20.79***

Note: *** *p* < 0.001; Explanatory variable: Healthcare Expenditure per Capita $ 2019. R² is the coefficient of determination. F is the ratio of the variance explained by the model to the unexplained variance.

Figure 1 illustrates the estimated relationship between COVID-19 fatality rate in 2022 and healthcare expenditures per capita.
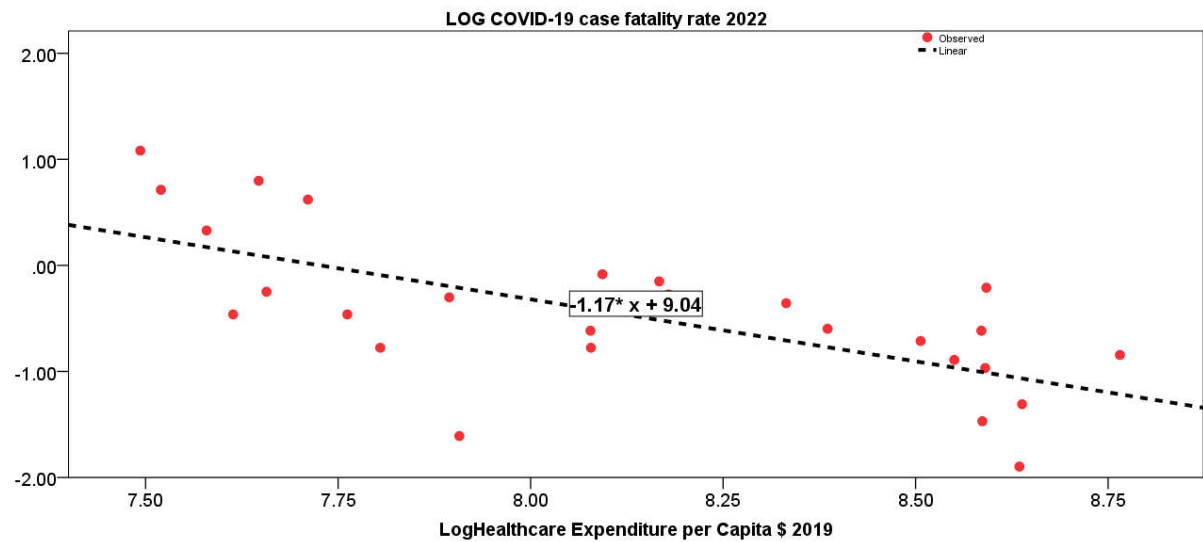

Figure 1. Regression line of the COVID-19 fatality rate in 2022 on healthcare expenditures per capita in 2019.

4. Discussion and Public Policy Implications to Face Complex Emergencies and Global Crises

Studies about COVID-19 discuss manifold implications about health and other socioeconomic effects (Sanyaolu et al., 2020; Shakor et al., 2021; Singh, 2024; Smith et al., 2023; Soltesz et al., 2020; Sorci et al., 2020; Tisdell, 2020; Uçkaç et al., 2023, 2023a; Upadhyay and Shukla, 2021; Verma and Prakash, 2020; Wieland, 2020; Wolff et al., 2021; Zhang et al., 2021). What this study adds is that countries with higher fatality rates have experienced a substantial rise in public debt (0.29% of GDP), resulting in a decline in overall health expenditures for healthcare system. Conversely, countries with lower fatality rates, despite a lesser increase in public debt (0.12% of GDP), had a notable escalation in health expenditures per capita, totaling 0.19% of GDP. Results suggest that countries with lower levels of public debt over time are associated with greater resilience in healthcare system and consequential lower-case fatality rate of COVID-19 (Aboelnaga et al., 2023; Almeida, 2024; Coccia, 2023; Sagan et al., 2020, 2021). The susceptibility of the health system stems from the high level of public debt in certain countries, often resulting from political economy strategies based on austerity measures aimed at alleviating the burden of government debt, such as the Stability and Growth Pact (SGP): several studies indicate that European nations striving to reduce their public debt levels adhere to the rules outlined in the SGP (Agoraki et al., 2023; Theodoropoulou, 2022). The findings here show that when countries have a 1% increase in healthcare expenditure per capita, they experienced a 1.2% reduction in the COVID-19 fatality rate. However, the European Central Bank

(ECB, 2016) affirms that excessive government debt leads economies to be less resilient to unforeseen shocks and the trimming of health and social expenditures is frequently a response to initiatives aimed at addressing high public debt. Iwata and Iiboshi (2023) contend that the greater scale of fiscal adjustments seems to be the primary factor contributing to the diminishing government spending multipliers, rather than the accumulation of debt itself. Hence, financial strategies and public finance that impose limitations in various European countries with significant public debt tend to heighten systemic fragility and diminish the ability of health systems to effectively respond to crises (Benati and Coccia, 2022). Undoubtedly, these governmental strategies fail to take into account the impact of elevated public debt on a nation's systemic ability to withstand crises. The fundamental implications of economic policy of these findings here are that countries must decrease public debt with good governance and steer clear of austerity measures in order to allocate more resources to the healthcare sector and enhance readiness to address unforeseen emergencies like the COVID-19 pandemic, natural calamities, conflicts, and other environmental disruptions.

5. Conclusions

One of the main problems for managing crises is to clarify drivers of systemic weaknesses to face emergencies. This study here analyzes the how the level of public debt can affect healthcare expenditures and fatality rates in the presence of pandemic crises, such as COVID-19.

Main findings of the empirical evidence are that:

- high public debt over time reduces health expenditures and increases the vulnerability of countries to face emergencies, such as COVID-19 pandemic crisis.
- more economic resources the nations spend in health sector, the better they are likely to face emergencies and reduce the case fatality rates.
- when countries experience a 1% increase in healthcare expenditure per capita, in general they have a 1.2% reduction in the COVID-19 fatality rate.
- countries must reduce public debt with good governance and institutions without reducing the allocation of economic resources to the healthcare sector in order to improve the preparedness to unforeseen emergencies and crises, such as pandemics, natural disasters, conflicts, and other environmental catastrophes.

These conclusions are of course tentative. There is need for much more detailed research with additional data and different methods into the relations of socioeconomic factors to reduce country risk and improve the resilience of countries in the presence of emergencies.

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