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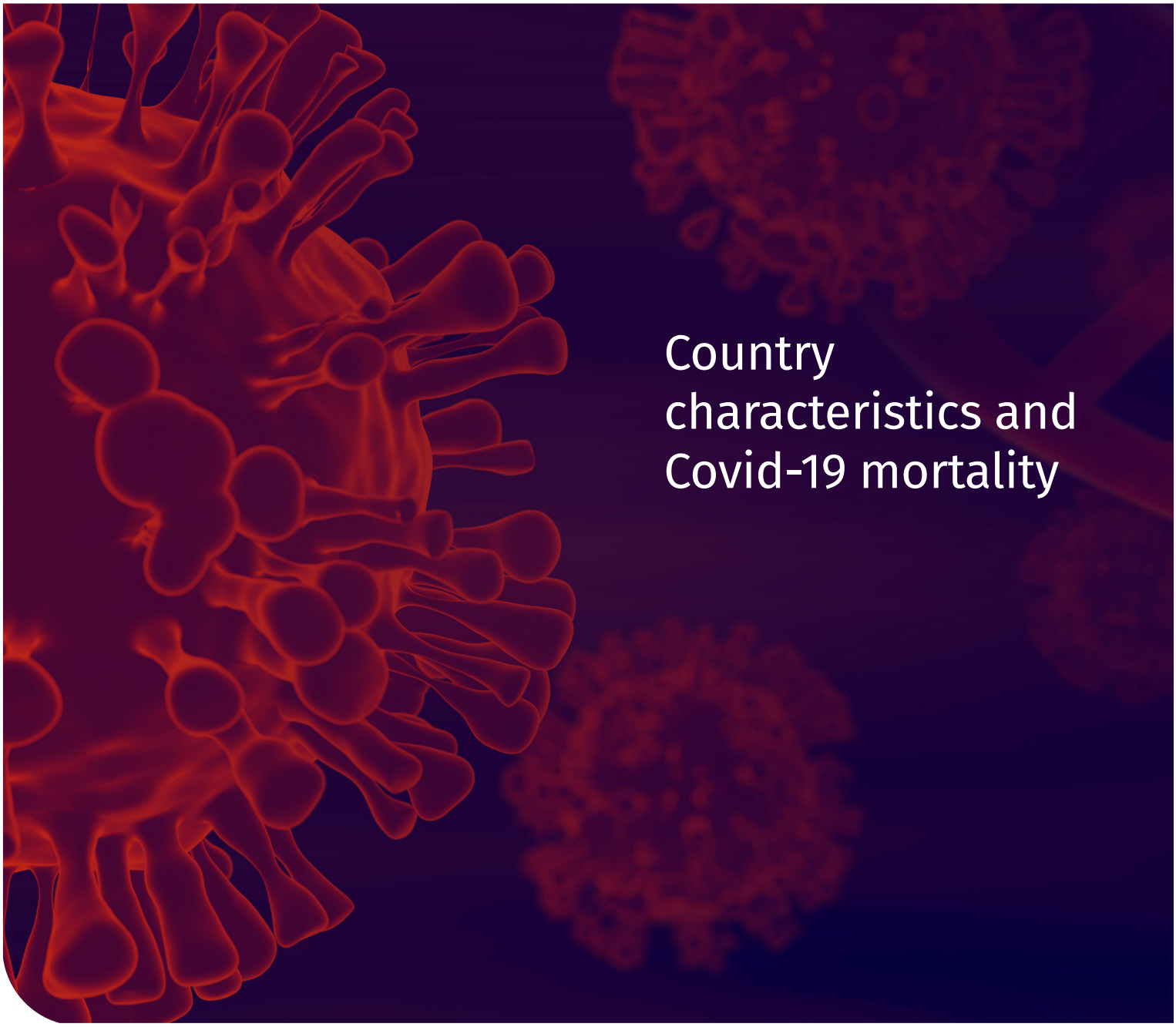

Country characteristics and Covid-19 mortality

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COUNTRY CHARACTERISTICS AND COVID-19 MORTALITY

The severity of the Covid-19 pandemic has varied sharply between countries. In this issue of *Infocus*, Stefan Gerlach and Joaquin Thul ask what factors may explain these differences. They find that as much as about half of the variation between countries in Covid-19 mortality is explained by four variables: the median age of the population, tourist arrivals, inequality and a measure of government effectiveness.

Covid-19 has had huge social and economic consequences. With the virus often causing serious illness and sometimes death, governments have shut down economies to stop its spread. The risk of falling ill has also led the public to voluntarily refrain from shopping, going to bars and restaurants and from travelling. The overall impact was responsible for deep recessions across the world.

The severity of the Covid-19 pandemic, as captured by deaths per million inhabitants, has varied sharply between countries. In early 2020, Italy and Spain appeared to experience particularly severe pandemics. During the spring of 2020 Sweden also seemed to suffer an unusually serious pandemic. Other countries, including New Zealand, Australia, and Finland, appeared to have been more fortunate.

What factors may explain these differences in mortality? Do they imply that some countries managed the pandemic better than others? Or do they simply reflect the fact that countries differ in important respects. Most obviously, since Covid-19 was generally a more severe disease among older patients, do differences in the average or median age of the population help explain differences in mortality?

Structural determinants of mortality

To address this and other questions, a data set comprising 135 countries is studied. As shown in Table 1, a range of different variables are included. These are divided into three areas:

1. Susceptibility to the virus:
   Reflected by the median age of the population. Mortality is likely to be higher in countries with an older population.

2. Risk of contagion:
   Captured by population density and a measure of the extent to which a country may be disproportionally at risk from contagion. The rationale is that higher population density may be associated with more contagion and therefore higher mortality. High income countries are more densely populated, with over 80% of their populations living in urban areas. In low-income economies this proportion drops to just one third of the population. Additionally, countries whose populations travel more or who receive many travellers from abroad may be more at risk of contagion. This is measured here by the ratio of international arrivals to the size of the population.

3. Policy and Governance:
   Domestic policy choices and the ability of governments to manage a crisis may also have played a role in the pandemic. These factors may be encompassed in variables that capture income inequality, a series of governance metrics, the stringency of lockdowns and the level of GDP.

   - ➞ Income inequality. Countries with a more egalitarian income distribution may do more to protect lower income earners that often are unable to work from home, for instance by offering a better safety net.

   - ➞ Ability of the government to manage a crisis. This is difficult to measure but may be correlated with indices on government effectiveness, the rule of law, the control of corruption, the degree of political stability or the quality of regulation. Countries with more capable governments are likely to be better positioned to mitigate pandemics.

   - ➞ Voice and accountability. Governments that are subject to public scrutiny have a strong incentive to enact policies to protect the wellbeing of the population.

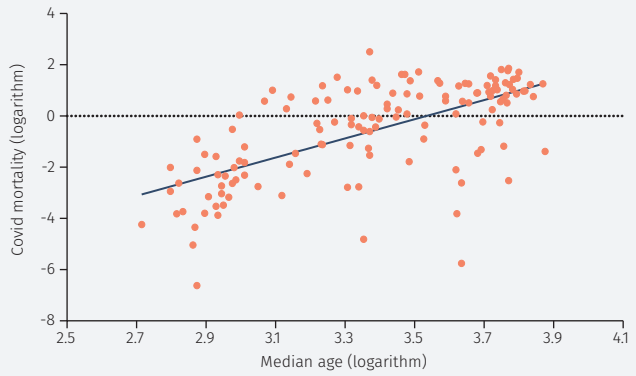
   - ➞ Stringency of lockdowns. A policy choice of greater stringency is expected to reduce mortality, leading to a negative relationship between the two variables. But countries that experienced more severe pandemics are likely to have adopted tighter lockdowns, leading to a positive relationship between them. This implies that there are two relationships: one from stringency to mortality, and one from mortality to stringency.

   - ➞ Level of GDP. While income on its own is unlikely to be correlated with mortality, it may be correlated with other important variables that are omitted from

the study. For instance, higher-income countries may have better health systems, leading to negative relationship between GDP and mortality.

As a preliminary, Figure 1 presents a scatter plot of the number of deaths per million inhabitants over the period April 2020 to August 2021 against the median age of the population and shows that there is a positive relationship between these variables (correlation = 0.64). However, there is substantial variation between countries, with some with relatively old populations reporting low mortality. That finding suggests that the median age is not the only variable explaining the severity of the pandemic but that other factors will have been important too.

1. Covid-19 mortality vs. median age



Sources: Our World In Data and EFGAM. Data as at 27 September 2021.

Statistical analysis

To explore the importance of other factors, a simple statistical exercise, stepwise regression, is performed. In this procedure, all the potential explanatory variables discussed above are considered and included if they satisfy a statistical criterion.[1] While the relationship between mortality and stringency can go either way, it is included in the list of potential explanatory variables.

The first column of Figure 2 shows the results.

- The single most important variable is the median age of the population, which captures the **susceptibility of the population** to the infection. Countries with a higher median age have experienced higher mortality.

- The second variable is the degree of stringency. However, the relationship is positive, suggesting that it reflects the fact that governments in countries with high mortality have adopted tight lockdowns to reduce the number of cases. If so, it should not be included in the analysis here but in a separate analysis of the factors that lead governments to introduce restrictions.

- The third variable picked by the procedure is the number of tourist arrivals normalised by population. Countries that have many tourists arriving (and who are likely to have many domestic residents travel abroad) are more likely to experience a serious Covid-19 epidemic. This variable captures the **risk of contagion**.

- The fourth variable is the degree of control of corruption, which enters with a negative coefficient. The index capturing the degree of control of corruption is strongly correlated with the rule of law index (correlation = 0.95), government effectiveness (0.93) and regulatory quality (0.90). Thus, countries whose governments score well in these regards experienced lower mortality rates. This variable captures differences in **policies and governance**.

- Finally, the fifth significant variable is voice and accountability. Surprisingly, countries scoring high on this variable also had many Covid-19 deaths.

2. Model results

	1	2	3
Dependent variable:	**Covid-19 deaths**	**Covid-19 deaths**	**Stringency**
Median age	2.30 (0.55)	4.27 (0.65)	
Stringency	0.06 (0.01)		
Tourism	0.35 (0.08)	0.29 (0.10)	-1.65 (0.53)
Control of corruption	-0.84 (0.19)	-0.60 (0.16)	
Voice and accountability	0.53 (0.20)		
Inequality		2.06 (0.65)	
Covid-19 deaths			4.24 (0.55)
Observations:	135	135	135
R-squared:	0.64	0.53	0.32

Standard errors in parenthesis. Constant suppressed for brevity.
Source: EFGAM calculations

[1] The criterion is that the p-value for the explanatory variables is less than 1%. If a standard significance level of 5% was used, the likelihood that one variable would be spuriously appear significant is about 46%, given that 12 regressors are considered. If a 1% critical value is used, that probability falls to 11%.

Given that the positive association between mortality and stringency likely reflects policy reactions to the pandemic, the degree of stringency is dropped from the analysis and the model is re-estimated. The results are shown in the second column of Figure 2.

In addition to the median age, the degree of control of corruption and tourism, inequality as measured by the Gini coefficient is now significant. More unequal societies have thus experienced more severe Covid-19 pandemics. The variable voice and accountability drops out.

Finally, in column 3 of the same table, we turn to the relationship between the degree of stringency and Covid. The results show that governments experiencing high mortality rates generally responded by tightening lockdowns. Furthermore, governments receiving large inflows of tourists have generally adopted lower levels of stringency.

Assessing country performance

The statistical model accounts for about half of the variation in mortality, implying that other factors have mattered as well. Table 3 shows the top 20 and bottom 20 countries, ranked according to the percentage difference between actual and predicted Covid-19 mortality. These differences are due to relevant factors that have been omitted from the models, such as a government's skill or luck in managing the pandemic.[2] The full results are shown in the Appendix.

Figure 3 shows vast differences between countries. Looking at the countries that had more deaths than predicted, it is striking that Sweden has the 8th largest prediction error, with 341% more Covid-19 deaths than predicted, followed by Belgium (340%). The UK is 16th on the list with 260% more deaths than predicted. It is striking how poorly Latin America has done: there are nine Latin American countries among the top 20.

Looking at the 20 countries with the largest negative prediction error, it is notable that New Zealand (-99%), Mauritius (-99%), Australia (-86%), Japan (-83%) and Iceland (-82%) are all islands. However, so are the UK (260%), Fiji (89%) and the Seychelles (67%). Thus, it is unclear whether there is a separate 'island factor'.

Reporting errors are also likely to play a role. For instance, it is surprising that while Malavi reports 118%, Rwanda 70% and Kenya 40% more deaths than predicted by the model, Tanzania reports 97% fewer deaths. Similarly, while Brazil and Colombia report 303% and 266% more deaths than predicted respectively, Venezuela and Haiti report far fewer deaths than projected. So does Uzbekistan.

3. Top 20 and bottom 20 country ranks

Top 20		Bottom 20	
Country	*Error, in %*	*Country*	*Error, in %*
Peru	1462.1%	Venezuela	-67.1%
Iraq	1268.9%	Cote d'Ivoire	-71.1%
Jordan	988.9%	Togo	-73.9%
Bolivia	597.7%	Central African Rep	-76.7%
Namibia	505.5%	Benin	-77.3%
Mauritania	472.5%	Haiti	-79.0%
Argentina	409.6%	Papua New Guinea	-79.4%
Sweden	340.7%	Iceland	-82.0%
Belgium	339.8%	Japan	-83.3%
Moldova	333.3%	Vietnam	-83.3%
Chile	306.4%	Australia	-86.5%
Brazil	303.7%	Thailand	-91.1%
Tunisia	291.5%	Uzbekistan	-91.6%
Nepal	283.9%	Burundi	-92.2%
Paraguay	283.6%	South Korea	-94.5%
Colombia	266.0%	Nicaragua	-94.9%
United Kingdom	260.2%	Bhutan	-96.4%
Uruguay	247.9%	Tanzania	-97.4%
Ecuador	240.0%	Mauritius	-98.9%
India	205.4%	New Zealand	-99.4%

Source: EFGAM calculations

Conclusions

The simple modelling exercise conducted here suggests several conclusions.

First, there are vast difference between countries in terms of Covid-19 mortality. Indeed, the number of deaths per million inhabitants ranges from just over 0 to over 12.

Second, about half of the differences can be attributed to a set of unsurprising factors. Thus, the median age of the population, the extent of tourism, government effectiveness (as captured by their ability to combat corruption) and inequality all matter. The other half remains unexplained but is at least partly due to differences in government skill or luck in managing the pandemic.

Third, the degree of severity of restrictions has also varied between countries. Countries with higher mortality have aimed for tighter restrictions and countries receiving more tourists have adopted softer restrictions.

Fourth, reporting errors seem large, in particular among low income or emerging economies, as suggested by the fact that some countries report much lower mortality than their neighbours.

[2] They could also be due to the use of an incorrect functional form.

APPENDIX

A1. Description and rationale for variables used

	Variable	Rationale	Source
SUSCEPTIBILITY	**Median age of population**, in years (natural logarithm used)	Since Covid-19 is a greater risk for older people, countries with an older population are likely to have been more severely affected.	Our World In Data
RISK OF CONTAGION	**Population density** (people per square km of land)	Higher population density may be associated with more contagion and therefore higher mortality.	Our World In Data
	International tourism (Ratio of number of tourist arrivals in 2019 to population)	Countries who received many travellers from abroad may be more at risk of contagions. (The population of such countries often also a lot.)	World Bank
POLICIES AND GOVERNANCE	**Gini Index** [0 (perfect equality, 100 perfect inequality)]	Countries with more egalitarian income distribution may offer better protection to lower income earners.	World Bank
	Government effectiveness [-2.5 (weak) to 2.5 (strong)]	Countries with stronger governance metrics are likely to be more capable of managing a crisis and be better positioned to mitigate the negative effects of the pandemic.	World Bank Governance Indicators
	Control of corruption [-2.5 (weak) to 2.5 (strong)]		World Bank Governance Indicators
	Rule of law [-2.5 (weak) to 2.5 (strong)]		World Bank Governance Indicators
	Political stability [-2.5 (weak) to 2.5 (strong)]		World Bank Governance Indicators
	Regulatory quality [-2.5 (weak) to 2.5 (strong)]		World Bank Governance Indicators
	Voice and accountability [-2.5 (weak) to 2.5 (strong)]	Governments subject to public scrutiny have an incentive to enact policies to protect wellbeing of the population.	World Bank Governance Indicators
	GDP per capita (USD millions)	Higher-income countries may have better health systems than lower-income ones and they may also be more densely populated, leading to a negative relationship between GDP and mortality.	Our World In Data
	Stringency Index [0 (weak) to 100 (strict)]	Greater stringency of lockdowns is expected to reduce mortality. However, countries that experienced more severe pandemics are likely to have adopted tighter lockdowns.	Refinitiv

Source: Our World In Data, Refinitiv, World Bank and EFGAM

(Cont.)

APPENDIX *(.cont)*

A2. Countries ranked according to percentage prediction error

Country	Error, in %	Country	Error, in %	Country	Error, in %
Peru	1462.1%	Indonesia	88.6%	Serbia	-28.5%
Iraq	1268.9%	Germany	87.3%	Croatia	-29.7%
Jordan	988.9%	Poland	87.3%	Bulgaria	-32.3%
Bolivia	597.7%	Bosnia and Herz	79.3%	Sri Lanka	-35.9%
Namibia	505.5%	Zimbabwe	73.5%	Madagascar	-37.0%
Mauritania	472.5%	Rwanda	69.5%	Cameroon	-37.3%
Argentina	409.6%	Panama	69.3%	Spain	-37.4%
Sweden	340.7%	Georgia	67.3%	Cyprus	-38.9%
Belgium	339.8%	Seychelles	66.7%	Dominican Rep	-39.2%
Moldova	333.3%	Ireland	65.3%	Latvia	-40.6%
Chile	306.4%	Philippines	54.1%	Ghana	-41.0%
Brazil	303.7%	France	49.8%	Finland	-41.7%
Tunisia	291.5%	Costa Rica	47.8%	Burkina Faso	-43.3%
Nepal	283.9%	Iran	45.6%	Italy	-43.9%
Paraguay	283.6%	Myanmar	41.6%	Albania	-48.7%
Colombia	266.0%	Sudan	41.6%	Jamaica	-50.6%
United Kingdom	260.2%	Azerbaijan	40.3%	Malta	-51.1%
Uruguay	247.9%	Kenya	39.8%	Belarus	-51.1%
Ecuador	240.0%	Hungary	36.3%	Norway	-52.4%
India	205.4%	Ukraine	34.6%	Greece	-54.7%
Botswana	200.6%	Canada	32.9%	Dem Rep of Congo	-55.9%
Senegal	199.9%	Egypt	27.0%	Gabon	-58.7%
Czechia	188.4%	Kyrgyzstan	25.4%	Chad	-59.4%
Pakistan	185.5%	Austria	24.4%	Nigeria	-64.8%
Slovenia	182.1%	Mongolia	21.6%	Congo	-66.4%
Israel	178.6%	El Salvador	20.3%	Venezuela	-67.1%
United States	177.4%	Estonia	15.4%	Cote d'Ivoire	-71.1%
Slovakia	175.1%	Angola	8.1%	Togo	-73.9%
Luxembourg	174.0%	Guinea	6.2%	Central African Rep	-76.7%
Eswatini	168.0%	Niger	-0.4%	Benin	-77.3%
Guatemala	167.1%	Portugal	-0.9%	Haiti	-79.0%
Zambia	153.0%	Lithuania	-1.2%	Papua New Guinea	-79.4%
Kazakhstan	149.7%	Malaysia	-1.5%	Iceland	-82.0%
South Africa	138.0%	Romania	-3.7%	Japan	-83.3%
Honduras	136.6%	Trinidad and Tobago	-9.3%	Vietnam	-83.3%
Mali	132.2%	UAE	-15.9%	Australia	-86.5%
Lebanon	125.6%	Turkey	-16.4%	Thailand	-91.1%
Bangladesh	119.0%	Russia	-18.9%	Uzbekistan	-91.6%
Malawi	118.2%	Algeria	-21.4%	Burundi	-92.2%
Netherlands	116.0%	Mozambique	-22.7%	South Korea	-94.5%
Mexico	114.4%	Sierra Leone	-24.5%	Nicaragua	-94.9%
Switzerland	96.8%	Djibouti	-24.6%	Bhutan	-96.4%
Ethiopia	93.0%	Morocco	-24.9%	Tanzania	-97.4%
Uganda	92.6%	Yemen	-26.2%	Mauritius	-98.9%
Fiji	88.7%	Denmark	-26.7%	New Zealand	-99.4%

Source: EFGAM calculations

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