Do National Health Expenditures Matter for the COVID-19? Evidence from the European Union

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Total health expenditures provide necessary resources to prepare a national health sector to cope with health emergency situations such as the current pandemic. Rich countries have the convenience to spend more on public and private provision of health services. This paper examines whether this simple logic is applicable to the current pandemic. Do countries with higher health expenditures (total, per capita and as percentage of GDP) show a better performance in terms of total and per capita deaths or in terms of the number of people (total and per capita) infected? One expects that this would have been the case but the descriptive evidence of this paper shows that the association is exactly the opposite. Rich countries had more deaths and more cases than poor countries. Data from 27 European Union countries are used to demonstrate that this was the case.

Keywords: COVID-19, European Union, Population, GDP, Per Capita GDP, Health Expenditures

Introduction

In a series of previous papers, I have examined various aspects of COVID-19. In a history paper, I compared ancient Athenian Plague of 430-427 BCE (Papanikos, 2020a) with the current pandemic. I showed the social and political similarities as well as individual impacts. Similarities are striking. The only constraint researchers face is the lack of economic and statistical data.

In a second paper (Papanikos, 2020b), I looked at the impact of lockdown on the Greek economy with an emphasis on international tourism arrivals and the dramatic fall in this year's tourism receipts. Using a scenario analysis based on pre-bookings, the economic effect in terms of Gross Domestic Product (GDP), may reach a double-digit figure.

My last paper (Papanikos, 2020c) investigated the association between the size of population sizes (including densities and age structure) and COVID-19 effects in terms of total and per million deaths and cases. Total population, as one would expect, had a positive impact even though population density and the aging of population did not exert a statistically significant impact. Future studies, at a less aggregated level, may shed light on this puzzle.

The surprising result of this study was the positive association of total and per capita GDP to the effects of COVID-19. One may explain the association with the number of people infected as a result of a better measurement in richer countries. However, this could not be the case of number of deaths. One expects that death rates are more accurately measured than the total number of people infected. After all, the latter statistic does not include the number of people who either did not notice it or avoided to be tested.

This study is an extension of a demographic study I have conducted. I look at a particular component of GDP that of total health expenditures. One may expect a negative association between health expenditures (total, per capita and per GDP) with the number of people died due to COVID-19. On the other hand, the finding of my previous study of a positive association between deaths and GDP and given the positive relations of GDP with health expenditures, makes the effect of health expenditures on deaths an empirical issue.

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At this stage, I do not impose any a priori theoretical conditions including causalities. There is little doubt that this year COVID-19 will have a negative impact on current and future years' GDP. However, the issue here is exactly the opposite. I am looking at the effect of past GDPs on the current pandemic I will leave the data speak for themselves. In other words, this analysis here is descriptive and detects correlations and associations and not causal relations even though theory does suggest a specific interpretation of these findings.

With this introduction included, this paper is organized as follows. The next section presents the association of health expenditures as a percentage of GDP and the level of GDP using data from the 27 EU countries. The following section discusses some important issues based on the raw data and summary statistics of the basic variables of this study. The section, before the final section tentative conclusions of the paper, presents results of some simple regressions which shed some light on the relationship between national health expenditures and deaths resulted from COVID-19.

National Health Expenditures and GDP

This paper uses data from EU countries because they form a relatively homogeneous area of countries linked together with a long period of official and unofficial cooperation. The issue is different for countries which have the same level of development but do not belong to the same integrated area such as USA and UK now or they belong to less developed countries. These issues have been extensively researched in the literature and for examples of such studies you can see Bucci et al (2019) and Akor et al. (2017).

Stańczyk (2016), using a structural equation model analyzed health inequalities across the regions of the EU, found that in the period of 2002-2012 there was a reduction in health inequalities. Socioeconomic variables were significant in determining public health status. One may then conclude that the EU tends towards a common health policy area.

The economics of health has many aspects both micro and macro. Some of these aspects are examined in a Special Issue of the *Athens Journal of Health and Medical Sciences (https://www.athensjournals.gr/ajh)* published in 2016 edited with an introduction by Błażej Łyszczarz (see https://www.athensjournals.gr/ajh/past/v3i1).

Figure 1 shows the relationship between GDP and the share of total health expenditures to GDP in the 27 EU countries for 2017 (the most recent data available). The regression line of the scatter diagram has a positive slope indicating a positive association. If the causality runs from GDP to health spending, then one may interpret the result as follows: a rise in GDP increases the percentage of total expenditures allocated to health.

The scatter diagram also shows that this relationship is non-linear. The effect of GDP increases at a decreasing rate. This cannot be easily seen in Figure 1. A simple regression suggests a non-linear effect. Table 1 reports regression results of a simple non-linear model. GDP exerts a statistically significant effect on total health expenditures as a percentage of GDP. A rise in GDP, increases total national health spending as a percentage of GDP. In addition, this effect is increasing at a decreasing rate showing that there is an upper limit to how large this percentage can become.

Figure 1. *National Health Expenditures and GDP*

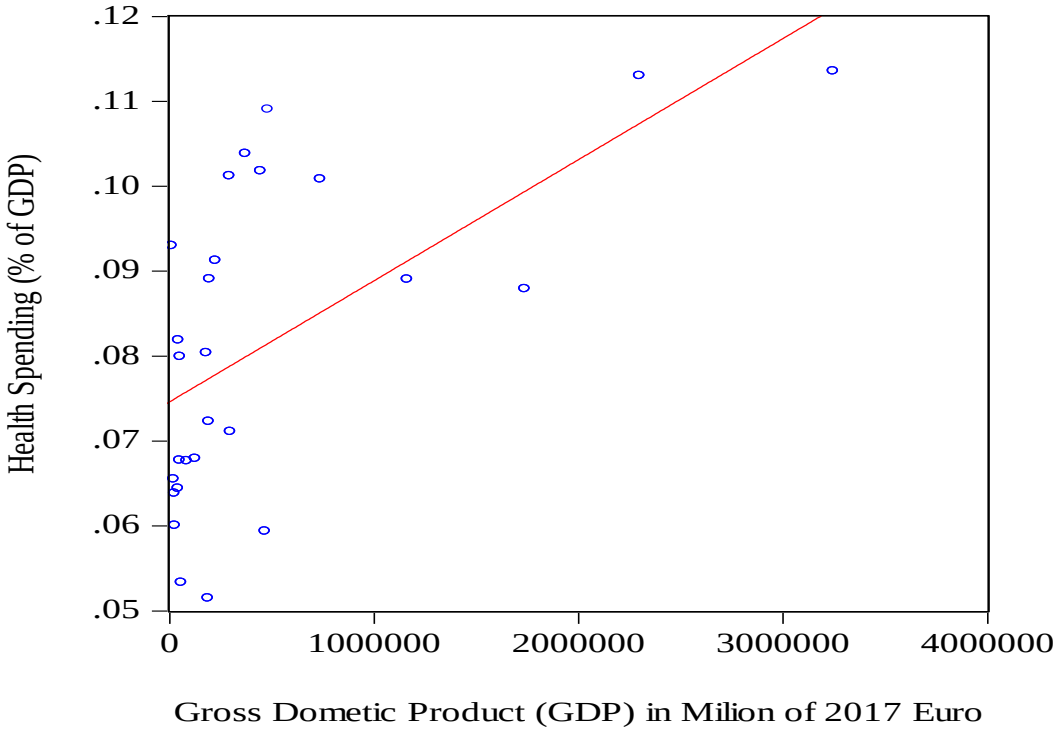

Table 1. *GDP Effects on Health Spending*

Dependent Variable: Total Health Expenditures as a % of GDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.071663	0.003	21.17	0.0000
GDP	2.98E-08	9.20E-09	3.24	0.0035
$(GDP)^2$	-5.57E-15	2.93E-15	-1.90	0.0693
Adjusted R-squared	0.3380			
F-statistic	7.64			
Prob(F-statistic)	0.003			
Prob (Wald F-statistic)	0.000			

Note: HAC standard errors & covariance are reported.

A logarithmic specification was estimated (not reported here). The regression results do not differ but a logarithmic specification cannot capture nonlinear effects which appear to be very strong. It imposes the restriction of a constant elasticity. The coefficient of the logarithmic function

was 0.09 implying that a 1% increase in GDP is associated with 0.09% growth in health expenditures.

All these regression results are to be expected and there is no need for further interpretation. The question of this paper is whether countries with higher percentage of GDP allocated to health expenditures outperformed countries with lower rates in coping with the lethality of COVID-19. This issue is discussed in the next two sections.

Descriptive and Summary Statistics

Table 2 reports raw data and summary statistics of the 27 EU countries. Data are reported for total health expenditures, population, total number of deaths and per million of population, total number people infected and per million of population. However, the most important variable for our purpose here is the percentage of total health expenditures to GDP reported in Column (4) of Table 2. This table reveals a number of important issues related to total health expenditures as a percentage of GDP.

1. The average total health expenditures as a percentage of GDP in EU countries is 8.2% and a median of 8% reveals a normal distribution with a standard deviation of 1.9% and a range of 6.2%. The minimum spending of 5.2% was reported by Romania and the maximum of 11.4% by Germany.
2. EU countries show large variations in almost all variables of concern here. Deaths from COVID-19 show large variations. The average value of deaths per million is 172 people but this varies from a maximum of 831 deaths per million reported by Belgium to only 5 deaths per million reported by Slovakia. The median is 57 which compared with the arithmetic mean of 172 deaths per million shows a large skewness something that is also indicated by the relatively large standard deviations of 224 deaths per million. These numbers need further research on a country by country case which goes beyond the purpose of this study.
3. A real puzzle is that the two most populated countries of the EU show exactly opposite results. Germany has a population of 82 million and France 67 million. The percentage of total health expenditures to GDP is almost the same, 11.4% and 11.3%, respectively. Yet the number of deaths reported by France is 3.4 times higher than that of Germany. How can such huge differences be explained? Effectiveness might be one explanation and requires further investigation, which goes beyond the limited scope of this paper.
4. The next two countries with the largest populations are Italy and Spain which happened to have about the same percentage of health spending of 8.8% and 8.9%, respectively. Their COVID-19 deaths are relatively comparable. Italy with a population of 61 million people had as of 31 of May 2020, 33 thousand deaths and in Spain, with a population of 47 million, the number of deaths reached 29 thousand.
5. The other countries show a mixture of performances which again need further explanation. Twenty countries of EU spend less than 10% of their GDP on health. Their performance shows great variations. On average, deaths per million in these 20 countries was 116 per million with a standard deviation of 180 people. The seven countries with health spending higher than 10% of GDP reported more than double deaths per million (332 people) and a standard deviation of 271 deaths per million.

Table 2. *Total Health Expenditures, Deaths and Infections in the European Union (2017)*

Country	Health Exp. 2017 (Millions) (1)	Pop 2017 (000s) (2)	GDP17 (Bn) (3)	H/GDP (%) (4)	Deaths (5)	Cases (6)	Deaths per Million People (7)	Cases per Million People (8)
Belgium	45405	11331	445957	10.2%	9453	58186	831	5115
Bulgaria	4183	7128	52310	8.0%	140	2513	20	355
Czechia	13864	10566	191722	7.2%	319	9230	30	871
Denmark	29598	5728	292408	10.1%	571	11633	99	2018
Germany	368597	82349	3244990	11.4%	8500	181482	103	2196
Estonia	1518	1316	23776	6.4%	67	1865	51	1416
Ireland	21130	4755	297131	7.1%	1651	24929	343	5186
Greece	14492	10776	180218	8.0%	175	2915	16	271
Spain	103489	46484	1161878	8.9%	29043	239600	623	5142
France	259638	66724	2297242	11.3%	28717	148436	429	2220
Croatia	3326	4172	49094	6.8%	103	2246	25	544
Italy	152705	60627	1736593	8.8%	33340	232664	551	3843
Cyprus	1313	852	20040	6.6%	17	943	20	1097
Latvia	1610	1960	26798	6.0%	24	1065	12	548
Lithuania	2724	2868	42269	6.4%	70	1670	25	590
Luxembourg	3031	583	56814	5.3%	110	4016	184	6734
Hungary	8535	9814	125603	6.8%	524	3867	54	395
Malta	1053	455	11322	9.3%	7	616	15	1316
Netherlands	74448	17030	738146	10.1%	5951	46257	347	2700
Austria	38457	8737	370296	10.4%	668	16638	76	1891
Poland	27756	37970	467313	5.9%	1061	23571	28	621
Portugal	17456	10325	195947	8.9%	1396	32203	136	3126
Romania	9672	19702	187773	5.2%	1253	19133	64	977
Slovenia	3520	2065	42987	8.2%	108	1473	52	713
Slovakia	5721	5431	84521	6.8%	28	1521	5	280
Finland	20614	5495	225836	9.1%	316	6826	57	1239
Sweden	52364	9923	480026	10.9%	4395	37113	437	3690
Average	47638	16488	483297	8.2%	4741	41208	172	2041
Max	368597	82349	3244990	11.4%	33340	239600	831	6734
Min	1053	455	11322	5.2%	7	616	5	271
Median	14492	8737	191722	8.0%	524	9230	57	1316
Standard Deviation	85787	22176	774610	1.9%	9603	70915	224	1816

Source: COVID-19 from WHO (https://covid19.who.int/) and all others from the European Union (https://ec.europa.eu/eurostat/web/national-accounts/overview).

The main points show that large variations exist among EU countries. From raw data and summary statistics of deaths and health spending is not clear the effect of the latter on the former. In the next section, regression analysis is used to discern if there is a statistically meaningful relation between health spending and the lethal effects of COVID-19 in EU countries.

Health Spending Effects

This section examines the effect of health spending, measured as a share of GDP, on the death rate, measured as total deaths per million of population. In the two previous sections of the paper, it was shown that large variations exist within EU member states in deaths, health spending, GDPs and populations. In this section, the regression results of death per million as a dependent variable and all other as explanatory variables are presented.

Do countries which spend a higher percentage of their GDP on health have managed better the situation with COVID-19? This question is answered using two regression specifications: a logarithmic regression and a non-linear one.

Tables 3 and 4 present the regression estimations of a logarithmic specification and a non-linear in levels one, respectively. Many different right-hand variables were used but only the best results obtained in terms of statistical significance and the coefficient of determination are reported here.

The results do not change as far as the variable of our interest is concerned which is the percentage of total national health expenditures to GDP. This variable is then associated with a measure of the COVID-19 which can be measured either as total or per million of population of deaths, or the number of people infected by the virus.

Two other types of variables are associated with the effect of COVID-19: economy and population.

Tables 3 and 4 show that there is no statistically meaningful association between total health expenditures and COVID-19 effects. The latter are measured as deaths per million. All other measures were used and the results were not different.

Table 3. *Regression Results I (Logarithmic Specification)*

Dependent Variable: Total Deaths per Million (in logs)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-12.01176	2.427865	-4.947458	0.0001
LOG(H17/GDP17)	-0.117158	0.678974	-0.172552	0.8645
LOG(POP17)	0.498422	0.123289	4.042711	0.0005
LOG(GDP17/POP17)	1.465476	0.177574	8.252739	0.0000
Adjusted R-squared	0.592475			
F-statistic	13.59993			
Prob(F-statistic)	0.000026			

White heteroskedasticity-consistent standard errors & covariance estimates are reported

One may then conclude that the percentage of total health expenditures of GDP did not play a role in the number of people died from COVID-19. Countries with lower spending perform as well as countries with higher rates of health spending.

Table 3 includes the logarithm of GDP and the per capita GDP. These variables capture the effects of a big economy (the volume of GDP) and of a rich economy (per capita GDP). Both variables have a positive impact. One interpretation might be that richer economies are the aging societies but the structure of population did not play a statistically significant role as explained in Papanikos (2020c). Table 3 shows that a one percent increase in population, raises the death rate by 0.49%. Similarly, a one percent increase in per capita GDP is associated with a 1.7% increase in the death rate.

The results of the logarithmic specification are reinforced by the non-linear specification. Both population and per capita GDP are positively related with deaths per capita. Here what is of interest is the non-linear effect. An increase in population increases deaths per capita but at a decreasing rate. Similarly, a rise in per capita income increase deaths per million but at a decreasing rate. The latter term is not statistically significant but it does have a negative sign.

Table 4. *Regression Results II (Non-Linear)*

Dependent Variable: Total Deaths per Million

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.346957	0.173509	-1.999649	0.0586
H17/GDP17	1.523879	2.424456	0.628545	0.5364
POP17	1.93E-05	6.15E-06	3.133617	0.0050
POP17^2	-2.27E-10	8.02E-11	-2.835119	0.0099
GDP17/POP17	0.011622	0.004861	2.390903	0.0263
(GDP17/POP17)^2	-7.59E-05	4.59E-05	-1.653550	0.1131
Adjusted R-squared	0.444559			
F-statistic	5.161926			
Prob(F-statistic)	0.003043			

White heteroskedasticity-consistent standard errors & covariance estimates are reported

Another result of interest (not reported) is that a regression of deaths per cases on all variables of Table 3 and showed a positive association which was statistically significant at 10% level. This may be interpreted that countries which spend relatively more on health they were capable of identifying more people who were infected because they had the medical infrastructure.

Some Tentative Conclusions

The reported findings by no means can be considered final. These are tentative and require much further research. The puzzle of no association of health expenditures and COVID-19 should be explained.

For example, how can one explain the dramatic difference between France and Germany? In general, how can one explain the disappointing performance of countries which spend a high percentage of their GDP on health, e.g., more than 10% of their GDP.

This puzzle might explain why health spending is not statistically significant. This despite the fact that EU is the most homogeneous group of countries ever existed. The finding by Stańczyk (2016) of convergence supports this idea but the evidence here shows different results. One would have expected that health spending would have a similar positive effect in all EU members. The no effect implies that this effect was not the same for all countries as the descriptive statistics of this paper have shown.

This puzzle cannot be solved using aggregate data. A future study should look at each country's policy reaction to COVID-19. I am going to express some thoughts on the Greek case since I have the experience of how Greece has coped so far with the diseases.

Greece has shown a remarkable performance given its fragile public health sector due to underfunding because of severe austerity measures. Everybody was expecting a tragedy but instead a miracle happened. What were the policy initiatives which prevented an expected huge death rate and an overcrowded hospital sector especially the intensive care units? The supply increased remarkably fast for Greece's notorious public sector and the demand for hospital services other than COVID-19 decreased.

Greece is a member of EU but unfortunately EU has not taken a common action as far as health policy is concerned. All their common actions have been taken to boost the economy after the COVID-19. In as series of documents, see European Commission (2020a, 2020b, 2020c and 2020d), the common action had to do with the severe economic impacts that the unorganized lockdowns of each EU country had on the entire economy of the area.

My suggestion in another paper (Papanikos, 2020c) was that of a common health policy. As a suggestion I used the experience of a European University since 1972 to propose a European Hospital which will be a protype for a common health policy.

Details be easily worked out, once the EU leaders accept the idea of a common health policy. The issue is ideological and political. Once these have been taken care of, then the common health policy is a matter of costs and benefits. It becomes a technocratic problem and the EU has excellent technocrats to solve such puzzles.

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