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Globalization and outbreak of COVID-19: An empirical analysis

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Abstract

The purpose of this study is to examine the relationship between globalization, Coronavirus Disease 2019 (COVID-19) cases, and associated deaths in more than 100 countries. Our ordinary least squares multivariate regressions show that countries with higher levels of socio-economic globalization are exposed more to COVID-19 outbreak. Nevertheless, globalization cannot explain cross-country differences in COVID-19 confirmed deaths. The fatalities of coronavirus are mostly explained by cross-country variation in health infrastructures (e.g., share of out of pocket spending on health per capita and the number of hospital beds) and demographic structure (e.g., share of population beyond 65 years old in total population) of countries. Our least squares results are robust to controlling outliers and regional dummies. This finding provides the first empirical insight on the robust determinants of COVID-19 outbreak and its human costs across countries.

Keywords: COVID-19; globalization; public health

JEL Classifications: I12; I18; I15 F63; F68

1. Introduction

The spread of the highly contagious coronavirus disease (COVID-19) caused by severe acute respiratory syndrome worldwide has affected 743,201 individuals and has taken the life of 35,000 persons[1] in 192 countries (by 30 March 2020). Yet, the negative impact of the coronavirus outbreak is not limited just to the loss of lives insofar as it has short and long-term socio-economic effects throughout the world.

There are already several reports and studies dealing with the economic consequences of the COVID-19 pandemic in different countries. The coronavirus outbreak has interrupted trade, supply chains and tourism – all of which have had an impact on the global economy (Ahani & Nilashi, 2020). McKibbin and Fernando (2020) demonstrate that, in the short-run, even a controlled outbreak could significantly affect the global economy. Evenett (2020) provides a critical review of the initial trade policy response to COVID-19.

According to the International Monetary Fund Managing Director, COVID-19 outbreak will cause a global recession in 2020 that could be worse than the one triggered by the global financial crisis of 2008-2009.[2] In a recent report, OECD (2020) forecasts that a longer-lasting and more intensive coronavirus outbreak can drop global growth by 1.5%in 2020. So far, it has been estimated that the outbreak will lead to a drop in economic growth in China from 6% to 2% (Khan & Faisal, 2020). Results of Wang et al. (2020)'s study reveal a similar picture where China's expected gross domestic product (GDP) growth rate in 2020 will reduce from 6.50% to 1.72%. Based on different scenarios for the impact of the pandemic on growth, the International Labour Organization (ILO) estimates that the global unemployment could increase by almost 25 million (ILO, 2020).

[1] https://ncov2019.live/ (note that data in this website is updated daily. Our analysis is based on data which were available at 30 March)

[2] https://www.imf.org/en/News/Articles/2020/03/23/pr2098-imf-managing-director-statement-following-a-g20-ministerial-call-on-the-coronavirus-emergency

As a result of the COVID-19 pandemic, many countries have banned or imposes restrictions on interpersonal interactions, social, cultural and international trade exchanges[3].

There is an increasing interest to understand the main explanatory factors of cross-country differences in the pattern of COVID-19 confirmed cases and fatalities. The pandemic seems to be a major blow to the current form of globalization (Bremmer, 2020), that slows its speed, if does not reverse it (Bloom, 2020), and even may create a new version of globalization which is more regulated (Hutton, 2020). Yet, globalization with the worldwide flow of people, goods, money, information, and ideas, in huge scale and speed, might also be guilty of allowing the speedy spread of the outbreak. Since, for instance, the spread of the COVID-19 disease relies heavily on human-to-human interactions, movement of people internationally could be a dominant driver of its outbreak.

In this paper, we examine whether and to what extent different aspects of globalization are responsible for the outbreak of the COVID-19. In our study, we assess the relationship between different components of globalization, COVID-19 cases, and associated deaths in more than 100 countries. We use multivariate regression analyses, controlling for other plausible factors of COVID-19 outbreak. There are studies which have examined the negative influence of globalization on health risks (for a review, see Pang et al., 2004 and Woodward et al., 2001). However, our research is the first empirical examination of socio-economic factors (globalization indicators in particular) which may explain, at least partially, the COVID-19 outbreak.

The paper proceeds as follows: Section 2 describes the data and the estimation method; Section 3 presents the findings; and Section 4 concludes.

[3] For a list of countries with travel restrictions see https://www.nytimes.com/article/coronavirus-travel-restrictions.html

2. Data and methodology

We hypothesize that countries with higher levels of globalization are associated with a higher number of COVID-19 cases, *ceteris paribus*. We, also expect to observe an insignificant relationship between globalization and confirmed deaths of COVID-19, controlling for other explanatory variables such as health infrastructure and demography of countries. To test these hypotheses, we use confirmed cases of COVID-19 and death figures per million by 30 March 2020. The data is regularly updated based on information of local governments' websites/ health departments and can be found at https://ncov2019.live/data.

The base-line econometric model has the following form:

$$COVID19\ cases\ or\ deaths_i = \beta_1.Globalization_i + \beta_2.Controls_i + \varepsilon_i \quad (1)$$

The subscript i refers to country i, where there are 100 countries with deaths associated with COVID-19 and 138 countries infected with the Coronavirus. To explain cross-country differences in confirmed cases and death numbers of COVID-19, we use *the revised version of KOF indices of globalization* as the main explanatory variable (Gygli et al., 2019). This composite index measures the economic, social and political dimensions of globalization. Based on 43 variables (instead of 23 variables in its original version as was introduced by Dreher, 2006), various dimensions of globalization including trade, finance, interpersonal, information, culture, and politics are covered. We examine the association between each of these dimensions of globalization and confirmed cases of COVID-19 and associate fatalities.

Potrafke (2015) provides a survey of various socio-economic effects of KOF globalization index. He identified more than 100 studies which have used this index to measure countries interaction with the rest of the world. His survey shows that globalization, on average, has more positive consequences for countries in a term of economic growth, gender equality, and human rights. On the negative side, globalization may also fuel within-country inequalities. In our study, we explore a

new dimension of globalization and that is the contagion level of COVID-19 across countries. We take the average the different dimensions of globalization from 2010 to 2017, the latest available data. Under economic globalization, we consider trade and financial dimensions. Social globalization dimensions comprise of interpersonal and information categories. Finally, political dimensions consider the degree of integration of a country in global politics.

While we estimate different specifications to examine the association between different dimensions of globalization and COVID-19 outbreak and deaths, we control for other important explanatory variables (obtained from the World Bank, 2020) and regional dummies:

GDP per capita: it is capturing the available financial resources and state capacity in testing COVID-19 and recording such statistics. Poor economies may not be able to test and diagnose COVID-19 cases or even may care less about the consequences of the outbreak of COVID-19 due to their lower opportunity costs.[4] We use log of GDP per capita (in purchasing power parity (PPP) prices) and the data are averaged values between 2010 to 2019.

Health system capacity: It has been a trending topic around the COVID-19 outbreak (Aleem, 2020). We use log of the number of nurses and midwives (per 1,000 people) and log of the number of hospital beds[5] (per 1000 people), averaged values between 2010 and 2019, as a measure of health system capacity to reduce the negative consequences of COVID-19. We expect to observe a negative correlation between the number of nurses, and hospital beds with death numbers of COVID-19. Modern infrastructures, public health institutions, and efficient medical treatment control the

[4] For a related study on the dynamic relationship between GDP and infectious diseases, see Zhang et al. (2016).

[5] Hospital beds include inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centres. In most cases, beds for both acute and chronic care are included (World Bank, 2020).

community of infected individuals and keep them far below the critical threshold which is needed for endemic or even epidemic transmission (Murphy, 2006).

Population density: A higher density of the population may mean more interactions among people and thus a higher risk of contagion. Tarwater and Martin (2001) found a significant effect of population density on the epidemic outbreak of measles or measles-like infectious diseases. We use the average values of population density between 2010 and 2019.

Demographic structure: the Coronavirus infects people, regardless of their age. However, evidence suggests that the infection rate is likely age-dependent (Suwanprasert, 2020) and older people are at a higher risk of getting severe COVID-19 disease[6]. A higher share of elderly in the population may also mean a higher vulnerability versus COVID-19. Analysis of Zhou et al. (2020) show in-hospital death due to COVID-19 is more likely for patients with older age. Early data from China suggest that a majority of coronavirus disease 2019 deaths have occurred among adults aged more than 60 years and among persons with serious underlying health conditions.[7] Evans and Werker (2020) also argue that uncontrolled virus could have a far lesser death toll in a much younger population. We use an average share of population ages 65 and above in the total population, from 2010 to 2019, and expect it to have a positive correlation with fatalities of COVID-19.

Costs of health care: to control for financial costs of health care for people, we use out-of-pocket expenditure on heath per capita, PPP (current international $) averaged from 2010 to 2019. Out of pocket payments are spending on health directly out of pocket by households in each country. Its higher levels may indicate a higher burden of health care and thus higher vulnerability of individuals against COVID-19. Earlier studies show that ineffective health financing systems and lack of social protection

[6] http://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/statements/statement-older-people-are-at-highest-risk-from-covid-19,-but-all-must-act-to-prevent-community-spread

[7] https://www.cdc.gov/mmwr/volumes/69/wr/mm6912e2.htm?s_cid=mm6912e2_w#suggestedcitation

networks are main drivers of out-of-pocket health expenditure which consequently leads to consumption a large portion of household's budget (e.g., van Doorslaer et al., 2006). Table 1 presents summary statistics of key variables.

Table 1. Summary statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
log of COVID-19 confirmed cases (per million)	138	3.30	2.29	-1.73	8.07
log of COVID-19 deaths (per million)	100	0.01	1.90	-3.94	5.18
KOF economics globalization index	138	61.08	15.88	28.21	94.24
KOF social globalization index	138	66.34	16.49	28.20	91.84
KOF political globalization index	138	71.14	17.28	21.82	98.32
log GDP per capita (PPP, US$)	138	9.42	1.13	6.70	11.67
log of population density	138	4.26	1.37	0.64	8.95
Population ages 65 and above (% of total population)	138	9.08	5.98	0.89	25.20
log of out of pocket spending on health (PPP, per capita, US$)	138	5.37	1.10	1.45	7.59
log of total number of nurses (per 1000)	138	1.01	1.10	-1.65	2.88
log of total number of hospital beds (per 1000)	138	0.79	0.89	-2.30	2.60

Table 2 presents the correlation between COVID-19 confirmed cases and associated deaths by 30 March 2020 (in log) and economic, social, and political KOF globalization indices.

Table 2. Correlation between (selected dimensions of) KOF globalization indices and COVID-19 cases and deaths (by 30 March 2020)

	log of COVID-19 confirmed cases per million	log of COVID-19 deaths per million	KOF economic globalization	KOF social globalization	KOF political globalization
log of COVID-19 confirmed cases per million	1				
log of COVID-19 deaths per million	0.8633	1			
KOF economic globalization	0.5422	0.3721	1		
KOF social globalization	0.8527	0.6844	0.6788	1	
KOF political globalization	0.234	0.1643	0.3503	0.3145	1

As can be seen from Table 2, there is a stronger correlation between social globalization index followed by economic and political dimensions of globalization with COVID-19 outbreak. We will examine the robustness of these correlations through multivariate regression analysis.

3. Results

Main analyses

We apply the ordinary least squares (OLS) estimation method with robust standard errors. The main variables of interest are different KOF globalization (sub-)indices. All models include *GDP per capita (PPP, US$)*, as a proxy for the relative wealth of nations and economic activities, *population density*, to account for the higher chance of human-to-human interaction which itself makes infection more likely, *ratio of people over 65 years old in the total population*, to take into account countries with more high-risk population as well as health system infrastructure proxies such as *number of nurses* and *number hospital beds*, both per 1000 population, and *out- of-pocket spending on health per capita (PPP, US$),* to consider degree of government involvement in the health system and financial burden of health care on people. Moreover, we incorporated regional dummies which control for regional specific characteristics which may also impact the outbreak of COVID-19 such as geography, cultural and behavioral norms and attitudes.

Table 3 shows the base-line regression results with the log of total confirmed cases of COVID-19 as the dependent variable. Different specifications control for various KOF globalization sub-indices which may explain the outbreak of COVID-19 across 138 countries. Our results show that there is a significant and robust association between almost all KOF globalization sub-indices and countries' levels of exposure to COVID-19. We can compare the explanatory power of different dimensions of KOF globalization indices in competition with other explanatory variables by examining their standardized coefficients (not reported in estimations). The most powerful, not only in magnitude but also in statistical significance, globalization dimension in

explaining cross-country variation of COVID-19 outbreak is the *social globalization* comprised of *interpersonal*, *information* and *cultural* aspects of globalization[8]. Countries with a one standard deviation (SD) higher levels in the social globalization score are associated with 0.51 SD higher levels of confirmed cases of COVID-19 (per million and in log). The least relevant aspect (in both magnitude and statistical significance) in explaining outbreak of COVID-19 is political dimension of globalization index. This superiority was expected as countries with more social connections are more prone to outbreak of the Coronavirus.

Moreover, we observe that countries with higher levels of income per capita are also showing higher levels of confirmed cases. This association is robust in all specification and shows that more wealthy countries have more financial resources to diagnose the COVID-19. Countries with a 1% higher level of income per capita are diagnosing between 0.68% and 1.23% higher levels of confirmed cases of COVID-19 (columns 1-8 of Table 3). In addition, in majority of models, the share of older population and the number of hospital beds are positively and negatively correlated with confirmed cases, respectively. Among regional dummies, the Europe and Central Asia dummies have the most effect which is in-line with the fact that Europe is the most globalized region in the world.

In Table 4, we use the log of total confirmed deaths associated with COVID-19 per million.[9] There are some differences in results reported in Table 4 in comparison with estimations for confirmed cases in Table 3. In contrast to Table 3, there is almost no statistically significant correlation between KOF globalization indices and associated death figures of COVID-19. While globalization of markets and societies in

[8] Under interpersonal aspects there are indicators such as international voice traffic, telephone subscriptions, transfers, freedom to visit, international tourism, international students, international airports and migration. For aspect of information globalization, we observe indicators such as used internet bandwidth, international patents, high technology exports, television access, internet access, and press freedom. Finally, cultural aspect includes indicators such as trade in cultural goods, trade in personal services, international trademarks, McDonald's restaurant, IKEA stores, and gender parity.

[9] Since some countries have reported zero death, the logarithmic transformation is not defined and thus we have a smaller sample size with 100 countries.

the past can be mentioned as one of the robust explanatory factors behind the current COVID-19 pandemic, but it has an insignificant role in explanting the deaths numbers associated with it.

Among the robust determinants of fatalities of COVID-19 pandemic, we can refer to demographic structure and health infrastructure of countries. We find a consistent positive association between higher share of elderly in population and COVID-19 deaths (per million). Countries with a one SD higher share of population beyond age of 65 are associated with approximately 0.4 SD higher (log) deaths per million. The effect of having older population has more contribution in explaining the number of deaths compared to the number of infected cases, as age is relatively more correlated to risk of death than getting infected in the case of COVID-19.

Furthermore, countries with a higher numbers of hospital beds and nurses (per 1000 of population) show lower records of fatalities. This negative association is especially more statistically significant for the case of number of hospital beds. On average and controlling for other explanatory variables, a 1% increase in the total number of hospital beds per 1000 population is associated with approximately 0.60% lower number of confirmed deaths of COVID-19 per million (column 1-8 of Table 4). The size effect of number of nurses per 1000 population is also comparable with the effect of hospital beds (with around 0.5% decreasing impact).

Countries in which people have a higher level of out-of-pocket spending on health suffer more from higher numbers of deaths of COVID-19 pandemic. People in countries with a weaker insurance system coverage and a higher private burden of health costs may visit less frequently doctors and are thus more vulnerable against high-risk diseases. They may not survive due to earlier health deficiencies amplified by COVID-19. The effect is also sizable, as countries in which the out-of-pocket spending on health (per capita) is on average 1% higher, experience approximately 0.70% higher numbers of COVID-19 deaths per million, ceteris paribus (column 1-8 of Table 4)

Among regional dummies, the EU and Central Asia dummy still has the most effect on the number of deaths due to the Coronavirus per million of population, while population density (although with expected positive sign) has no statistically significant impact on the number of these deaths.

Sensitivity analysis

To control for the possible effects of outliers in our cross-country estimations, we re-estimate the most general specifications and compare the results of robust regressions with OLS. When there is a probability of outliers or influential observations in data, robust regression is used as an alternative to least squares[10]. We use a number of robust estimators for linear regression models (MM and M regressions) as introduced and explained by Jann (2010a, 2010b). The MM and M estimators identify outliers and reduce their weights in final estimations. Thus, they are closer to weighted least squares.

Using the defaults, MM estimator suggests that having 85% of the efficiency of OLS while being able to deal with up to 50% contamination in data. M-robust regression is about 95% as efficient as OLS. Tables 5 to 8 show the results of robust regressions. The positive and statistically significant effect of almost all KOF globalization (sub)indices on total number of confirmed cases of COVID-19 remains robust, after assigning lower weights to observations (countries) with extreme residuals or leverages. The association between globalization dimensions and death numbers of COVID-19, as before, remains statistically insignificant as well.

4. Conclusion

In our study, we examined cross-country variation in exposure to COVID-19 and associated fatalities in a multivariate regression analysis, covering more than 100 countries. Based on ordinary least squares regressions and several robust estimators for linear regression models which address the possibility of outliers, we find a robust

[10] For more details see Verardi and Croux (2009).

and significant positive association between records of almost all KOF globalization sub-indices with the current level of accumulated COVID-19 confirmed cases, but not with the level of accumulated COVID-19 confirmed deaths. These findings are robust in different models and after control for other possible drivers of the disease including health system infrastructures, demographic structure, and regional dummies.

Among control variables, a higher GDP per capita, a higher share of elderly in the population, and a higher share of out-of-pocket spending on health are positively correlated with the number of diagnosed cases and deaths due to COVID-19 while a larger number of hospital beds and a higher number of nurses (per 1000 population) are negatively associated with COVID-19 related human losses.

Our results have important implications for policymakers. While globalization has a significant positive impact on economic growth and employment, the adverse effect of the large number of confirmed COVID-19 cases could show its dark side during a disease epidemic. Therefore, policymakers should take into account the health risks associated with the increasing trend of globalization of markets and societies. Based on our empirical results, demographic structure, as well as health infrastructures are among the most significant explanatory variables with references to COVID-19 deaths numbers. Policymakers need to invest in the expansion of health infrastructures such as modern hospital beds (considering the size of their population) as well as training and employing skilled medical staff (e.g., physicians, and nurses).

In addition, we show that a higher level of out-of-pocket spending on health is explaining part of larger numbers of human costs of COVID-19 pandemic. Therefore, policymakers should improve the efficiency and affordability of access to health care for all individuals and reduce the financial cost of health care on households. Tracing the demographic developments of societies and planning for health needs of the elderlies are also important parts of the resistance package for future pandemics.

Table 3. Regression results: Relationship between globalization sub-indices and COVID-19 confirmed cases (by 30 March 2020)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: log of COVID-19 confirmed cases (per million)							
KOF economic globalization index	0.026*							
	(1.90)							
KOF trade globalization index		0.014						
		(1.30)						
KOF financial globalization index			0.026**					
			(2.49)					
KOF social globalization index				0.072***				
				(4.69)				
KOF interpersonal globalization index					0.045***			
					(4.84)			
KOF information globalization index						0.069***		
						(4.24)		
KOF cultural globalization index							0.021*	
							(1.69)	
KOF political globalization index								-0.008
								(-1.20)
log of population density	0.046	0.073	0.052	0.053	0.056	0.089	0.090	0.115
	(0.57)	(0.91)	(0.67)	(0.84)	(0.79)	(1.37)	(1.26)	(1.54)
log of GDP per capita (PPP, US$)	1.025***	1.125***	1.011***	0.684***	0.881***	0.888***	1.092***	1.228***
	(4.73)	(5.38)	(4.91)	(3.34)	(4.73)	(4.95)	(4.43)	(6.24)
population ages 65 and above (% of total population)	0.077**	0.086***	0.073**	0.027	0.073***	0.038	0.051	0.107***
	(2.43)	(2.66)	(2.35)	(0.89)	(2.76)	(1.16)	(1.40)	(3.03)
log of out of pocket spending on health (PPP, US$ per capita)	0.323*	0.313	0.296	0.316*	0.345*	0.230	0.332*	0.294
	(1.71)	(1.61)	(1.56)	(1.74)	(1.96)	(1.28)	(1.68)	(1.54)
log of number of nurses (per 1000 population)	-0.113	-0.094	-0.142	-0.364*	-0.248	-0.314	-0.295	-0.100
	(-0.50)	(-0.39)	(-0.67)	(-1.79)	(-1.14)	(-1.63)	(-1.34)	(-0.41)
log of number of hospital beds (per 1000 population)	-0.294	-0.329*	-0.274	-0.274*	-0.365**	-0.285*	-0.245	-0.407**
	(-1.61)	(-1.76)	(-1.51)	(-1.71)	(-2.10)	(-1.71)	(-1.36)	(-2.06)
America dummy	0.869	1.122*	0.767	0.534	0.577	0.592	1.141*	1.299**
	(1.40)	(1.83)	(1.23)	(0.84)	(0.94)	(0.89)	(1.83)	(2.16)
EU & Central Asia dummy	1.484**	1.732**	1.545**	1.756***	1.533**	2.010***	2.136***	2.165***
	(2.13)	(2.49)	(2.31)	(2.85)	(2.48)	(3.13)	(3.29)	(3.30)
East Asia & Pacific dummy	0.286	0.505	0.263	0.461	0.546	0.329	0.688	0.792
	(0.41)	(0.73)	(0.38)	(0.73)	(0.89)	(0.49)	(1.04)	(1.19)
Middle East & North Africa dummy	1.038	1.236*	1.060	1.266*	1.115*	1.229*	1.499**	1.562**
	(1.45)	(1.71)	(1.59)	(1.91)	(1.75)	(1.79)	(2.21)	(2.40)
Sub-Sahara Africa dummy	0.908	1.195**	0.713	1.009	0.907	1.114*	1.377**	1.328**
	(1.49)	(2.05)	(1.12)	(1.65)	(1.52)	(1.86)	(2.26)	(2.29)
Countries	138	138	138	138	138	138	137	138
R-sq.	0.80	0.79	0.80	0.82	0.82	0.82	0.80	0.79

Notes: OLS estimates; t statistics in parentheses are based on clustered (at country level) standard errors. KOF globalization index is averaged values between 2010 to 2017. Other explanatory variables are averaged values between 2010 to 2019 (or latest available period). ***, **, * refers to statistical significance at 1, 5, and 10% levels, respectively.

Table 4. Regression results: Relationship between globalization sub-indices and COVID-19 confirmed deaths (by 30 March 2020)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: log of COVID-19 deaths (per million)							
KOF economic globalization index	-0.009							
	(-0.52)							
KOF trade globalization index		-0.008						
		(-0.55)						
KOF financial globalization index			-0.005					
			(-0.33)					
KOF social globalization index				0.013				
				(0.59)				
KOF interpersonal globalization index					0.027*			
					(1.80)			
KOF information globalization index						0.004		
						(0.17)		
KOF cultural globalization index							-0.012	
							(-0.79)	
KOF political globalization index								-0.014
								(-1.19)
log of population density	0.206	0.204	0.190	0.161	0.145	0.172	0.188	0.171
	(1.55)	(1.58)	(1.44)	(1.33)	(1.22)	(1.39)	(1.51)	(1.43)
log of GDP per capita (PPP, US$)	0.855***	0.828***	0.832***	0.666*	0.499*	0.756**	0.911***	0.773***
	(2.87)	(2.93)	(2.75)	(1.98)	(1.70)	(2.58)	(2.74)	(2.86)
population ages 65 and above (% of total population)	0.126***	0.124***	0.124***	0.109**	0.109***	0.117**	0.140***	0.151***
	(2.85)	(2.87)	(2.83)	(2.28)	(2.71)	(2.44)	(2.70)	(2.97)
log of out of pocket spending on health (PPP, US$ per capita)	0.719**	0.722**	0.716**	0.711**	0.717**	0.712**	0.723**	0.714**
	(2.28)	(2.30)	(2.25)	(2.21)	(2.32)	(2.20)	(2.30)	(2.28)
log of number of nurses (per 1000 population)	-0.526*	-0.538*	-0.523*	-0.554*	-0.497*	-0.545*	-0.504*	-0.527*
	(-1.83)	(-1.86)	(-1.81)	(-1.90)	(-1.69)	(-1.82)	(-1.71)	(-1.82)
log of number of hospital beds (per 1000 population)	-0.646**	-0.637**	-0.633*	-0.597**	-0.591**	-0.606**	-0.633**	-0.678**
	(-2.05)	(-2.09)	(-1.96)	(-2.01)	(-2.07)	(-2.02)	(-2.05)	(-2.18)
America dummy	2.035***	2.002***	1.976***	1.732***	1.454**	1.834***	1.966***	1.833***
	(3.26)	(3.35)	(3.15)	(2.86)	(2.53)	(2.85)	(3.56)	(3.59)
EU & Central Asia dummy	3.314***	3.344***	3.188***	3.001***	2.539***	3.095***	3.100***	3.021***
	(4.48)	(4.41)	(4.84)	(4.85)	(3.81)	(5.27)	(5.44)	(5.24)
East Asia & Pacific dummy	1.716**	1.738**	1.632**	1.480**	1.269**	1.542**	1.613**	1.564**
	(2.42)	(2.46)	(2.41)	(2.21)	(1.99)	(2.26)	(2.56)	(2.51)
Middle East & North Africa dummy	2.395***	2.424***	2.311***	2.197***	1.944***	2.241***	2.239***	2.285***
	(3.57)	(3.53)	(3.78)	(3.63)	(3.14)	(3.67)	(4.25)	(4.48)
Sub-Sahara Africa dummy	3.141***	3.076***	3.098***	2.862***	2.505***	2.959***	3.042***	2.887***
	(4.47)	(4.85)	(4.24)	(4.59)	(4.05)	(4.96)	(5.30)	(5.39)
Countries	100	100	100	100	100	100	100	100
R- sq.	0.64	0.64	0.64	0.64	0.65	0.64	0.64	0.64

Notes: OLS estimates; t statistics in parentheses are based on clustered (at country level) standard errors. KOF globalization index is averaged values between 2010 to 2017. Other explanatory variables are averaged values between 2010 to 2019 (or latest available period). Robust t statistics are in (). ***, **, * refers to statistical significance at 1, 5, and 10% levels, respectively

Table 5. Robust MM regressions: Relationship between globalization sub-indices and COVID-19 confirmed cases (by 30 March 2020)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: log of COVID-19 confirmed cases (per million)							
	Robust MM-Regression (85% efficiency)							
KOF economic globalization index	0.036**							
	(2.14)							
KOF trade globalization index		0.024						
		(1.28)						
KOF financial globalization index			0.029***					
			(2.90)					
KOF social globalization index				0.073***				
				(3.01)				
KOF interpersonal globalization index					0.039***			
					(2.90)			
KOF information globalization index						0.060***		
						(2.88)		
KOF cultural globalization index							0.017	
							(1.00)	
KOF political globalization index								-0.012
								(-1.54)
log of population density	0.066	0.090	0.104	0.134*	0.081	0.185*	0.162	0.130
	(0.49)	(0.61)	(0.88)	(1.65)	(0.85)	(1.65)	(1.59)	(1.53)
log of GDP per capita (PPP, US$)	0.863***	1.025***	0.926***	0.589**	0.871***	0.921***	1.073**	1.211***
	(2.94)	(2.97)	(3.91)	(2.11)	(2.99)	(4.23)	(2.55)	(3.34)
population ages 65 and above (% of total population)	0.087*	0.090	0.102***	0.034	0.084**	0.074**	0.088**	0.144***
	(1.66)	(1.17)	(3.15)	(0.76)	(2.18)	(2.21)	(2.09)	(4.42)
log of out of pocket spending on health (PPP, US$ per capita)	0.228	0.324	0.144	0.279	0.299	0.096	0.239	0.271
	(0.96)	(0.84)	(0.73)	(1.37)	(1.34)	(0.64)	(1.34)	(1.12)
log of number of nurses (per 1000 population)	-0.003	-0.040	-0.059	-0.248	-0.173	-0.180	-0.199	-0.148
	(-0.01)	(-0.12)	(-0.24)	(-0.94)	(-0.68)	(-0.62)	(-0.79)	(-0.38)
log of number of hospital beds (per 1000 population)	-0.155	-0.195	-0.137	-0.332	-0.339	-0.219	-0.158	-0.293
	(-0.79)	(-0.85)	(-0.77)	(-1.43)	(-0.99)	(-1.15)	(-0.79)	(-1.35)
America dummy	1.217	1.380	1.415	-0.298	0.435	1.427	2.043	1.451
	(0.57)	(0.56)	(0.60)	(-0.26)	(0.20)	(0.43)	(1.21)	(0.96)
EU & Central Asia dummy	1.360	1.536	1.737	0.723	1.200	2.385	2.582*	2.034
	(0.70)	(0.70)	(0.83)	(0.58)	(0.61)	(0.80)	(1.65)	(1.53)
East Asia & Pacific dummy	0.680	0.894	1.058	-0.507	0.402	1.270	1.771	1.407
	(0.29)	(0.34)	(0.45)	(-0.42)	(0.19)	(0.39)	(1.09)	(0.98)
Middle East & North Africa dummy	1.186	1.137	1.641	0.093	0.869	1.753	2.188	1.754
	(0.54)	(0.42)	(0.73)	(0.07)	(0.40)	(0.56)	(1.36)	(1.17)
Sub-Sahara Africa dummy	1.025	1.412	1.145	-0.102	0.540	1.837	2.106	1.510
	(0.46)	(0.59)	(0.48)	(-0.09)	(0.23)	(0.56)	(1.29)	(0.98)
Countries	138	138	138	138	138	138	137	138

Note: MM estimation aims to obtain estimates that have a high breakdown value and more efficient. Breakdown value is a common measure of the proportion of outliers that can be addressed before these observations affect the model. Robust estimators should be resistant to a certain degree of data contamination. MM-estimator has a breakdown point of 50%, e.g., it is resistant to a contamination of up-to 50% of outliers

Table 6. Robust M regressions: Relationship between globalization sub-indices and COVID-19 confirmed cases (by 30 March 2020)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: log COVID-10 confirmed cases per million							
	Robust M-Regression (95% efficiency)							
KOF economic globalization index	0.031***							
	(2.67)							
KOF trade globalization index		0.019*						
		(1.79)						
KOF financial globalization index			0.029***					
			(3.10)					
KOF social globalization index				0.069***				
				(3.08)				
KOF interpersonal globalization index					0.043***			
					(4.28)			
KOF information globalization index						0.064***		
						(4.06)		
KOF cultural globalization index							0.019	
							(1.41)	
KOF political globalization index								-0.010
								(-1.58)
log of population density	0.045	0.069	0.060	0.088	0.065	0.129**	0.111	0.118*
	(0.62)	(0.91)	(0.86)	(1.40)	(0.96)	(2.20)	(1.58)	(1.71)
log of GDP per capita (PPP, US$)	0.945***	1.062***	0.956***	0.684***	0.883***	0.893***	1.070***	1.204***
	(3.96)	(4.75)	(4.76)	(2.71)	(4.58)	(4.63)	(3.44)	(4.95)
population ages 65 and above (% of total population)	0.077**	0.083**	0.080***	0.036	0.074**	0.051	0.061	0.120***
	(2.24)	(2.36)	(2.61)	(0.96)	(2.37)	(1.59)	(1.49)	(3.39)
log of out of pocket spending on health (PPP, US$ per capita)	0.300	0.329	0.238	0.264	0.315*	0.186	0.312	0.294
	(1.51)	(1.61)	(1.28)	(1.16)	(1.76)	(1.12)	(1.32)	(1.51)
log of number of nurses (per 1000 population)	-0.074	-0.065	-0.117	-0.317	-0.210	-0.263	-0.265	-0.091
	(-0.29)	(-0.25)	(-0.54)	(-1.46)	(-0.92)	(-1.32)	(-1.11)	(-0.31)
log of number of hospital beds (per 1000 population)	-0.224	-0.266	-0.203	-0.240	-0.350*	-0.262	-0.202	-0.365*
	(-1.14)	(-1.34)	(-1.19)	(-1.38)	(-1.85)	(-1.37)	(-1.02)	(-1.84)
America dummy	0.923	1.158	0.876	0.695	0.536	0.613	1.352	1.345
	(1.12)	(1.39)	(1.02)	(0.73)	(0.50)	(0.57)	(1.25)	(1.35)
EU & Central Asia dummy	1.349	1.580*	1.486*	1.760**	1.416	1.850*	2.192**	2.084**
	(1.59)	(1.84)	(1.86)	(2.01)	(1.43)	(1.79)	(2.10)	(2.19)
East Asia & Pacific dummy	0.354	0.580	0.416	0.547	0.491	0.381	0.937	1.040
	(0.40)	(0.65)	(0.48)	(0.58)	(0.47)	(0.35)	(0.87)	(1.04)
Middle East & North Africa dummy	0.978	1.121	1.137	1.264	1.012	1.079	1.590	1.608
	(1.12)	(1.22)	(1.32)	(1.31)	(0.95)	(1.00)	(1.44)	(1.57)
Sub-Sahara Africa dummy	0.870	1.209	0.696	1.025	0.765	1.049	1.472	1.385
	(1.03)	(1.45)	(0.77)	(1.06)	(0.71)	(1.01)	(1.31)	(1.34)
Countries	138	138	138	138	138	138	137	138

Table 7. Robust MM regressions: Relationship between globalization sub-indices and COVID-19 confirmed deaths (by 30 March 2020)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: log of COVID-19 death per million							
	Robust MM-Regression (85% efficiency)							
KOF economic globalization index	-0.002							
	(-0.06)							
KOF trade globalization index		-0.002						
		(-0.05)						
KOF financial globalization index			-0.003					
			(-0.17)					
KOF social globalization index				0.025				
				(0.65)				
KOF interpersonal globalization index					0.036			
					(1.56)			
KOF information globalization index						0.015		
						(0.32)		
KOF cultural globalization index							-0.010	
							(-0.48)	
KOF political globalization index								-0.014
								(-0.82)
log of population density	0.271	0.269	0.216	0.231	0.233*	0.239	0.281*	0.255*
	(1.23)	(1.26)	(1.39)	(1.23)	(1.78)	(1.11)	(1.84)	(1.74)
log of GDP per capita (PPP, US$)	0.800*	0.793*	0.758**	0.568	0.426	0.704	0.897*	0.809**
	(1.74)	(1.67)	(2.51)	(0.91)	(1.00)	(1.38)	(1.95)	(2.01)
population ages 65 and above (% of total population)	0.084	0.083	0.110**	0.057	0.060	0.072	0.098	0.111
	(0.80)	(0.81)	(2.06)	(0.78)	(1.18)	(0.91)	(0.93)	(1.19)
log of out of pocket spending on health (PPP, US$ per capita)	0.825	0.822	0.785**	0.768*	0.747**	0.782	0.836	0.766*
	(1.34)	(1.41)	(2.00)	(1.70)	(2.30)	(1.63)	(1.59)	(1.86)
log of number of nurses (per 1000 population)	-0.411	-0.412	-0.478	-0.431	-0.314	-0.456	-0.384	-0.389
	(-0.88)	(-0.87)	(-1.46)	(-1.09)	(-0.93)	(-1.04)	(-0.79)	(-0.98)
log of number of hospital beds (per 1000 population)	-0.677	-0.668	-0.620	-0.594	-0.615*	-0.610	-0.702	-0.732*
	(-1.30)	(-1.52)	(-1.38)	(-1.34)	(-1.79)	(-1.23)	(-1.59)	(-1.65)
America dummy	2.107***	2.095***	1.985***	1.797**	1.512**	1.878**	2.139***	1.998***
	(2.39)	(2.55)	(3.02)	(2.22)	(2.09)	(2.06)	(3.33)	(3.37)
EU & Central Asia dummy	3.298***	3.298***	3.171***	3.001***	2.393***	3.174***	3.257***	3.085***
	(3.01)	(2.53)	(4.63)	(3.84)	(2.76)	(4.65)	(5.08)	(4.26)
East Asia & Pacific dummy	1.935*	1.933*	1.668**	1.654**	1.513**	1.716*	1.987***	1.936***
	(1.91)	(1.74)	(2.44)	(2.05)	(2.48)	(1.82)	(2.81)	(2.89)
Middle East & North Africa dummy	2.039*	2.038	2.148***	1.778**	1.355*	1.872**	1.978***	1.969***
	(1.85)	(1.56)	(3.46)	(2.26)	(1.65)	(2.25)	(3.22)	(3.59)
Sub-Sahara Africa dummy	3.142***	3.122***	3.089***	2.841***	2.413***	2.985***	3.165***	2.970***
	(2.62)	(2.92)	(3.52)	(3.22)	(3.03)	(3.41)	(3.99)	(4.25)
Countries	100	100	100	100	100	100	100	100

Table 8. Robust M- regressions: Relationship between globalization sub-indices and COVID-19 confirmed deaths (by 30 March 2020)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent variable: log of COID-19 death (per million)							
	Robust M-Regression (95% efficiency)							
KOF economic globalization index	-0.008							
	(-0.40)							
KOF trade globalization index		-0.008						
		(-0.47)						
KOF financial globalization index			-0.003					
			(-0.17)					
KOF social globalization index				0.017				
				(0.81)				
KOF interpersonal globalization index					0.029*			
					(1.83)			
KOF information globalization index						0.010		
						(0.39)		
KOF cultural globalization index							-0.009	
							(-0.59)	
KOF political globalization index								-0.013
								(-0.95)
log of population density	0.231	0.231	0.216	0.187	0.180	0.195	0.218*	0.202
	(1.52)	(1.61)	(1.39)	(1.37)	(1.39)	(1.45)	(1.67)	(1.46)
log of GDP per capita (PPP, US$)	0.789***	0.776***	0.758**	0.574*	0.447	0.682**	0.852**	0.745*
	(2.63)	(2.68)	(2.51)	(1.67)	(1.45)	(2.24)	(2.25)	(1.85)
population ages 65 and above (% of total population)	0.113**	0.112**	0.110**	0.089*	0.090**	0.096*	0.124**	0.134**
	(2.16)	(2.25)	(2.06)	(1.76)	(2.03)	(1.78)	(2.30)	(1.98)
log of out of pocket spending on health (PPP, US$ per capita)	0.788**	0.776**	0.785**	0.761**	0.738**	0.776**	0.767**	0.743*
	(2.11)	(2.35)	(2.00)	(2.08)	(2.32)	(2.17)	(2.08)	(1.78)
log of number of nurses (per 1000 population)	-0.478	-0.488	-0.478	-0.503	-0.417	-0.513	-0.463	-0.464
	(-1.43)	(-1.56)	(-1.46)	(-1.57)	(-1.32)	(-1.55)	(-1.35)	(-1.37)
log of number of hospital beds (per 1000 population)	-0.642	-0.625	-0.620	-0.564*	-0.572**	-0.581	-0.629*	-0.671*
	(-1.55)	(-1.62)	(-1.38)	(-1.89)	(-1.97)	(-1.57)	(-1.69)	(-1.70)
America dummy	2.043***	2.017***	1.985***	1.730***	1.502***	1.806***	1.991***	1.883***
	(3.39)	(3.59)	(3.02)	(2.90)	(2.59)	(2.80)	(3.72)	(3.77)
EU & Central Asia dummy	3.304***	3.352***	3.171***	2.962***	2.502***	3.092***	3.123***	3.022***
	(4.30)	(4.20)	(4.63)	(5.08)	(3.76)	(5.53)	(5.62)	(4.83)
East Asia & Pacific dummy	1.748**	1.769**	1.668**	1.483**	1.333**	1.546**	1.677***	1.670***
	(2.50)	(2.54)	(2.44)	(2.33)	(2.21)	(2.35)	(2.64)	(2.65)
Middle East & North Africa dummy	2.250***	2.299***	2.148***	2.002***	1.736***	2.032***	2.109***	2.117***
	(3.20)	(3.16)	(3.46)	(3.57)	(2.85)	(3.48)	(4.22)	(4.39)
Sub-Sahara Africa dummy	3.157***	3.103***	3.089***	2.839***	2.477***	2.956***	3.062***	2.907***
	(3.90)	(4.45)	(3.52)	(4.54)	(3.83)	(4.48)	(4.79)	(4.79)
Countries	100	100	100	100	100	100	100	100

Data Availability Statement

The datasets generated during and/or analysed during the current study are available from the corresponding author on request.

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