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RESEARCH ARTICLE

Was the response to COVID-19 in the West disappointing in terms of comparative outcomes achieved?

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ABSTRACT

This paper features an analysis of country level data generated by the COVID-19 pandemic as revealed in data related to deaths, populations, infections, recovered cases, and tests, for a global sample of 208 countries, plus measures of their policy responsiveness and relative preparedness. A subsample of the 39 OECD countries is also analysed in an assessment including measures of GDP per capita, and indices of country specific trust levels, The cumulative data set is taken from the Worldometer data source. The GHS Index and Oxford Stringency Index are used as policy benchmarks. Other indicators used include GDP/capita, Trust and Personal Trust Indices from the OECD. The results suggest that the advanced economies in the West have not managed the COVID-19 pandemic particularly well and there is no evidence of reduced death rates in these countries when compared to the average performance. On a relative global comparison, the poorer nations, and those in Africa particularly, appear to have performed relatively well, subject to the obvious caveat about the accuracy of the data used in this study. The Oxford Stringency Index does not appear to be informative and countries with a higher GHS Index rating performed relatively poorly. There is a perverse positive relationship between the GHS rating and the number of deaths and cases. This pattern is repeated in the smaller sample of 38 OECD countries. There is no evidence that higher levels of trust or country wealth led to improved outcomes except in the case of case fatality rates (CFR) which are just under 2 percent for OECD countries as opposed to 3.8 percent for the total sample.

Keywords: COVID-19, death rates, transmission, test regimes, relative performance, GSH Index, Stringency Index, Policy Indicators, Trust levels.

1. Introduction

The goal of this paper is to assess the effectiveness of country-level responses to manage the COVID-19 pandemic at a global level, and to seek statistical evidence about whether infections, as revealed in statistics on cases and deaths, varied systematically across different jurisdictions. It also seeks answers as to whether wealthier countries managed the pandemic better than poorer ones.

Did prolonged and more stringent lock-down policies have beneficial effects? Do countries that appear to display higher levels of inter-personal trust have better outcomes? In a reduced section of the sample across the relatively wealthier OECD countries, which countries had better results in the form of fewer infections and deaths? Is there any correlation between a country's wealth and its policy outcomes? These are very basic but compelling issues which deserve attention.

The outbreak of the SARS-CoV-2 virus that causes the COVID-19 disease was first detected in Wuhan, the capital city of Hubei Province, China, and reported to the World Health Organization (WHO) office in Wuhan on 31 December 2019. A "Public Health Emergency of International Concern" was declared by the WHO on 30 January 2020, and the name COVID-19 was given to the novel coronavirus disease on 11 February 2020. The virus spread to all continents and dominated the daily news for the past three years as governments struggled to manage and contain the spread of the virus.

The COVID-19 pandemic is a very topical subject in the academic community across all disciplines, but especially in the medical and biomedical research disciplines. Leading medical journals, such as the Journal of the American Medical Association (JAMA), The Lancet, and the New England Journal of Medicine, have published a great deal of innovative and informative research on the topic.

The topic is a rapidly moving one, in that the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was affected by mutations, leading to new variants of the virus. Some of these variants were classified as variants of concern (VOC), such as Alpha, Beta, Gamma, Delta, and Omicron. VOC are characterised by increased human-to-human transmissibility.

Government responses to the pandemic varied enormously and attempts were made to capture their nature by the creation of indices. 1, 2 The Blavatnik School of Government at the University of Oxford introduced the Oxford COVID-19 Government Response Tracker (OxCGRT), to provide a systematic way to track government responses to COVID-19 across countries and sub-national jurisdictions over time. They combined this data into a series of novel indices that aggregate various measures of government responses. These indices are used to describe variation in government responses in a summary form in this study.

The value of the index on any given day in any given and country comes from the average of nine sub-indices (school closures, workplace closures, cancelation of public events, restrictions on gathering size, closure of public transport, stay at home requirements, restrictions on internal movement, restrictions on international travel, and public information campaign), each taking a value between 0 and 100.

3 Gostin, Hodge Jr., and Wiley (2020) analyzed Presidential powers and the response to COVID-19, which led to the challenging Comment that "With Great Power Comes Great Responsibility". The authors suggest that a fine balance is required between individual rights and liberty, and public health concerns, with self-isolation, quarantining, social distancing, and international travel restrictions being essential to curb the spread of the disease.

One of the aims of the current study is to assess whether relatively more stringent policies led to a reduced level of infection and mortality. 4, 5 McAleer refers to the GHS Index and this index is used in this study as an indicator of pandemic readiness.

In 2021 the Nuclear Threat Initiative and the Johns Hopkins Centers for Health Security, and Bloomberg School of Public Health in collaboration with sponsors the Economist, and the Bill and Melinda Gates Foundation, produced an updated version of the GHS (Global Health and Security Index). They ironically note that just months after the release of the inaugural Global Health Security (GHS) Index was released in 2019, the first cases of COVID-19 were reported. 5 A second version of the Index was released in December 2021.

In measuring health security, the Index assigns the highest scores to countries with the most extensive capacities to prevent and respond to epidemics and pandemics. Given its vast wealth and scientific capacities, the United States was ranked first in both the 2019 GHS Index and in 2021. The report notes that potential to meet a crisis does not necessarily translate into effective action, as politicians, policy makers and the populace must respond accordingly. In the analysis that follows it will be seen that the USA performed very poorly on a comparative basis.

The Trust Indices were taken from the 'Our World in Data' website, https://ourworldindata.org/trust. The OECD Guidelines on Measuring Trust suggest that trust can be viewed as a person's belief that another person or institution will act consistently with their expectations of positive behaviour. Trust matters for the well-being of people and the country where they live and has a role in supporting social and economic relations.

Measures of trust are used in this study in an attempt to explore whether indices of trust capture any of the nuances of the general public's response to COVID-19 policies and to see whether they are reflected in any of the country statistics relating to infections and death rates.

Measures of GDP per capita are also adopted for an OECD sub-sample of the dataset to see whether wealthier countries had more effective policies related to COVID-19.

The paper is divided into five sections, the introduction is followed be a review of previous work on the topic in section 2, section 3 introduces the sample and methods adopted in the study, section 4 presents the results, whilst section 5 concludes.

2. Previous work

6, 7 Allen and McAleer presented evidence related to the European and global spread respectively, of the SARS-CoV-2 virus that causes the COVID-19 disease. 6 analysed the spread across 48 European countries and territories, including the Monaco and Andorra principalities and Vatican City, and 7, the 30 most afflicted countries globally, at the time of their study. They reported that simple cross-sectional regressions, using country populations, were able to predict quite accurately both the total number of cases and deaths, which cast doubt on measures aimed at controlling the disease via lockdowns.

Nevertheless, the policies aimed at combatting pandemics have implications on numerous different fronts, apart from the direct economic impact of containment policies there are social, institutional, and cultural effects, 8.

9 Tiganasu et al. (2022), suggest that socio-demographic factors are important in explaining the different incidence rates of COVID-19 in European countries. 10 Sharma et al., (2021) analyse the effects of use non-pharmaceutical interventions (NPIs) by European governments to control resurging waves of COVID-19, and report that the combined effect of all NPIs was smaller in the second wave than in the first.

11 Forman and Mossialos (2021) examine the EU response to COVID-19: from reactive policies to the formulation of more strategic decision-making. They suggest that there is a constitutional asymmetry inherent in the EU healthcare policy system that exacerbated challenges in the first year of the COVID-19 crisis in particular. They suggest that the EU must learn from these experiences and take an increasingly central role in efforts to deal with cross-border threats to health.

3 Gostin et al., (2023) highlight the fact that response to the pandemic caused the failure of many states to live up to their human rights obligations. They note that the pandemic began with Wuhan officials in China suppressing information, silencing whistleblowers, and violating the freedom of expression and the right to health. Subsequently they suggest that COVID-19's effects have been profoundly unequal, both nationally and globally. They suggest that pandemics undermined human rights and fuel further violations. They suggest that equity demands treating health as a global public good and creating new legal instruments grounded in rights and equity.

12 Fuss et al., (2023) draw attention to evidence of a different behaviour of Omicron waves in terms of wave dynamics, and thereby confirms that the Omicron variant is not only genetically different but even more so in terms of epidemiological dynamics.

In this very selective and brief review of some of the salient literature I have tried to draw on some of the previous work that is relevant to the ground explored in the current paper. One central issue is the extreme breadth of the social and economic response and consequences of the COVID-19 pandemic. This paper takes a very global bird's eye view and only touches upon these factors to the extent that they are captured in the broad indices used to measure restrictive measures, via the Oxford Stringency Measure (STR) and the measure of readiness in Global Health Security (GHS). Economic factors are touched upon via the use of GDP/capita and measures of trust via the (TRUST) and (PTI) indices. The influence of different forms of virus and the recent Omicron variants is ignored in that the measures used are summary ones reflecting the country specific totals at the current point in time. These limitations have to be borne in mind when considering the results that follow.

3. Sample and Methods

The data was downloaded data from https://www.worldometers.info/coronavirus/ (Accessed 17 January 17 2023). The data series covered 209 countries and involved some simple aggregate series per country such as population, total cases, new cases, total deaths, new deaths, total recovered, new recovered, active cases, serious critical cases, total deaths per million population, total tests and tests per million population.

A number of authors have attempted to check the accuracy of COVID data using a variety of numerical techniques including Benford's law 13, 14, 15, 16.

The Oxford Stringency Index was downloaded from Github. (https://github.com/OxCGRT, accessed on 22 January 2023. The value of the index for each country is reported daily until the end of 2022. To achieve a summary measure, I cumulated the daily values for each country to achieve an overall score for that country. The assumption was that a higher score involves more stringent policies up to that point in time, over a longer period. The median value of the result for this country index was 46793, with a minimum score of 32 and a maximum of 69124.

The GHS index was downloaded directly from their website. (https://www.ghsindex.org, accessed 22 January 2023). The median value for the GHS index was 36.4, with a minimum of 16 and a maximum of 75.9.

The Indices of Trust were downloaded from the 'Ourworldindata' website, https://ourworldindata.org/trust and from the OECD, as accessed on 22 January 2023. The Trust index is described in Algan and Cahan (2014) 17, and reflects measures taken in (2014). The median value of the Trust Index was 43.670 with a minimum value of 21.58 and a maximum of 83.78. The PTI index is a measure of personal trust taken from OECD data sources. It had a median value of 0.32, with a minimum value of 0.11 and a maximum of 0.68.

3a. Econometric methods

The analysis involved several ordinary least squares regressions (OLS). For example, the number of cases ci, for each country i, was regressed on the total population of that country pi, as shown in Eq. (1)

$$c_i = a + bp_i + e_i \quad (1)$$

This was repeated with total deaths in each country d_i as the dependent variable.

$$d_i = a + bp_i + e_i \quad (2)$$

This establishes a simple benchmark, which countries had more than average cases and deaths per unit of population, up to the end of 2022, and which had less.

The analysis can then be repeated using the two indices as benchmarks, if I_i represents the Index for country i, total cases and total deaths can be regressed on Index I_i, to explore whether the index has any explanatory power.

$$c_i = a + bSTR_i + e_i \quad (3)$$

Equation (3) explores the impact of the Oxford University Stringency Index, whilst equation (4) examines the influence of the GHS Index.

$$d_i = a + bGHS_i + e_i \quad (4)$$

$$d_i = a + bc_i + e_i \quad (5)$$

Finally, in equation (5) we can explore the death rate per the number of case infections.

The World Health Organisation notes that an important feature of a novel pathogen is the estimation of fatality rates, which helps to evaluate the severity of a disease, identify at-risk populations, and evaluate quality of healthcare (see https://www.who.int/news-room/commentaries/detail/estimating-mortality-fromcovid-19). One metric is the case fatality ratio (CFR), which estimates the proportion of deaths among identified confirmed cases. The cofficient on c_i in equation (5) provides an estimate of CFR across the countries in the sample at the time of estimation.

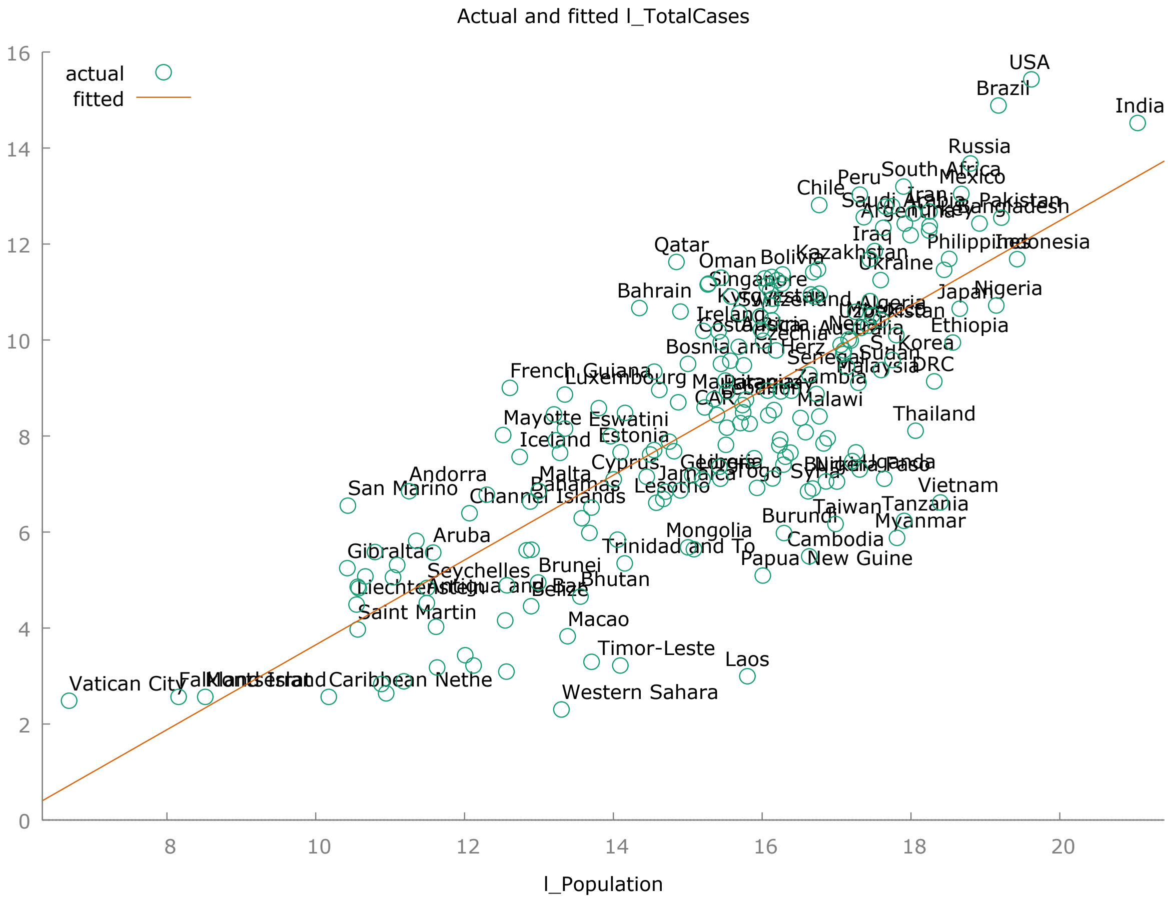
In addition, the regressions can be run in multivariate format to see if the Indices have any explanatory power when included in the original regressions shown above.

4. Results

The results of the regression analysis are shown in Table 1. The first row in Table 1 reports the results of the regression cases by country-on-country population. The slope coefficient is positive, significant, and the overall regression is also significant at the one per cent level. The Adjusted R Square is over 29 percent. The second row reports the results of the regression of the logarithm of cases by country on the logarithm of country populations. This formulation is more effective and is also significant at the one per cent level, for both the slope coefficient, which is now 0.88, and regression equation, which has an F statistic of 284, whilst the Adjusted R Square increases to almost 58 per cent.

Figure 1 shows the fit of this regression line, and it suggests that in terms of the average relationship between the number of cases and population, the USA, India, Mexico, Russia, South Africa, Chile and Peru all plot above the line in the region of heavily populated countries. However, to the author's surprise, the Vatican City, Gibraltar, The Falklands, San Marino, the Channel Islands, and Iceland also plot above the line. Multiple African Nations, Laos, Vietnam, Japan, and Myanmar plot below the line.

Figure 1: Regression $lc_i = a + blp_i + e_i$



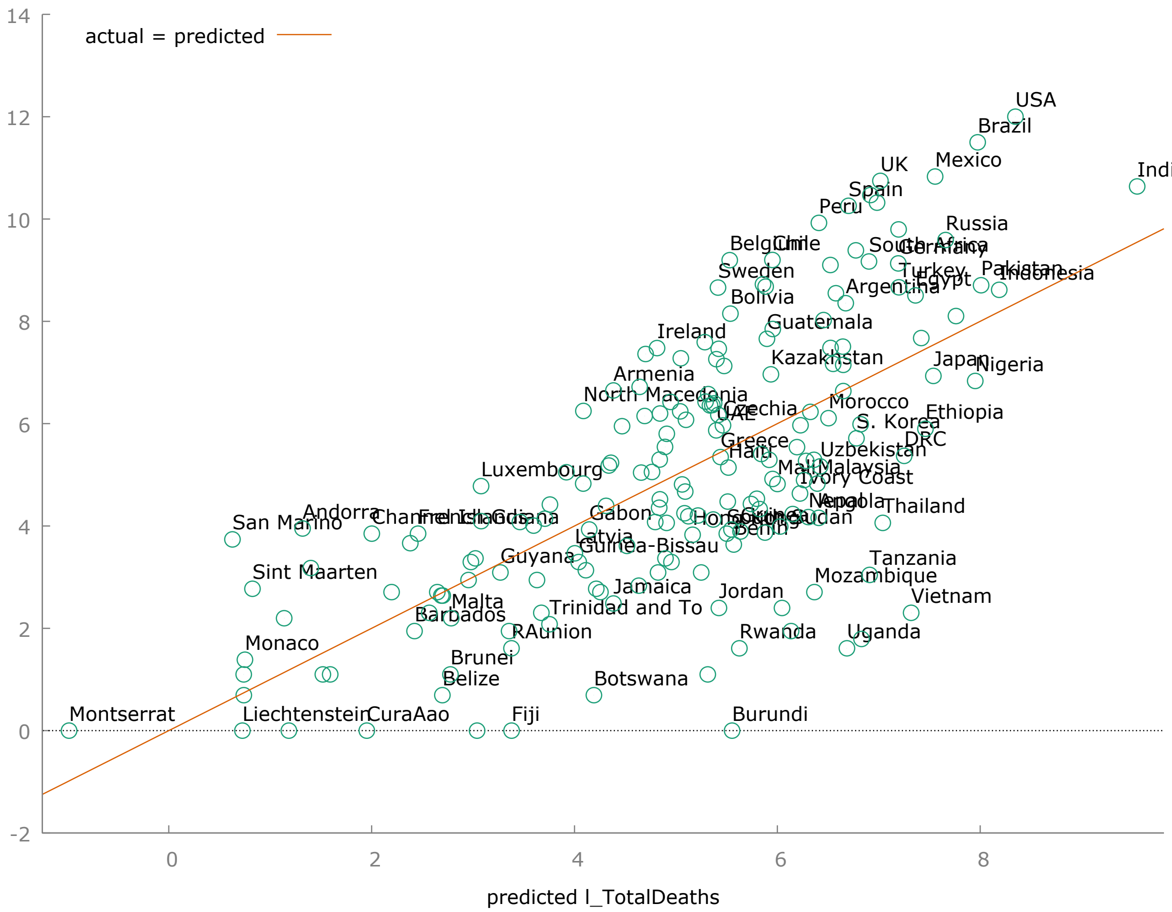
However, the crucial outcome is the rate of deaths per size of population. Row 3 in Table 1 shows the regression of deaths per country-on-country population, which once again is significant at the one per cent level, in terms of the slope coefficient of 0.0000608, an F statistic of 42 and an Adjusted R Square of 18 per cent.

The fourth row reports the same regression in logarithmic format, which again, is an improved specification. The slope coefficient is now 0.84, the F statistic 163, both significant at the one percent level, and the Adjusted R Square is over 46 per cent. A plot of this regression is shown in Figure 2, in which the regression line depicts the average relationship between deaths and the size of population. Countries which plot above the line have more deaths relative to the average.

Figure 2 shows, that at the top end of the line, the USA, India, Mexico, the UK and Brazil, all performed relatively poorly. Ireland, Sweden, Spain, Peru and Chile also performed poorly, whilst below the line many African and Island nations performed relatively well.

The fifth row of Table 1 shows the results of regressing the number of cases on the cumulative daily level of the Oxford Stringency Index. The slope coefficient is positive, has a value of 6.387 and is significant at the five per cent level. The regression has an F value of 4.11 which is also significant at the five per cent level, but the Adjusted R Square shows that the regression explains only 1.74 per cent of the variation around the regression line. Perversely, the slope of the regression line is positive, suggesting that greater stringency is associated with more cases. However, this is not a time-series regression, so it may be picking up that a large case load leads to greater stringency, and the whole process may take weeks to work through. A dynamic feature that is not picked up in summary measures taken at the end of a period.

Figure 2: Regression $ld_i = a + blp_i + e_i$



The sixth row of Table 1 shows the results of a similar regression in which the GHS Index is used as the explanatory variable. The slope coefficient again is positive, highly significant, with a value of 9.58.4, the Adjusted R Square is increased to 6.6 per cent and the F statistic is significant at the 1 per cent level with a value of 13.58.

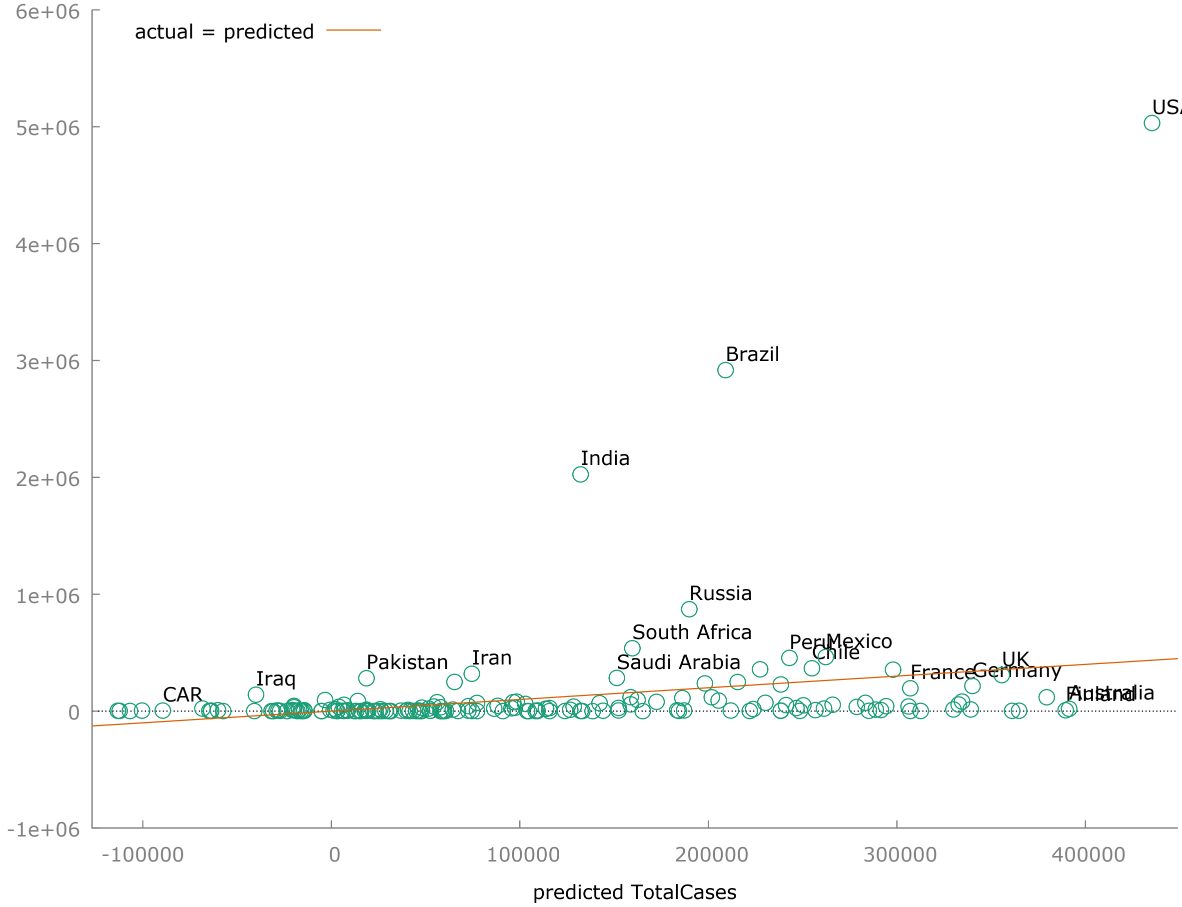
Table 1: Global Regression Results

Regression equation	Slope Coefficient	Adjusted R-Square	F Statistic
$c_i = a + bp_i + e_i$	0.0023***	0.2948	87.57***
$lc_i = a + blp_i + e_i$	0.8838***	0.5778	284.19***
$d_i = a + bp_i + e_i$.	0.0000608***	0.1814	42.22***
$ld_i = a + blp_i + e_i$	0.8403***	0.4660	163.35***
$c_i = a + bSTR_i + e_i$	6.387**	0.0174	4.11**
$c_i = a + bGSH_i + e_i$	9158.4***	0.066	13.58***
$d_i = a + bc_i + e_i$.	0.0319***	0.8803	1369.4***
$ld_i = a + blc_i + e_i$	0.998271***	0.8734	1285.27***

Note: ***,**,* Indicate significance at the 1, 5, and 10 per cent levels respectively.

The result again is perverse, as the positive slope suggests that the countries with a high GSH Index faired relatively worse, in direct opposition to the prediction. Figure 3 provides a plot of this relationship.

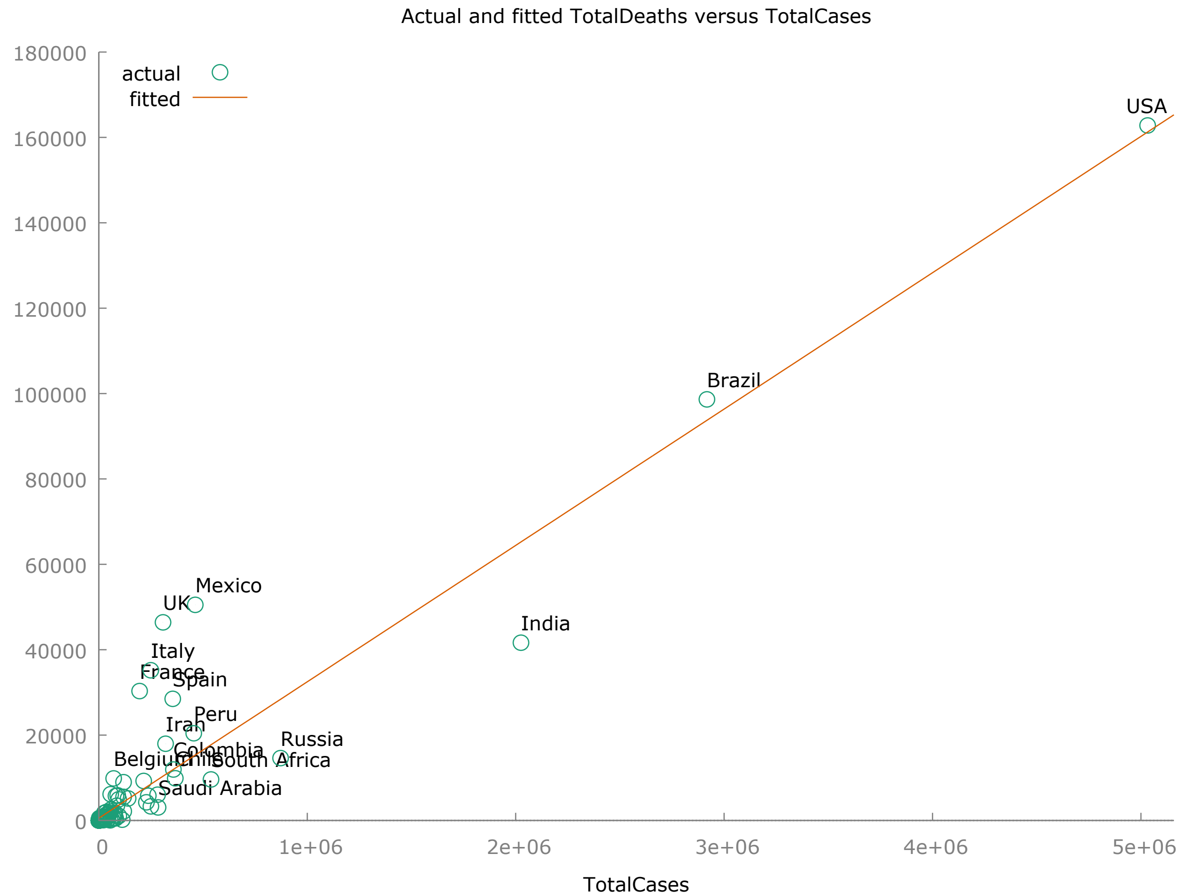
Figure 3: Regression $c_i = a + bGHS_i + e_i$



The seventh row in Table 1 shows the regression relationship between the number of cases and the number of deaths. The value of the slope coefficient is 0.032, suggesting a Case Fatality Ratio (CFR), of 3.2 per cent. This is a high death rate, particularly when contrasted with the typical death rate of seasonal flu, which has variously been suggested to be a fraction of 1 per cent.

Figure 4 provides a plot of this relationship, and the USA sits at the top of the line but is close to it, as is Brazil. However, Mexico, the UK, Italy, France and Spain all plot well above the line, suggesting that they experienced a CFR that is above the average. By contrast, India, Russia, South Africa and Saudi-Arabia, plot below the line.

Figure 4: Regression $d_i = a + bc_i + e_i$



A more effective specification is to adopt a logarithmic scale for both variables. The interpretation of logarithmic regressions is slightly different from standard regressions. The interpretation of the above relationship is given as an expected percentage change in d_i when c_i increases by one percent. Such relationships, where both d_i and c_i are log-transformed, are commonly referred to as elasticities in economics, and the coefficient of log c_i is referred to as an elasticity. In terms of the effects of changes in c_i on d_i:

- multiplying c_i by e will multiply expected value of d_i by e^{β}.
- to obtain the proportional change in d_i associated with a p percent increase in c_i, calculate $a = \log([100 + p]/100)$ and take $e^{a\beta}$.

The eighth row in Table 1 presents the results of this regression. The slope coefficient is 0.9983, which is significant at the 1 per cent level, the Adjusted R Square is 0.87, the F statistic is 1285.27, also significant at the 1 per cent level. The application of the calculation above suggests that the elasticity of a 1 percent increase in cases is to increase deaths by 0.01, or about 100th of a per cent on average.

A plot of this regression is shown in Figure 5. One of the advantages of the use of a logarithmic specification is that adjusts for the proportionate effects of different populations, so the countries plot around the full length of the regression line. Countries plotting above the regression line, who experienced above average death rates include, the USA, Brazil, Mexico, the UK, France, Spain, Italy, Peru, Belgium, Germany, the Netherlands, Switzerland, and Ireland, to name a few. On the other side of the line, Singapore, Botswana, Iceland, and Nepal, all appear to have performed relatively well, if the figures reported are accurate.

Figure 5: Regression $ld_i = a + blc_i + e_i$

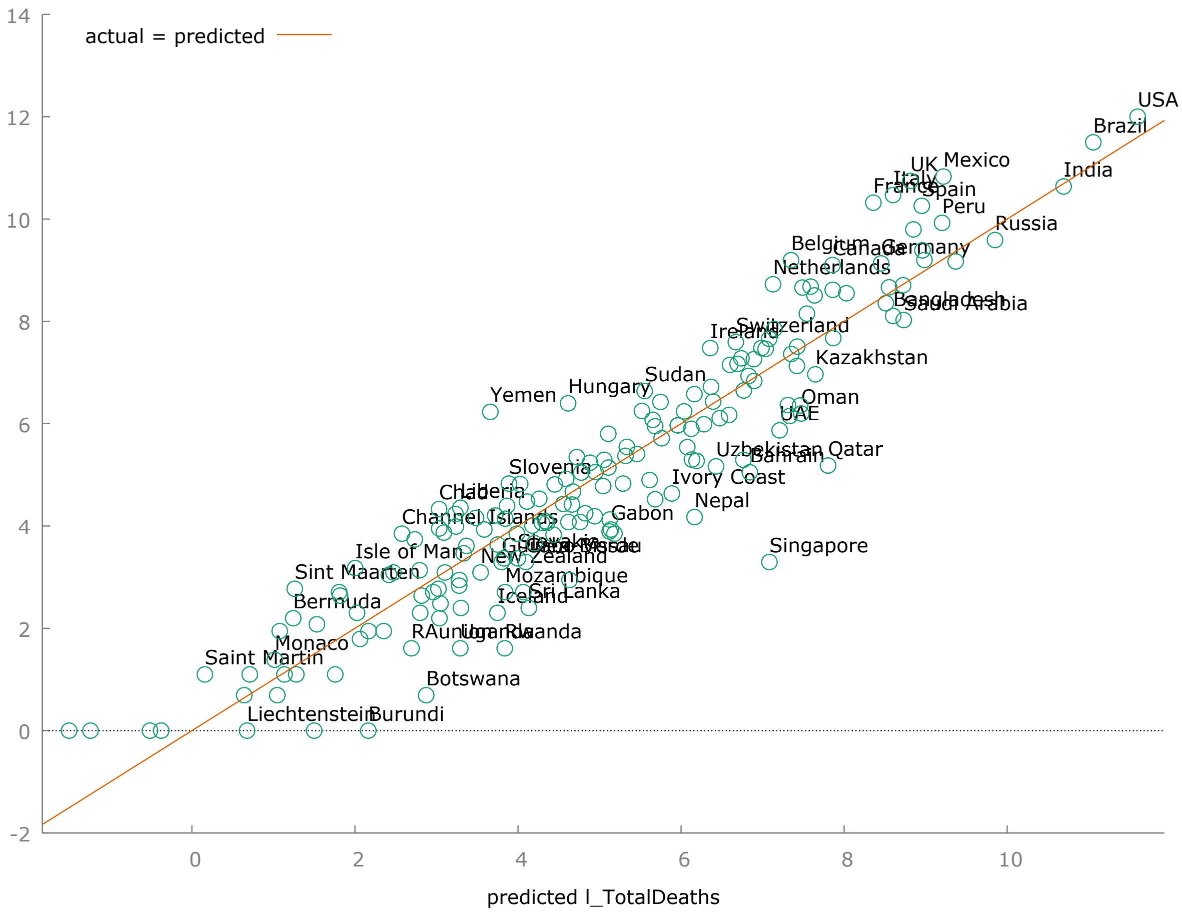


Table 2 reports some multivariate regression results for the global set of countries. The first line of Table 2 reports the results of regression deaths/million population on the GHS Index for that country plus the total cases/million population. The GHS index is a dimensionless index so it was appropriate to use deaths and cases per million because of the variation in population size in individual countries. Both slope coefficients are significant at the 1 per cent level, the regression is significant at the 1 per cent level and the Adjusted R Square is 33 per cent. There is still a perverse positive slope to the coefficient on the GHS index.

Table 2: Global Multivariate Regression Results

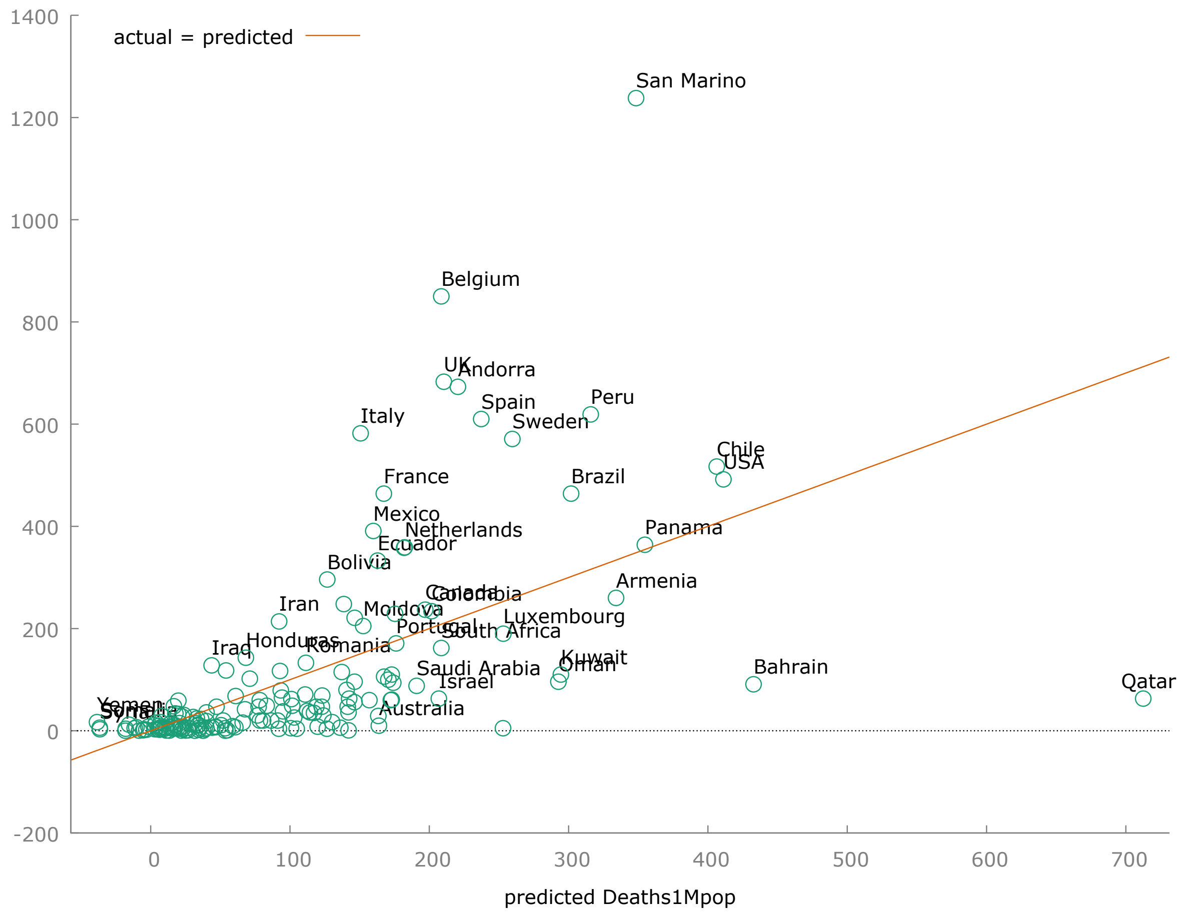
Regression equation	Slope Coefficient GHS	Slope Coefficient Cases/Million	Slope Coefficient Log Cases/Million	Adjusted R-Square	F Statistic
$Deaths/Mill_i = a + GHS_i + bCases/Million_i + e_i$	3.469***	0.01600***	na	0.334	42.87***
$logDeaths/Mill_i = a + GHS_i + blogCases/Million_i + e_i$	0.0167***	na	0.9439***	0.785	305.03***

Note: ***,**,* Indicate significance at the 1, 5, and 10 per cent levels respectively.

I do not report the results of applying the Oxford Stringency Index instead of the GHS Index in the interests of brevity. However, if that index is used, the Adjusted R Square is 30 per cent, the coefficient on the Stringency Index is very small at 0.0004, positive and significant at the 5 per cent level.

Figure 6 provides a plot of the GHS multivariate regression results with deaths/million as the dependent variable. San Marino plots way above the line in Figure 6, followed by Belgium, the UK, Andorra, Italy, Spain and Sweden. The latter, Sweden, had a score on the Oxford Stringency Index of 40176, whilst the median score on this index was 46793. By contrast, the USA had a score of 54742 on this index and Belgium had a score of 43892. Thus, Sweden, whilst having relatively less-severe lockdowns, did not appear to secure relatively better outcomes in terms of deaths/million population.

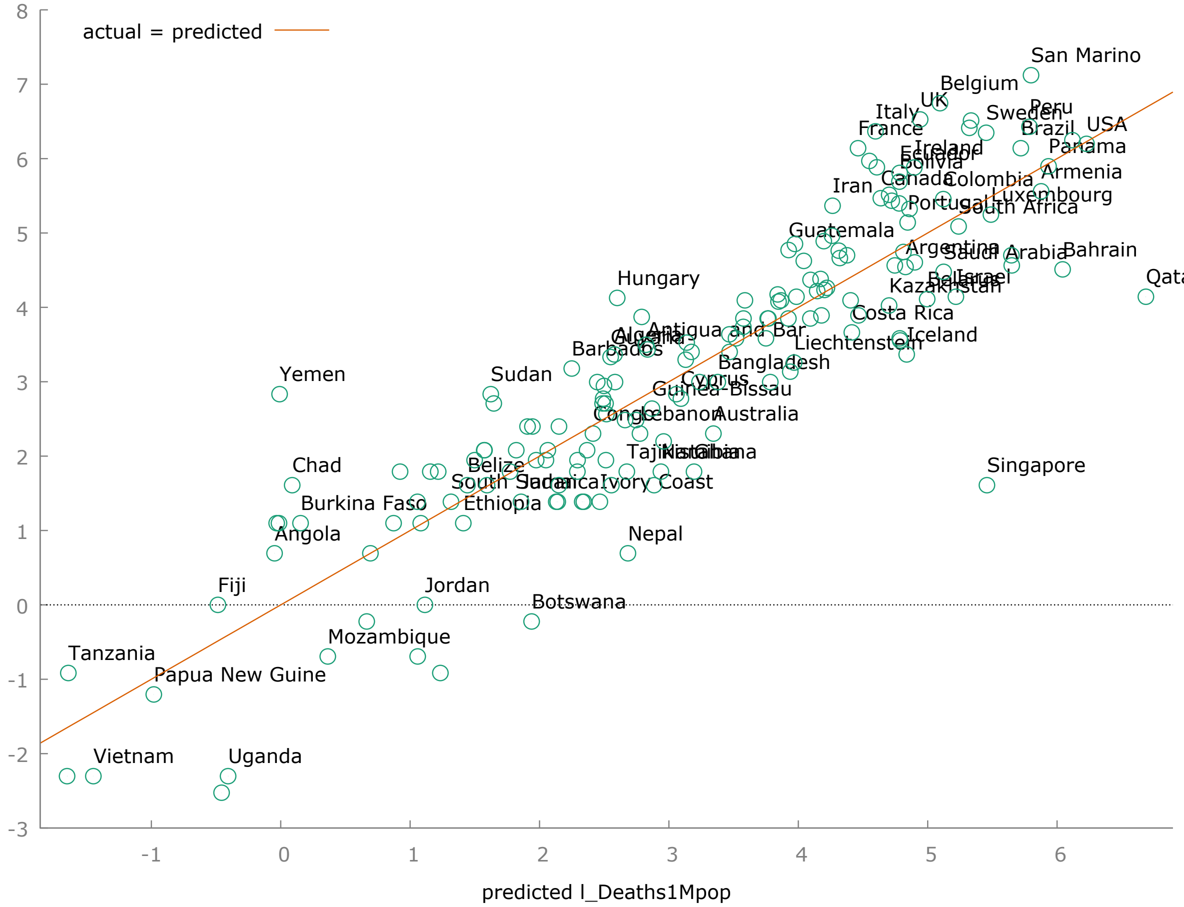
Figure 6: Regression deaths/millioni = a + bcases/millioni + GHSi+ ei



The second row in Table 2 reports the results of the same regression when deaths and cases per million are transformed into logarithmic form. In this regression the slope coefficient on GHS is significant at the 1 per cent level and positive, as is the coefficient on cases/million and the Adjusted R Square is a remarkable 0.785 per cent. This implies that almost 80 per cent of the variation in deaths/million population is captured by this simple regression relationship.

Figure 7 provides a plot of the fit of this regression. San Marino is an outlier well above the line, and the major European countries of The UK, Italy, Belgium, France and Ireland are well above the line. The USA is close to it and below the line are Singapore, Nepal, a group of African countries, Iceland and Australia.

Figure 7: Regression logdeaths/million$_i$ = a + blogcases/million$_i$ + GHS$_i$+ e$_i$



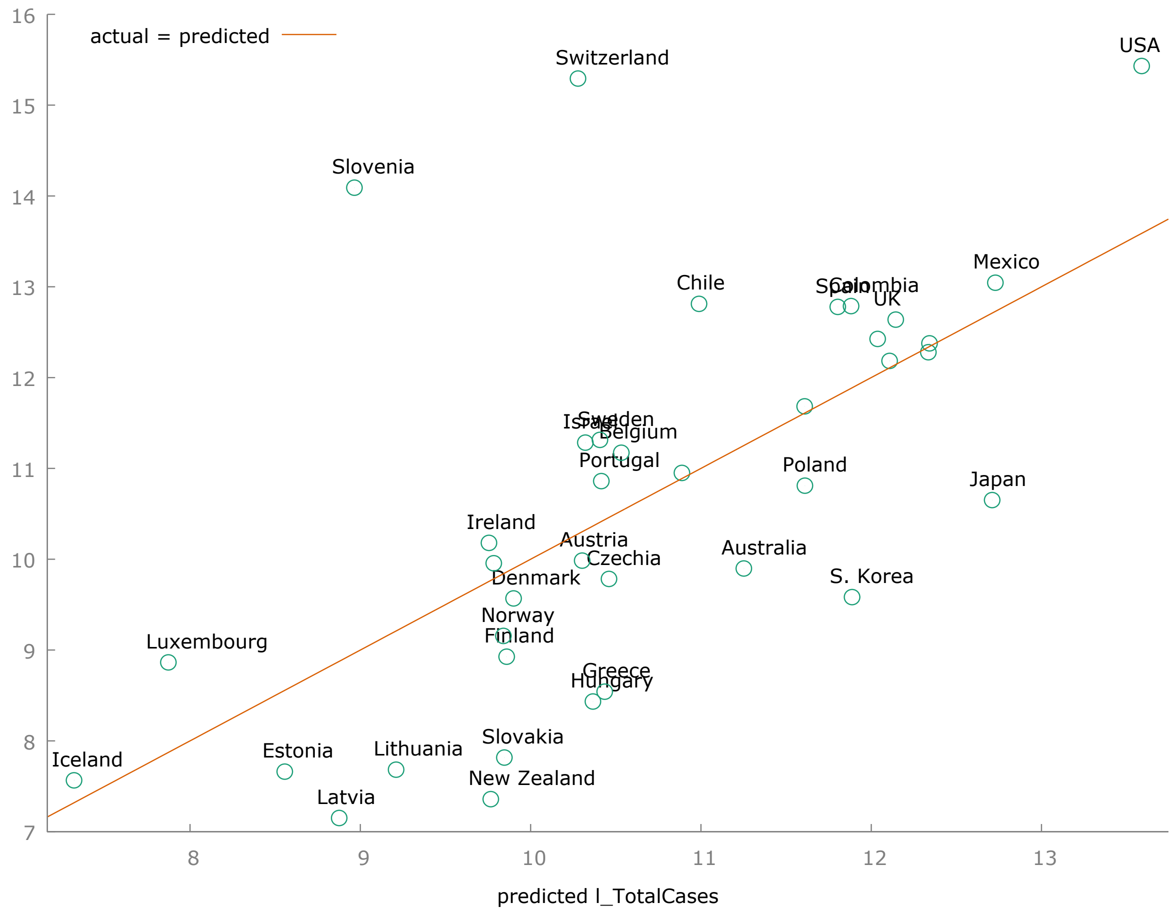
The common picture in all these analyses appears to be that European countries managed this pandemic particularly badly. This will be explored further in the next section of the analysis which will concentrate on a smaller sample of 39 OECD countries.

Table 3 reports the results of univariate regressions for the set of OECD countries. The first row of Table 3 reports the results of the regression of cases on population. The slope coefficient on populations has a value of 0.01059, significant at a 1 percent level, the Adjusted R-Square is 0.34 and the F statistic is 19.75. also significant at the 1 per cent level.

Row 2 of Table 3 reports the same regression in logarithmic format. The slope coefficient has a value of 0.9116 which is significant at the 1 per cent level, the Adjusted R-Square increases to 0.40, and the F statistic has a value of 25.79 significant at the 1 per cent level.

Figure 8 provides a plot of the fit around the regression line. Slovenia, Switzerland and the USA had above average number of cases in relation to the size of their population. Chile, Spain, Columbia, the UK, Israel, Sweden, Belgium and Portugal, are also amongst the group of countries plotting above the line. By contrast, Latvia, New Zealand, Hungary, Greece, Australia, South Korea and Japan, all plot well below the line.

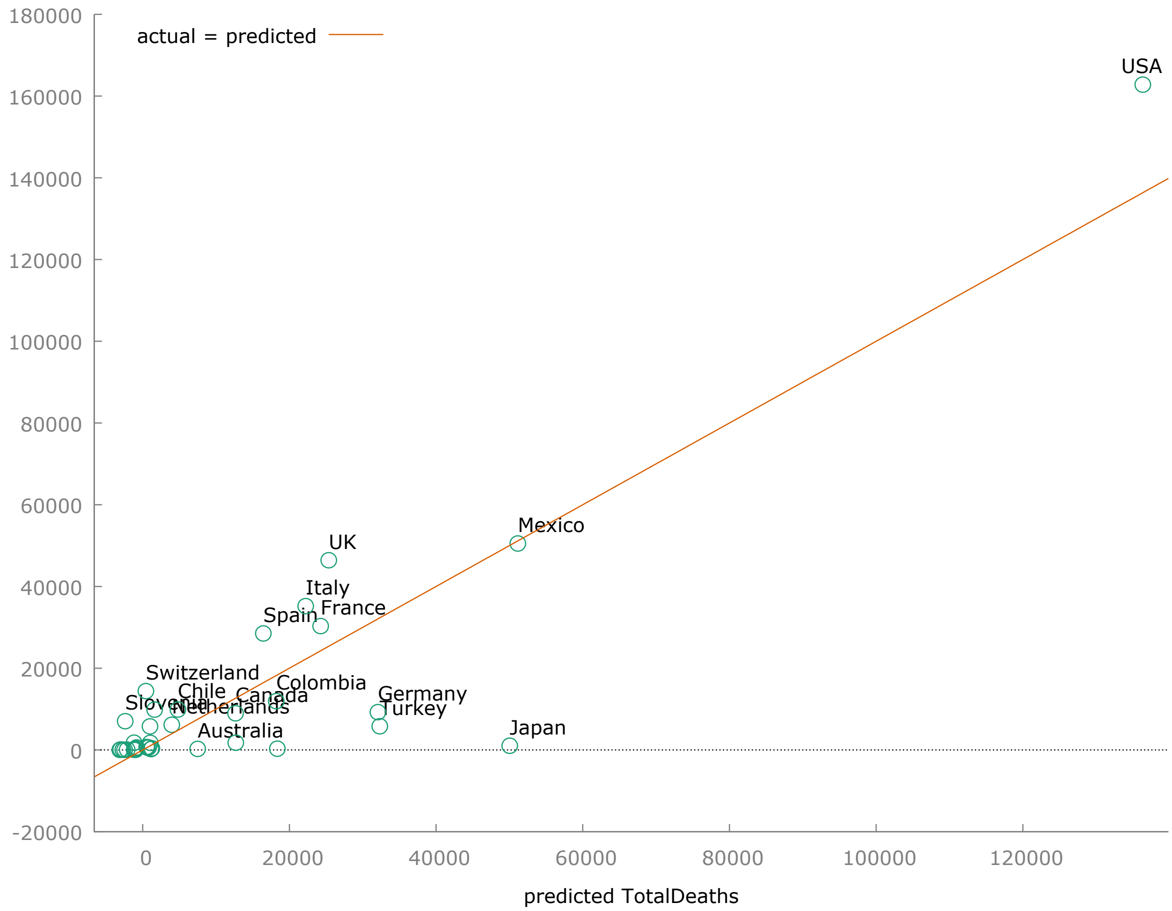
Figure 8: OECD Regression $lc_i = a + blp_i + e_i$



Row 3 of Table 3 presents the results of a regression of total deaths per OECD country on the population of that country. The slope coefficient of 0.00042 is significant at the 1 per cent level. The Adjusted R Square is a very high 79 per cent and the F statistic is 137.95 which is significant at better than the 1 per cent level. This regression suggests that almost 80 per cent of the deaths from COVID-19 in OECD countries are attributable to differences in the relative sizes of their populations.

Figure 9 provides a graph of these regression results. The USA, the UK, Italy, Spain, France and Switzerland plot above the regression line, whilst Germany, Turkey, Japan and Australia plot well below it. Thus, the above-mentioned countries experienced relatively high death rates in an OECD context.

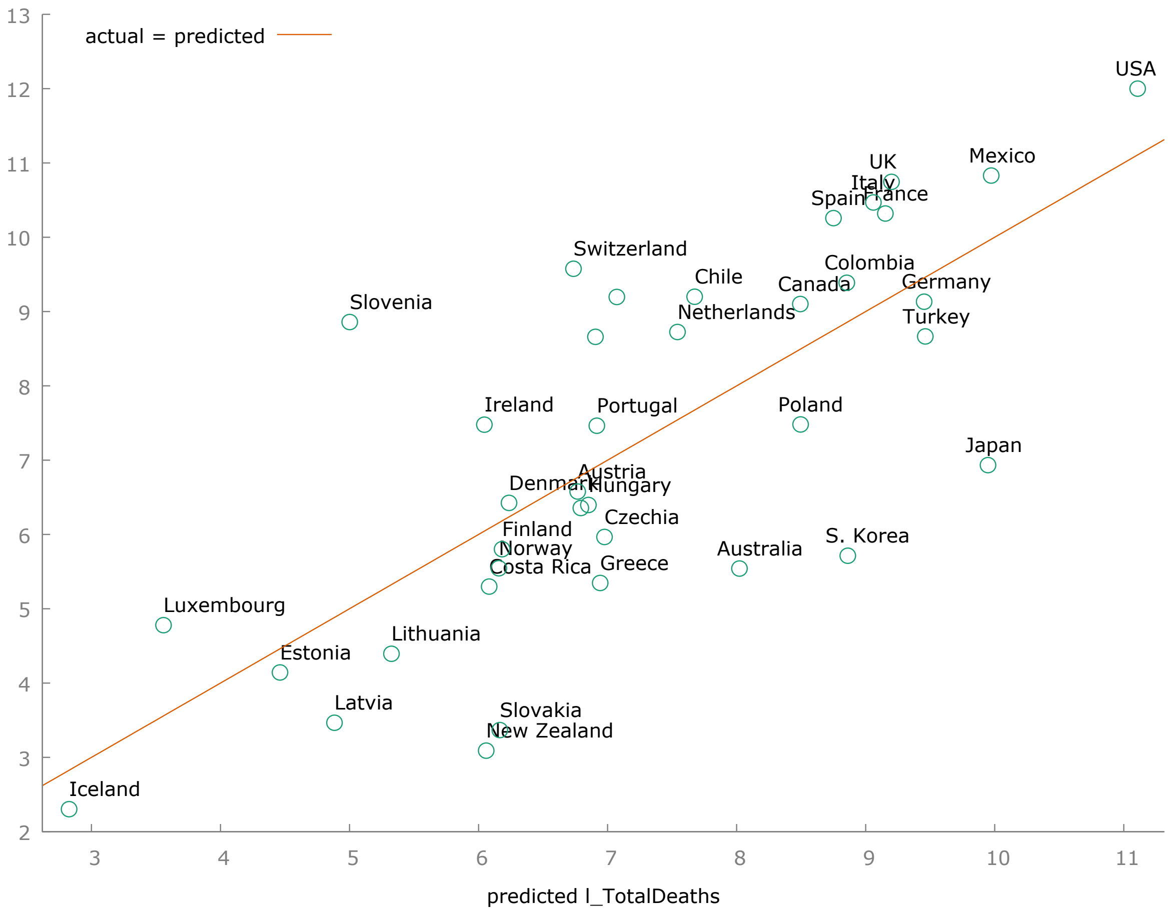
Figure 9: OECD Regression $d_i = a + bp_i + e_i$



The fourth row of Table 3 shows the results of the same regression of deaths on population but in logarithmic format. The slope coefficient is 1.2041 which is significant at the 1 percent level. The Adjusted R Squared has reduced to 0.55 whilst the F statistic of 45.53 is significant at the 1 percent level.

Figure 10 provides a plot of the results of this regression. Given that the results are now proportionate to populations the points representing individual countries are spread more evenly around the line and are easy to visualize. The USA, the UK, Italy Spain, France, Mexico, Switzerland, and Slovenia, all plot well above the regression line. At the other extreme, New Zealand, Slovakia, Australia, South Korea and Japan, plot well below the line. The results suggest that these countries faired better, in terms of experiencing relatively fewer deaths, in proportion to the size of their populations.

Figure 10: OECD Regression $ld_i = a + lbp_i + e_i$



The fifth row of Table 3 shows the results of regressing the total number of cases in OECD countries on the Oxford Stringency Index. The slope coefficient is insignificant, the Adjusted R Square is negative, and the F statistic for the regression is insignificant.

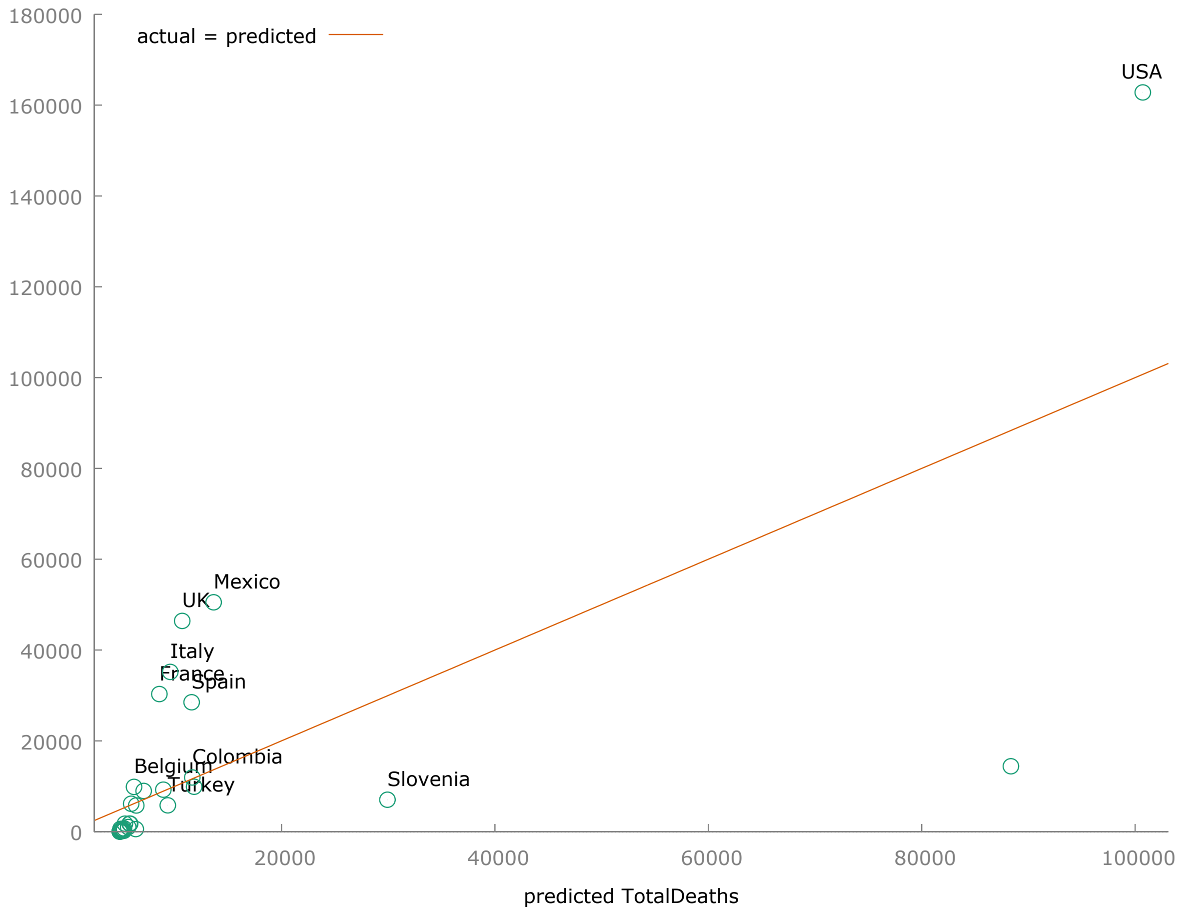
The sixth row of Table 3 shows the results of the same regression except that the GHS Index is used as the explanatory variable. The slope coefficient is positive and significant at the 10 percent level, the Adjusted R Square is 7 percent, and the F statistic is significant at the 10 per cent level. This is a weak regression, and it suggests that perversely, the higher the GHS Index the larger the number of COVID-19 cases.

The penultimate row 3 of Table 3 reports the results of the regression of all deaths for each OECD country on the total number of cases reported for each of these countries. The slope coefficient for this regression is 0.19 which is significant at the 1 percent level. This is also a measure of the Case Fatality Ratio (CFR) which is just under 2 percent. The Adjusted R Square is 50 percent, and the F statistic is 38.00 which is significant at the 1 per cent level.

This CFR is lower than the CFR for the total sample which was 3.2 percent. This suggests that the wealthier OECD countries experienced a lower CFR and that having more resources did lead to a better outcome in terms of overall mortality.

Figure 11 plots the results of this regression. It shows that the worst performing OECD countries in terms of this regression benchmark were the USA, Mexico, the UK, Italy, France and Spain.

Figure 11: OECD Regression $d_i = a + bc_i + e_i$



The final row in Table 3 reports the results of the same regression in logarithmic format. The slope coefficient on the logarithm of total cases in each OECD country is 1.048, significant at the 1 percent level. The Adjusted R Square is 0.84, a remarkably high figure which suggests that 84 percent of the variation in deaths is captured by this relationship. In effect, once a COVID case occurs, the death rate can be predicted with great accuracy. A plot of this regression result is provided in Figure 12. Countries plotting above the regression line include Mexico, Italy, the UK, France, Spain, Belgium, Canada, the Netherlands, Ireland, Hungary, Denmark and Greece. By contrast, Switzerland, Slovenia, Israel, Costa-Rica, Luxembourg, Iceland, and New Zealand, plot well below the line.

Table 3: OECD Regression Results

Regression equation	Slope Coefficient	Adjusted R-Square	F Statistic
$c_i = a + bp_i + e_i$	0.01059***	0.34	19.75***
$lc_i = a + blp_i + e_i$	0.9116***	0.40	25.79***
$d_i = a + bp_i + e_i$.	0.00042***	0.79	137.96***
$ld_i = a + blp_i + e_i$	1.2041***	0.55	45.53***
$c_i = a + bSTR_i + e_i$	12.697	-0.021	0.22097
$c_i = a + bGSH_i + e_i$	44976.2*	0.077	4.0989*
$d_i = a + bc_i + e_i$.	0.0190***	0.50	38.00***
$ld_i = a + blc_i + e_i$	1.048***	0.84	192.05***

Note: ***,**,* Indicate significance at the 1, 5, and 10 per cent levels respectively.

Figure 12: OECD Regression $ld_i = a + blc_i + e_i$

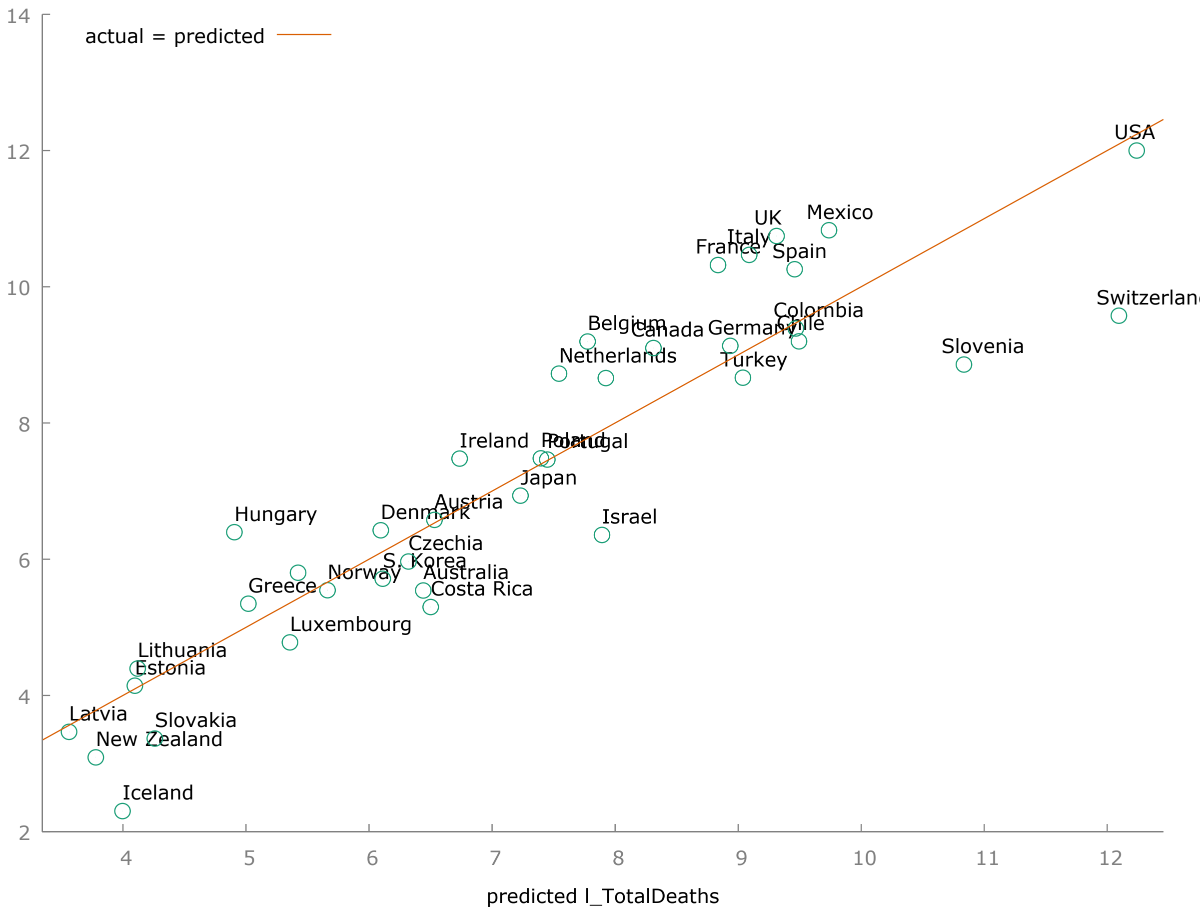


Table 4 reports some multivariate regression results for OECD countries which parallel those for the whole sample previously reported in Table 2. However, Table 4, reports the results of adding the Oxford Stringency Index to the regression, as opposed to the GHS index which showed no significant effect in the regression, when included.

Once again, the result is perverse, in that the slope coefficient on the Stringency Index is positive, suggesting that the more stringent the measures adopted, the more deaths/million that eventuated. The first row of Table 4 reports a slope coefficient of 0.0143 on the Stringency Index which is significant at the 5 percent level, whilst the coefficient on cases/million is 0.00434, significant at the 1 percent level. A similar result occurs when the regression is re-run in logarithmic format, though the Adjusted R Square reduces from 0.83 to 0.70. The respective slope coefficients are 0.00005 and 0.82 respectively, whilst the significance levels remain the same as previously reported in the non-logarithmic specification.

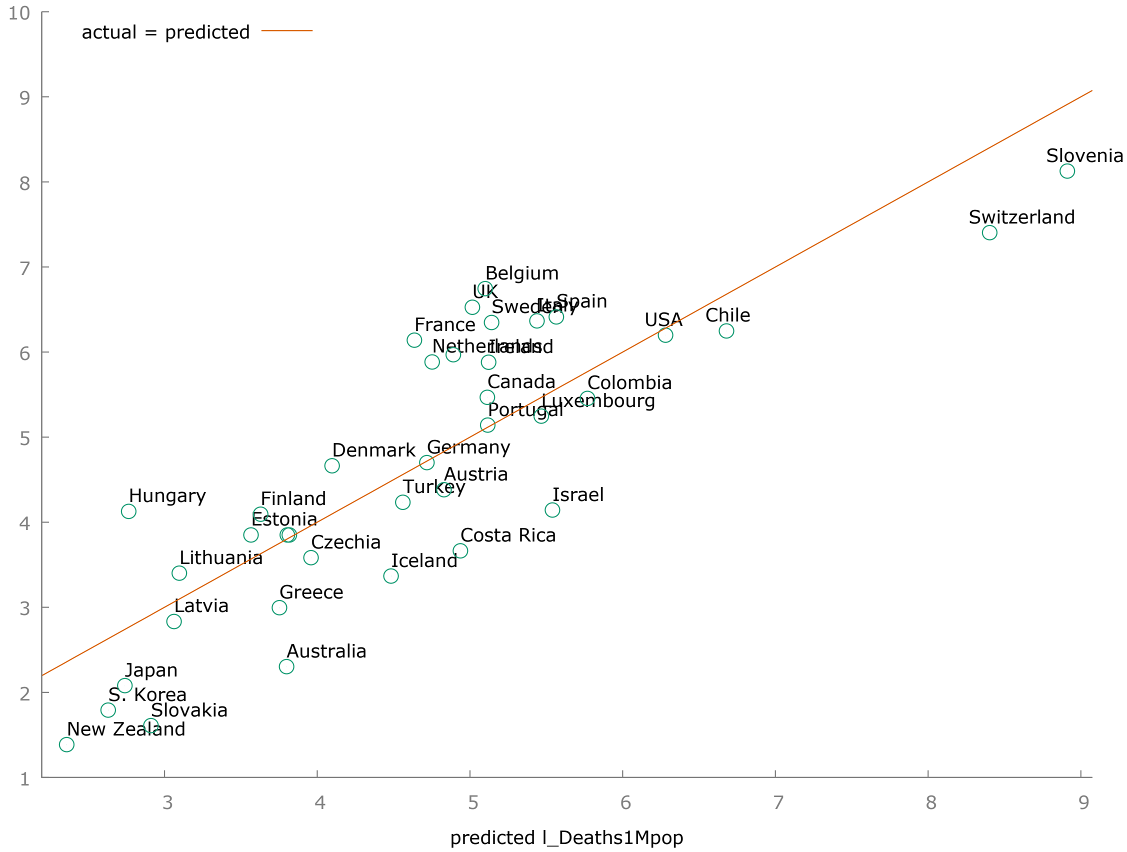
Table 4: OECD Multivariate Regression Results

Regression equation	Slope Coefficient STR	Slope Coefficient Cases/Million	Slope Coefficient Log Cases/Million	Adjusted R-Square	F Statistic
$Deaths/Mill_i = a + STR_i + bCases/Million_i + e_i$	0.0143**	0.00434***	na	0.83	89.61***
$logDeaths/Mill_i = a + STR_i + blogCases/Million_i + e_i$	0.000050**	na	0.8155***	0.70	43.99***

Note: ***,**,* Indicate significance at the 1, 5, and 10 per cent levels respectively.

A plot of the fit of the logarithmic version of the regression is provided in Figure 13, as this reveals the plot of the countries around the regression line more evenly. Once again, the same OECD countries show relatively poor performance in that Belgium, the UK, Italy, France, Spain, the Netherlands, Canada, Denmark and Hungary, all plot above the regression line.

Figure 13: Regression logdeaths/millioni = a + blogcases/millioni + STRi+ ei



Our data set included two measures of policy reaction to COVID-19 the Oxford Stringency Index, STR, plus the index of preparedness for a pandemic, the Global Health Security Index, GHS. The data set included a measure of relative wealthiness in the form of GDP per capita, plus two measures of Trust within the general population; Trust and PTI. The intention was to try to explore whether relatively wealthy countries within the OECD grouping, or countries which displayed higher levels of trust within the population, were likely to cooperate more, respond to government directives with more alacrity, and generally behave in a way that produced better outcomes in relation to COVID-19 policy measures.

There is a large literature on the importance of trust in economic affairs, as emphasized by Arrow (1972) 18. 19 Guiso et al. (2006), further explore the relationship between culture and economic outcomes. 17 Algan and Cahuc (2010) suggest that trust is positively related to economic output, for example, as measured by GDP per capita.

Several multivariate regression specifications were explored. The successful ones are reported in Table 5. The first row in Table 5 reports the result of the regression of the log of cases/million on STR and GHS. The coefficient of STR is positive and significant at the 1 percent level, whilst the coefficient on GHS is positive and significant at the 10 percent level. The Adjusted R Squared is 28 percent and the F statistic of 8.054 is significant at the 1 per cent level. These results are entirely consistent with the previous ones and suggest that the more stringent or prepared that an OECD country is, the worse the outcome in terms of the number of cases.

The second row in Table 5 shows the result of the regression of the logarithm of GDP/capita on TRUST and PTI. The coefficients on these two variables are 0.017 and 2.06, with both significant at the 1 percent level. The Adjusted R Squared is 0.58 and the F statistic is 26.03, also significant at the 1 percent level. These results suggest that 58 percent of the variation in GDP per capital across the OECD countries can be attributed to these two measures of trust. Both coefficients are positive, indicating that higher levels of trust imply higher levels of GDP per capita.

The third row in Table 5 assesses the relationship between the GHS, the two measures of trust and the logarithm of GDP per capita. This is a significant relationship, as the slope coefficient on Trust is −0.1596 significant at the 10 per cent level, the coefficient on PTI is 33.72, significant at the 1 per cent level, whilst the coefficient on LGDPCAP is insignificant. The Adjusted R Squared is 26 per cent and the F statistic of 5.247 is also significant at the 1 per cent level. Thus, there does seem to be evidence of linkages between the measures of trust, GDP per capita, and some of the indices of supposed readiness to cope with a pandemic.

The extent of testing also seems to be related to measures of national wealth as revealed by the fourth row in Table 5. This reports the regression of the logarithm of tests per million population on GDP/capita, PTI and STR. The coefficient on GDP/capita is 0.00003 significant at the 1 percent level, that on PTI is −2.774 significant at the 10 percent level, the Adjusted R Squared of the regression is 0.32 and the F statistic is 6.65, which is significant at the 1 percent level. This all makes good sense, suggesting that wealthier countries do more testing. What is lacking in this analysis, is any evidence that individually wealthier countries had better outcomes, in the form of reduced death rates across this set of OECD countries.

Table 5: OECD Multivariate Regression Results including Trust and GDP measures

Regression equation	Slope Coefficient STR	Slope Coefficient GHS	Slope Coefficient	Adjusted R-Square	F Statistic
$lCases/Mill_i = a + bSTR_i + cGHS_i + e_i$	0.00017^{***}	0.068^{*}	na	0.28	8.054***
Regression equation	Slope Coefficient TRUST	Slope Coefficient PTI	Slope Coefficient	Adjusted R-Square	F Statistic
$lGDP/CAP_i = a + bTRUST_i + bPTI_i + e_i$	0.0171^{***}	2.0600^{***}	na	0.58	26.03^{***}
Regression equation	Slope Coefficient TRUST	Slope Coefficient PTI	Slope Coefficient lGDP/CAP	Adjusted R-Square	F Statistic
$GHS_i = a + bTRUST_i + cPTI_i + dlGDP/CAP_{i+} e_i$	-0.1596^{*}	33.718^{***}	0.5974	0.26	5.25^{***}
Regression equation	Slope Coefficient STR	Slope Coefficient PTI	Slope Coefficient lGDP/CAP	Adjusted R-Square	F Statistic
$ltests/Mill_i = a + bTRUST_i + cPTI_i + dlGDP/CAP_{i+} e_i$	0.000026	-2.77433^{*}	0.00003^{***}	0.32	6.65^{***}

Note: ***,**,*, Indicate significance at the 1, 5, and 10 per cent levels respectively.

5. Conclusion

This paper features an analysis of the COVID-19 experience of a global sample 208 countries and a subsample of 38 OECD countries. Regression analysis suggests that there is no evidence that relatively wealthier countries had better outcomes in terms of infections and death rates than poorer ones. Indeed, the wealthier European countries and the USA appeared to perform relatively poorly in most of the analyses.

A measure of the stringency of responses (STR) and of pandemic readiness (GHS) had a perverse, positive relationship with country level pandemic outcomes. Indices of trust within the community (TRUST) and (PTI), though significantly related to economic performance, as captured by GDP/capita, were not related to better pandemic outcomes. There was evidence of greater testing in the wealthier countries. However, the single, but important metric, upon which OECD countries appeared to perform better than their average global counterpart, was the Case Fatality Ratio (CFR) which was 3.8 percent for the whole sample and just under 2 percent for the OECD subset of countries.

Broader negative economic effects caused by stringent and prolonged lockdowns, health issues associated with lack of access to hospitals and prompt medical care and assessment, mental health implications and the social and educational impacts of non-attendance at school or college, though important, are not addressed in the current analysis. 20 implied that policies produced serious human rights effects.

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