Human capital and the COVID-19 pandemic

Khemraj, Tarron and Yu, Sherry

New College of Florida

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Tarron Khemraj, New College of Florida

Sherry X. Yu, New College of Florida

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Abstract

This paper examines the effect of socioeconomic, institutional and medical factors on cross-country coronavirus death rates. Our findings suggest that countries with high income and human capital, as well as effective government are likely to experience lower mortality. Furthermore, a low-income country could have low mortality and high-income high mortality when human capital is interacted with average income. Hence, the human-capital channel of income.

Key words: pandemic, human capital, mortality, COVID-19

Introduction

Too numerous to cite here, a growing body of literature explores various economic dimensions of pandemics. A sample of the topics studied range from the impact of pandemics on commodity prices to the short and long-term effects on per capita income (Barro et al. 2020, Bakas and Triantafyllou 2020, Carillo and Japelli 2020). Yet another strand examines whether pandemics have long-run effects on human capital formation, particularly as it relates to future health and education outcomes (Almond 2006, Guimbeau et al. 2020).

Our paper contributes by studying the implication of economic factors for cross-country mortality rate during the COVID-19 pandemic. COVID-19 presents a natural experiment to evaluate whether pre-pandemic economic factors determine the present mortality rate. Assa (2020) follows a similar strategy to examine whether years of pre-pandemic privatization of healthcare provision contribute to COVID-19 mortality today.

Our results show that human capital, per capita income and government efficiency are the strongest factors in reducing deaths after controlling for population density, health resources and other variables. Moreover, death rate in low-income countries may be dampened by a relatively higher level of human capital. This view is supported by our results from interacting human capital with per capita income.

Data, Methodology and Definitions

The paper explores whether economic and non-economic factors determine COVID-19 death rate in a sample of 148 countries. Death rate (DR), the dependent variable, is defined as the percentage of cumulative[1] COVID-19 deaths to confirmed cases, expressed in per million people terms to control for large variations in population size. We pay specific attention to the death rate of *confirmed* cases to control for the vast differences in testing availability as COVID-19 mortality in the overall population may be influenced by the number of coronavirus tests performed in each country. Data is obtained from European Center for Disease Prevention and Control and Roser et al. (2020). The Lancet (2020) redefines vulnerability in the era of COVID-19 in reference to elderly people and population with limited access to medical resources. In light of the present medical consensus and research from economists, we propose the following explanatory variables. All statistics are obtained from the World Bank using the 2013-2018 reported averages unless otherwise noted. Table A.1 in the appendix provides the summary statistics.

<u>Socioeconomic Factors</u>

Population 65+. This variable measures the percentage of elderly population ages 65 and above, including both male and female. A country with a high proportion of elderly population is likely to experience a higher death rate.

[1] Data range is from December 31, 2019 to June 12, 2020.

Human Capital Index (HCI). The World Bank's Human Capital Index database provides an overall index that measures the amount of human capital that a child born today can expect to attain by age 18, given the risks of poor health and education that prevail in that country. The HCI ranges between 0 and 1 (multiplied by 100 for estimation purposes) with 1 meaning countries are best in mobilizing economic and professional potential of its citizens. It combines information from infant survival rate, quantity of education, quality of education, to adult survival rate and healthy growth among children. We expect HCI to be negatively related to mortality as the population could be better informed and prepared for the pandemic.

Population Density. This variable accounts for the number of people (in thousands) per square kilometers of land area in each country. We expect higher density to lead to greater spread and death.

Gross Domestic Production per Capita (GDPP). This variable controls for income variation across the world, measured in constant 2010 US dollars. Different income levels could also lead to variation in public and private resources to combat the pandemic. The statistics are transformed by natural logs in order to reflect the idea of diminishing returns. We anticipate a negative relationship between income and mortality rate.

Interaction of GDPP and HCI. We include this interaction term aiming to account for the difference in relationship between COVID-19 death rate and human capital at different levels of income. Although lower income hinders the quality of education and human capital accumulation, it is also possible that high quality of education and health system in a poor country could dampen the effect on death rate as citizens are more conscious of the scientific aspects of the pandemic and may utilize limited resources more effectively. The interaction term allows us to calculate the income channel of human capital formation.

System Efficiency

Government Efficiency. In light of a global pandemic, the role of government is critical in both the speed of response as well as the effective balance between economic and health outcomes. Decisions such as school closures, stay-at-home orders, regional lockdowns and medical resource allocation are crucial to the success of our fight against the spread of the virus. Erikson (2020) comments on how governments are critical in organizing testing centers and treatment facilities, and Moser and Yared (2020) theorize conditions on how the government can limit a pandemic's impact via a lockdown with credible commitment. An efficient government is expected to act promptly and effectively to counter the spread of the virus. The government efficiency index from the Global Competitiveness Report compiled by the World Economic Forum annually is measured on a scale from 1 to 7 with 7 being the most efficient institution. It measures the burden of regulation and transparency of policymaking, and wastefulness of government spending to produce an overall score and global ranking. We expect efficient governments to be more successful in controlling mortality.

Medical Resources

Hospital Beds and Physicians per 1000 People. Since the beginning of the global pandemic, hospital and intensive care capacity have captured media attention as indicators of the severity of medical shortages. Patients infected with the virus have been reportedly in short of access to ICU beds and ventilators. The access to physicians is also critical to the fight of the pandemic. We include these two variables to reflect the medical resource availability in each country. Greater medical capacity and professional knowledge allows patients to receive adequate care and leads to a better rate of recovery.

We have a cross-sectional dataset of 148 countries and seven independent variables including demographics, institutional efficiency and medical resource availability. The following model is estimated using least squares and robust standard errors. The notation x_i indicates government efficiency, $y_i h_i$ the interaction between per capita income and human capital, z_1 a vector of socioeconomic variables including human capital, and z_2 a vector of medical-resource variables. δ and γ are row vectors of parameters to be estimated, as well as the scalar parameters β_0, β_1 and β_2.

$$DR_i = \beta_0 + \beta_1 x_i + \beta_2 y_i h_i + \delta z_1 + \gamma z_2 + \varepsilon_i \quad (1)$$

As robustness checks we perform the following: (i) post-estimation Ramsey RESET test for omitted variable bias; (ii) White's heteroskedasticity test although robust standard errors are estimated; and (iii) the survival-rate (SR) model characterized by

$$SR_i = \alpha_0 + \alpha_1 x_i + \alpha_2 y_i h_i + \psi z_1 + \xi z_2 + u_i \quad (2)$$

The survival rate is calculated as follows: $SR_i = \log(1 - DR_i)$. The independent variables are the same as in equation 1, but the parameters to be estimated are α_0, α_1, α_2, vector ψ, and vector ξ. Finally, ε_i and u_i are well-behaved error terms.

Results and Discussion

Table 1 presents the estimation results for the first model. Except for physicians, all other variables are statistically significant at least at 95 percent and coefficients possess the expected sign. We only comment on a few coefficients from model 8. Using the sample mean for DR and the coefficient estimate of -1.7203, the income-death elasticity is -0.488, implying that a 1% rise in income reduces death by 0.488%[2].

[2] Approximate elasticity is -1.7203/sample average DR given the lin-log specification.

Table 1 Estimation results for determinants of death rate

Variable	Eq(1)	Eq(2)	Eq(3)	Eq(4)	Eq(5)	Eq(6)	Eq(7)	Eq(8)
% Over 65	0.2404***	0.3949***	0.3710 ***	0.3799***	0.3381***	0.2400***	0.2730***	0.3105***
	(0.055)	(0.068)	(0.070)	(0.071)	(0.066)	(0.068)	(0.064)	(0.076)
Human Capital Index		-0.0815***	-0.0675**	-0.1257***	-0.3986***	-0.5592***	-0.5496***	-0.5269***
		(0.029)	(0.031)	(0.043)	(0.139)	(0.161)	(0.163)	(0.175)
Population Density			-0.4140**	-0.3785**	-0.5951***	-0.4596***	-0.4668***	-0.5092**
			(0.170)	(0.179)	(0.172)	(0.165)	(0.160)	(0.219)
Log(GDPP)				0.6344**	-1.2387*	-1.8926**	-1.9134**	-1.7203*
				(0.267)	(0.754)	(0.836)	(0.836)	(0.915)
Human Capital Index * Log(GDPP)					0.0329**	0.0531***	0.0529***	0.0510***
					(0.014)	(0.017)	(0.017)	(0.018)
Government Efficiency						-1.5163***	-1.5559***	-1.5527***
						(0.577)	(0.567)	(0.564)
Hospital Beds							-0.2040**	-0.1955**
							(0.082)	(0.084)
Physicians								-0.3591
								(0.275)
Constant	1.3484**	4.7562***	4.2641***	2.01	17.3490**	28.1085***	28.2743***	26.6302***
	(0.523)	(1.467)	(1.546)	(1.608)	(6.806)	(8.633)	(8.728)	(9.640)
Observations	148	139	139	139	139	139	139	135
R^2	0.16	0.18	0.19	0.20	0.23	0.27	0.29	0.29

Note: *** = 99% confidence interval, ** = 95% and * = 90%

Interestingly, when GDPP is interacted with HCI the coefficient becomes positive, indicating that high income country could have high death rate if HCI is relatively low and vice versa. The coefficient on human capital is consistently economically and statistically significant. A 1% increase in HCI results in a substantial 0.5269% decrease in DR, holding everything else constant. A somewhat surprising result is the negative coefficient between population density and DR. Virus may spread more easily in densely populated areas (particularly urban centers), but could also be associated with lower mortality given better nutrition, healthcare, regulations and information coverage. This is consistent with recent findings from Fang and Wahba (2020).

White's heteroscedasticity estimates Chi^2 (43) = 31.45 and accompanying p-value = 0.904, thus strongly fails to reject the null of heteroscedasticity. The Ramsey RESET F-Stat (3, 123) = 1.84 and p-value = 0.144 indicate we cannot reject the null of no misspecification.

Table 2 presents the results for the second model on logged survival rates. We validify findings from the first model with reversed signs and consistent Ramsey and White's test results. The coefficient on human capital is statistically significant across different specifications. The approximate human capital-survival elasticity – given the coefficient estimate of 0.0058 and a sample average of 58.197 for human capital – is 0.338, which means a 1% increase in HCI results in a 0.338% response or improvement in the survival rate. The income-survival elasticity is 0.0191 given the double-log specification. The approximate government efficiency-survival elasticity is 0.061, given the parameter estimate of 0.0169 and the sample average of 3.62. Note, the approximate elasticity of the log-lin specification is $0.0169 \times 3.62 = 0.061$.

Our results suggest that an efficient government and informed population with adequate resources could effectively reduce pandemic mortality. Future studies should consider controlling for the variations in testing availability and restrictive policies implemented during the pandemic to provide a deeper understanding on the contributable factors to COVID-19 mortality rate.

Table 2 Estimation results for survival rate (equation 2)

Variable	Eq(1)	Eq(2)	Eq(3)	Eq(4)	Eq(5)	Eq(6)	Eq(7)	Eq(8)
% Over 65	-0.0025***	-0.0042***	-0.0038***	-0.0040***	-0.0036***	-0.0025***	-0.0029***	-0.0032***
	`	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Human Capital Index		0.0009***	0.0007**	0.0013***	0.0043***	0.0061***	0.0060***	0.0058***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Population Density			0.0043**	0.0039**	0.0063***	0.0048***	0.0049***	0.0053**
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log(GDPP)				-0.0069**	0.0137*	0.0208**	0.0210**	0.0191*
				(0.003)	(0.008)	(0.009)	(0.009)	(0.010)
Human Capital Index * Log(GDPP)					-0.0004**	-0.0006***	-0.0006***	-0.0006***
					(0.000)	(0.000)	(0.000)	(0.000)
Government Efficiency						0.0165**	0.0170***	0.0169***
						(0.006)	(0.006)	(0.006)
Hospital Beds							0.0022**	0.0021**
							(0.001)	(0.001)
Physicians								0.0038
								(0.003)
Constant	4.5915**	4.5555***	4.5606***	4.5849***	4.4167***	4.2993***	4.2976***	4.3144***
	-0.0058	-0.0162	-0.0171	-0.0175	-0.0738	-0.0957	-0.0966	-0.1068
Observations	148	139	139	139	139	139	139	135
R^2	0.1467	0.1707	0.1782	0.1917	0.2167	0.2627	0.2773	0.2794

Note: *** = 99% confidence interval, ** = 95% and * = 90%

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Appendix

Table A.1 Summary of Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Covid-19 Death Rate	148	3.5234	3.7719	0.0000	23.0123
% Population Over 65	148	9.0488	6.1891	0.9438	25.8786
Human Capital Index	139	58.1971	15.0461	29.3000	88.4000
Population Density	148	0.2496	0.8692	0.0019	7.7800
Log (GDP per Capita)	148	8.7744	1.4540	5.6228	11.6067
Government Efficiency	148	3.6207	0.7496	1.6607	5.7531
Hospital Beds/Thousand	148	3.0494	2.6513	0.1000	19.3510
Physicians per Thousand	142	1.8682	1.4125	0.0262	5.4328

Source: World Bank and World Economic Forum