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Original Research Article

Per Capita GDP and Covid-Related Deaths: A Cross-Sectional Study

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Abstract: The main objective of this paper is to investigate the relationship between per capita GDP and covid-related deaths across countries. Two measures of covid-related deaths are considered: official deaths related to COVID-19 per one hundred thousand people and excess mortality per one hundred thousand people. The regression analyses reveal that covid-related deaths and per capita GDP show a non-linear pattern (an "inverted U-shaped pattern). The findings suggest that the incidence of covid-related deaths was relatively lower in lower and higher-income countries, compared to middle-income countries.

Keywords: COVID-19, Excess Mortality Rate, Official Mortality Rate, Per Capita GDP, Regression Analysis.

INTRODUCTION

The Covid pandemic, as of April 13, 2024, according to *Worldometers*, affected more than 704 million people worldwide and caused more than 7 million deaths. The incidence of Covid-19 varied across countries because of several factors such as the effectiveness of the healthcare system, intensity of lockdown measures (Islam and Tarannum, 2020), geographic concentration of the population, and the demographic composition of the population. This paper addresses a major research question: How has the incidence of covid-related deaths been affected by per capita GDP across countries? In other words, has the incidence of covid-related deaths varied across poor, middle, and advanced countries?

One relevant issue is the reliability of covid-related deaths as reported officially by countries. It is likely that official data underestimate the true covid-related deaths, especially in developing countries. Accordingly, it is useful to use excess mortality rate as a metric for covid-related deaths, which is described in the next section.

DATA AND METHODOLOGY

For per capita GDP this paper uses per capita GDP at purchasing power parity for 2022 (PCG22), available from the IMF. For covid-related deaths, two measures are considered: Official mortality rate-related to COVID-19 (OMCV) per one hundred thousand people and excess mortality rate per one hundred thousand people (EMR). Excess mortality rate is the difference between total deaths regardless of causes in a country during a time period and the expected deaths if the covid-19 had not occurred (Economist, 2022, October 25). Computation of excess mortality rate is difficult because of several reasons: some covid-related deaths were not included in official statistics because covid patients were not tested; the Covid-19 pandemic might have reduced some deaths caused by air pollution and road accidents because of lockdowns; some non-covid patients might have died because of lack of treatment caused by over-crowding of hospitals during the pandemic. This paper uses the data of OMCV and EMR from the Economist magazine (Economist 2022). For EMR this paper uses the average of the upper limit and lower limit.

For regression analyses, the paper uses OMCV or EMR as the dependent variable and PCG22 and the square of PCG22 (PC2) as the independent variables. The PC2 variable has been included to capture a non-linear relationship.

Table 1 reports data on PCG22, OMCV, and EMR on selected countries. The main points can be summarized as follows. First, for some large countries such as the USA, Russia, UK, Italy, Brazil, and Mexico, both OMCV and EMR are higher compared to many other countries. Second, for some developing countries such as Bangladesh, Nigeria, India, Indonesia, South Africa, Pakistan, and China, values of EMR are significantly higher than values of OMCV. Finally, for some countries such as Denmark, Sweden, France, and New Zealand, values of EMR are lower than values of OMCV.

Table 1: Per Capita GDP, Official Covid-related Death, and Excess Mortality Rate

Country	PCG22	OMCV	EMR
Australia	52,531.30	93.8	135
Bangladesh	6,750.75	17.2	565
Brazil	16,004.08	326.1	440
Canada	49,388.90	141	185
China	18,127.56	8.6	185
Denmark	60,412.74	162.8	155
Finland	49,498.69	206.8	335
France	47,686.00	247.7	235
Germany	54,276.02	209.9	345
India	7,112.04	37.6	465
Indonesia	12,438.76	58.8	415
Italy	43,893.24	332.4	510
Japan	41,575.06	60.3	220
Korea	45,602.72	69.3	165
Mexico	19,943.18	262.7	520
Netherlands	59,900.95	130.9	350
New Zealand	44,008.00	71.8	17
Nigeria	5,004.25	1.4	228.5
Norway	66,071.72	105.5	205
Pakistan	5,670.44	13	370
Russia	28,162.46	277.6	1080
Saudi Arabia	56,604.91	26.5	154
Singapore	108,036.11	34.7	155
South Africa	13,320.82	171.3	500
Spain	40,407.31	256.2	365
Sri Lanka	12,083.25	77.4	252.5
Sweden	55,973.94	256	225
Switzerland	73,057.59	162.2	290
Turkey	33,295.94	118.8	290
United Kingdom	46,432.03	343.8	385
United States	64,656.89	346.2	415
Vietnam	11,250.46	44	405

REGRESSION RESULTS AND DISCUSSION

A regression analysis, based on the Ordinary Least Squares (OLS) method was carried out first with OMCV as the dependent variable and PCG22 and PC2 as the independent variables. The results are reported below.

OMCV = 22.96. + .00827 PCG22 - 7.45 e^{-08} PC2
t-values (1.52) (8.43) (-4.45)
p-values (0.129) (0.00) (0.00)
n= 181. $R^{2.}$ = .3023. F(2,178) = 38.56

The coefficients on PCG22 and PC2 are statistically significant at the 1% level. The findings confirm a non-linear relationship between OMCV and per capita GDP.

Another OLS regression analysis was carried out with EMR as the dependent variable and PCG22 and PC2 as independent variables.

'The results are shown below.
EMR = 267.83 + .00587 PCG22 - 7.39 e^{-08} PC2
t-values (11.70) (3.94) (-4.41)
p-values. (0.00) (0.00) (0.00)
n= 181. $R^{2.}$ = 0.099 F(2,178) = 9.78

The results reveal that all the coefficients including the intercept are statistically significant at the 1% level. The results support the hypothesis of a non-linear ("inverted U-shaped") relationship between covid-related deaths and per capita GDP

A diagnostic analysis, based on the Breusch-Pagan test, reveals that the error terms in the above regressions are heteroscedastic. However, regression results after adjusting for heteroscedasticity show results largely similar to the OLS results.

Additional regression analyses were carried out with Global Health Security Index (GHSI) as one of the independent variables (Brown University School of Public health Pandemic Center, 2021). This index measures the capacity of a country to detect, prevent, and respond to pandemics. However, the coefficient on GHSI in regression results had a wrong sign, which suggests that as GHSI increases, mortality from Covid-19 increases.

CONCLUSION

The data on official covid-related deaths (OMCV) and excess mortality rate (EMR) show significant differences between the two measures for many countries. The regression results reveal that there is a non-linear relationship between OMCV and EMR and per capita GDP: As per capita GDP rises, OMCV and EMR first increases then decreases. This suggests that the incidence covid-related deaths may be higher in the middle-income countries compared to low-and high-income countries. The incidence of covid-related deaths may be lower in low-income countries because of lower urbanization and a higher proportion of younger population. The incidence of covid-related deaths in high-income countries may be lower because of developed healthcare facilities to manage the covid pandemic.

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