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ABSTRACT

Are COVID Fatalities in the US Higher Than in the EU, and If So, Why?[1]

The COVID crisis has severely hit both the United States and the European Union. Even though they are the wealthiest regions in the world, they differ substantially in economic performance, demographic characteristics, type of government, health systems, and measures undertaken to counteract COVID. We construct comparable measures of the incidence of the COVID crisis and find that US states had more COVID-related deaths than EU countries. When taking account of demographic, economic, and political factors (but not health-policy related factors) we find that fatalities at 100 days since onset are 1.3 % higher in a US state than in an EU country. The US/EU gap disappears when we take account of health-policy related factors. Differences in number of beds per capita, number of tests, and early lockdown measures help explain the higher impact of COVID on US fatalities measured either 50 or 100 days after the epidemic started in a nation/state.

JEL Classification: I18, J1, J18

Keywords: COVID-19, mortality, Europe, US, health policy

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1. Introduction

It is becoming increasingly common to compare the European Union (EU) and the US rather than the US and various European countries that are members of the EU. For example, according to Richter (2020) "the trend of daily new COVID cases has taken completely different trajectories for the U.S. and the European Union." COVID fatalities are also routinely compared across the two unions. For example, Drum (2020) charted 7-day averages of daily deaths in the two unions, letting the US lag the EU by 12 days (reproduced in Figure 1). It shows weekly mortality in the US in June 2020 lying substantially above that of the EU.

There are at least three problems with such comparisons. First, they ignore the enormous variation in COVID outcomes within the EU and within the US (see Table 1, showing cumulative deaths per million). Second, a lag of 12 days between the average onset of COVID in the entire EU and its average onset in the entire US masks the great variation in onset dates among 78 nation/states also reported in Table 1. France was first to experience a death from COVID, on February 15, 2020 (we define time of onset as the day a first death was recorded). Wyoming was the last to experience its first COVID death on April 13, almost two months later. Third, many observers of the US/EU fatality gap have been quick to give credit or assign blame to politicians, overlooking other factors that may contribute to COVID deaths.

To address the first problem we analyze cumulative deaths from COVID in 79 nation/states: 29 European countries and fifty US states. [2] In average population and a number of other characteristics, US States tend to be similar to European countries (see Table 2). To address the second problem we use statistics on reported COVID deaths at two time intervals after the onset of COVID in that nation/state: 50 and 100 days after each nation/state onset.[3] Looking at simple means we find a US/EU gap of 213 more COVID-related deaths per million inhabitants 100 days after a nation/state's first death: the mean number of deaths per million is 407 in the US and 194 in the EU (see Table 2). These averages include New York (the nation/state with most deaths per million inhabitants), Belgium ranking 7th and a number of other EU countries among

[2] We include 26 of the 28 members of the European Union (Malta and Cyprus were dropped due to missing data). We also include the UK (since it belonged to the EU up to recently), Switzerland (a country associated with the EU through a series of bilateral treaties), and Serbia, currently in negotiations with the EU and expected to join the Union by 2026. For simplicity we call our sample of European countries EU countries.

[3] We stop at 100 days because in Wyoming 100 hundred days from onset occurred on July 23, and we stopped data collection in early August 2020.

the 20 most affected. Most nation/states in the top20 at 100 days since onset are part of the US.[4] The 5 nation/states with the best 100-days performance include Alaska, where deaths stood at 26.5, and Slovakia, with 5 COVID deaths per million. The third problem is addressed by taking account of differences in demographic, political, economic, and health-system characteristics as well as variation in the time that elapsed between onset of pandemic and France and its onset in each of the nation/states.

2. Methods

We estimate log-linear regressions of the log of cumulative number of deaths using a sample of 78 nation/states: 29 countries associated with the EU (for simplicity: EU) countries and 50 US states. Logarithms allow us to interpret coefficients in percentage terms, which facilitates comparability across highly heterogeneous nation/states.[5] The following equation is estimated:

$$\log\,(Deaths)_r = \beta_0 + \beta_1 US_r + \beta_2 POP_r + \beta_3 POL_r + \beta_4 X_r + \beta_5 Z_r + \varepsilon_r, \qquad (1)$$

where Deaths are the number of cumulative COVID-caused deaths 50 and 100 days after the first death in nation/state *r*, US is a dummy for whether the nation/state is in the USA, *POP* stands for size of the population, *POL* are variables related to politics, *X* is a vector of demographic and economic control variables, and *Z* is a vector of variables related to COVID and health policy. All variables and data sources are defined in Appendix Table 1. More details about our data can be found in Aparicio-Fenoll and Grossbard (2020).

The first regression model of cumulative fatalities that we estimate (Model 1) only takes account of the US dummy and the size of the nation/state's population. Model 2 adds two variables related to politics: Left and Left x US (an indicator for government leaning to the left and its interaction with a US dummy). Model 3 adds to Model 2 by also including other demographic factors included in *X*, i.e. intergenerational co-residence (measured as proportion of those ages 18 to 34 who live with their parents), percent of the population over 65, and percent urban, as well as economic variables (Gross Domestic or State Product per capita and rent levels). The final regression model (Model 4) includes population size, political variables, the variables in *X* as well

[4] California, Florida, and Arizona reached 100 days from onset respectively on June 12, June 14 and June 28. As of August 13 these states have experienced new increases in COVID infections. Cumulative deaths per capita in those states reached 816, 369 and 535, respectively. This implies that 160 days after its onset, Florida had fewer cumulative deaths from COVID per capita than France after 100 days.

[5] https://stats.stackexchange.com/questions/298/in-linear-regression-when-is-it-appropriate-to-use-the-log-of-an-independent-va.

as the following variables that are related to COVID or health policy (vector *Z* in equation 1): number of hospital beds per capita, number of tests 14 days prior to the day cumulative deaths were measured[6], and two variables related to lockdown measures: whether there was a lockdown and how many days it took for the lockdown to be in effect. Models 3 and 4 also control for time since onset in the West, i.e. time that elapsed between the onset of the epidemic in the West, when France recorded its first death on February 15, and the first death recorded in a particular nation/state in our sample. Time since onset in the West is specified in quadratic terms as we discovered it has a non-linear relationship with fatalities from COVID.

3. Findings

All regression results based on equation 1 are reported in Table 3. Model 1, including only a US dummy and population size, was estimated 50 days after onset (col 1) and 100 days after onset (col. 2). It indicates no US/EU gap 50 days after onset. Cumulative casualties 100 days after onset are 0.9% (almost 1%) higher in a US state than in an EU country (col. 2). Given that on average a nation/state has 332 deaths after 100 days of epidemic, this implies, on average, approximately 30 extra deaths per million. In Model 2 (cols 3 and 4) we examine how the US/EU gap changes when we add two variables related to type of government. In the case of EU countries we defined ‘left’ as having a government that belongs to the Greens-European Free Alliance, European United Left-Nordic Green Left, or Progressive Alliance of Socialists and Democrats groups in the European parliament; in the case of US states ‘left’ is defined as presence of a governor belonging to the democratic party. We also include an interaction term US x Left, as we realize that ‘left’ is vaguely defined and depends on whether the nation/state is in Europe or the US. It can be seen from a comparison of cols 1 and 2 with cols 3 and 4 that adding these two variables does not have much of an effect on the size of the coefficient of the US dummy: in the case of deaths at 50 days the US dummy continues to be essentially zero (col. 3). After 100 days from a nation/state’s onset cumulative casualties are 0.8% higher in a US state than in an EU country (col. 4), not very

[6] Based on data from Los Angeles and New Jersey, Harris (2020) estimates that, on average, it took 16 days from a test-based COVID diagnosis to death. He presumes that during the worst phase of the epidemic in Italy the time from diagnosis to death was shorter (Harris, personal communication). We measure tests 14 days prior to the time we measure deaths, which is reasonable if many of those tested already have severe symptoms. However, if tests are widely available and many of those tested are asymptomatic it may take more than 16 days from test time to death.

different from 0.9% according to col. 2. It also appears that having a left-leaning government is associated with about 1% more cumulative casualties.

The US/EU gap grows larger when we estimate Model 3, which also takes account of other demographic factors, economic factors, and time since onset in the West: there were 0.8% more deaths in the US after 50 days (col. 5) and 1.3% more deaths after 100 days (col. 6). The US/EU gap is larger according to Model 3 than according to Model 1, for two main reasons: (1) higher rates of intergenerational co-residence have a positive association with COVID deaths, and on average US states had lower proportions of households involving intergenerational co-residence (Mean for the US is 31 and for EU is 49, see Table 2),[7] and (2) later onsets of COVID are associated negatively with COVID deaths (the coefficient of days since onset, squared, is negative) and, on average, COVID epidemics started later in US states than in EU countries (the mean time that elapsed between first onset in the West and onset for a US state is 33.5 days; it is 28.8 for a EU country). It can be seen that time from onset in the West has positive coefficients in regressions in cols. 3 to 6, but its square value has a negative coefficient. This implies that there is a maximum number of days since onset in the West associated with more deaths. We calculate that in the regression in col. 5 countries/states that started their epidemic less than 20 days after France have more cumulative deaths, but after 20 days each additional day from onset in the West is associated with fewer deaths 50 days after onset in a particular nation/state.[8] Despite these two advantages US states have higher cumulative fatalities, which is reflected in the US/EU gap being larger according to Model 3 than according to Model 1 or 2. It can also be seen that once additional demographic variables and economic factors are added to the model the political variables that were added in Model 2 no longer make a difference.

Model 4, presented in cols. 7 and 8 of Table 3, helps us identify some possible channels responsible for the US/EU gap apparent from cols 1 to 6. Here variables related to health care and policy interventions are added to the model: days from onset to first lockdown, a variable for no lockdown, tests per capita (measured 14 days prior to the measurement of cumulative deaths), and number of hospital beds per capita. Adding the health-policy variables to the regressions washes

[7] For more on why intergenerational co-residence can contribute to the spreading of COVID among more vulnerable older adults see Harris (2020b). Aparicio-Fenoll and Grossbard (2020) review some of the literature on this topic.
[8] We reach this number of 20 days by taking the first derivative of the function log y = ax + b(x, square), where x is days since onset in the West. This leads to x = a/2b. According to col. 5, a = 0.109 and b = -.00270. The drop after 20 days could reflect medical advances that are the result of the experience of nation/states that were hit by COVID earlier and that benefit nations/state facing COVID emergencies at a later stage (also see Landoni et al 2020).

out the US/EU differential: the magnitudes of the point estimates decrease significantly. For example, comparing columns 5 and 7, and then 6 and 8, we see that the coefficient of the "US" dummy goes down by 76% and 37% for deaths at 50 and 100 days, respectively. Moreover, that coefficient is never statistically significant in cols 7 and 8 of Table 3.

This implies that if US states and EU countries had not only the same demographic and economic characteristics, but also the same health-related institutions and COVID-related policies, cumulative deaths from COVID in US states would not have exceeded COVID deaths in EU countries. It appears that US states have more deaths from COVID than EU countries due to a tendency for US states to rely on less effective health-related mechanisms either as a response to the epidemic (lockdowns or tests) or prior to the epidemic (hospital beds). Could lives have been saved in the EU due to extra hospital beds (European countries have an average of 4.95; US states an average of 2.6) or earlier lockdowns (European countries imposed lockdown 4.3 days after their first COVID death while US states imposed lockdown 7.7 days later on average)? Differences in how many tests were taken 36 or 86 days after the pandemic's onset don't seem to possibly account for the EU/US gap in fatalities.

This aggregate analysis does not allow us to be more specific in terms of attributing the source of the US/EU gap. None of the regression coefficients of the health-related variables is statistically significant in the Model 4 regressions estimated in cols 7 and 8.

4. Conclusions

We have established that 50 days past the onset of a nation/state's COVID pandemic there is no significant gap in cumulative deaths from COVID between US states and EU countries when we only take account of population size. According to such simple model, at 100 days past onset cumulative casualties are almost 1% higher in a US state than in an EU country. Given that on average a nation/state had about 3,709 cumulative deaths 100 days after its first death from COVID, this translates into 341 extra cumulative deaths and 34.6 extra deaths per capita (average population for a nation/state standing at 9.85 million). The gap decreases slightly when we take account of what we define as presence of left-leaning government: a governor affiliated with the Democratic party in the US or a leading party considered leftwing in the EU. In contrast, the US/EU fatality gap at 100 days since onset increases by 59% when we control for a number of factors that favor the US: a lower proportion of young adults living with their parents and more time that elapsed since the epidemic started in France (giving doctors and public health specialists in nation/states with late onsets a chance to learn from the experience of countries with early onsets of the epidemic). When these additional demographic and economic factors are taken into account whether a government is left-leaning or not does not seem to affect fatalities any longer.

Once national or state differences in health-related policies and institutions are taken into account, the US-EU gap disappears. This suggests that the gap originated due to better health-related measures implemented by European countries that tend to have more beds per inhabitant, more COVID tests, and that implemented lockdowns sooner after onset.

There is much left for further research to establish. We hope that our estimations will be computed with better statistics on deaths from COVID, better health policy data and based on a larger sample of countries. Better death statistics are based on comparisons of number of deaths before and after COVID (Aparicio-Fenoll and Grossbard, 2020). It would also be useful to further explore our findings at a more detailed level, such as the US counties, European provinces, or other sub-national levels. There have been studies estimating determinants of fatalities using data for small geographic units in the US (e.g. Ahammer et al 2020) or Europe (e.g. Arpino et al. 2020, Belloc et al. 2020, Laliotis and Minos 2020). Insights could also be gained from combining such sub-national data from the US and Europe. We also hope that further research will keep track of further changes in lockdown policy, beyond the measures taken in the first 70 days of the pandemic and covered in this study.

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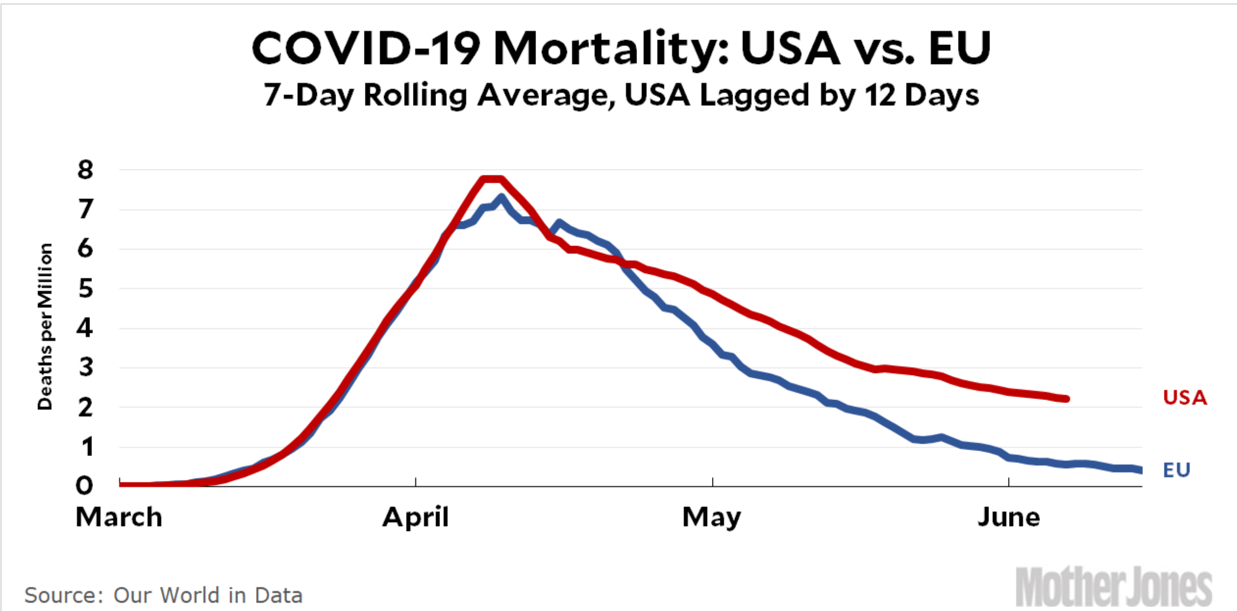
Figure and Tables

Figure 1.



Reproduced from K. Drum (2020).

Table 1. Cumulative deaths from Coronavirus per capita 100 days after the start of the coronavirus outbreak in that nation/state and date when country/state reached 100 days. EU countries in red.

Rank	Country/state	Deaths pc @100days	Reached 100 days on
1	New York	2072	06/22/20
2	New Jersey	1888	06/18/20
3	Connecticut	1580	06/26/20
4	Massachusetts	1523	06/28/20
5	Rhode Island	1181	07/06/20
6	Louisiana	907	06/22/20
7	Belgium	847	06/19/20
8	Michigan	806	06/26/20
9	Illinois	732	06/25/20
10	Delaware	692	07/04/20
11	Maryland	688	06/26/20
12	Pennsylvania	679	06/26/20
13	United Kingdom	627	06/15/20
14	Spain	578	06/13/20
15	Italy	555	06/02/20
16	Indiana	522	06/24/20
17	Sweden	494	06/20/20
18	Mississippi	474	06/27/20
19	France	423	05/25/20
20	Colorado	382	06/20/20
21	New Hampshire	353	07/01/20
22	Minnesota	352	06/29/20
23	Netherlands	351	06/15/20
24	Ireland	349	06/20/20
25	Georgia	335	06/20/20
26	New Mexico	325	07/03/20
27	Ohio	319	06/28/20
28	Iowa	309	07/02/20
29	Arizona	297	06/28/20
30	Alabama	273	07/03/20
31	Virginia	253	06/22/20
32	Missouri	223	06/26/20
33	Nevada	214	06/24/20
34	Washington	204	06/08/20
35	Nebraska	203	07/05/20
36	Switzerland	196	06/14/20
37	North Carolina	181	07/03/20
38	Luxembourg	179	06/23/20
39	Wisconsin	179	06/27/20
40	South Carolina	178	06/24/20

41	Florida	176	06/14/20
42	Kentucky	168	06/24/20
43	California	167	06/12/20
44	North Dakota	159	07/05/20
45	Portugal	151	06/26/20
46	Oklahoma	133	06/27/20
47	Arkansas	125	07/02/20
48	South Dakota	123	06/18/20
49	Kansas	121	06/20/20
50	Vermont	115	06/27/20
51	Tennessee	115	06/29/20
52	Texas	111	06/24/20
53	Germany	107	06/18/20
54	Denmark	104	06/24/20
55	Maine	103	07/05/20
56	Romania	85	07/01/20
57	Utah	79	06/30/20
58	Austria	78	06/21/20
59	Idaho	73	07/04/20
60	West Virginia	68	07/07/20
61	Finland	59	06/30/20
62	Oregon	59	06/22/20
63	Hungary	59	06/24/20
64	Wyoming	58	07/22/20
65	Slovenia	53	06/26/20
66	Estonia	52	07/04/20
67	Norway	46	06/21/20
68	Serbia	39	06/29/20
69	Poland	35	06/21/20
70	Czechia	33	07/01/20
71	Montana	29	07/05/20
72	Lithuania	28	06/29/20
73	Bulgaria	28	06/20/20
74	Croatia	27	07/03/20
75	Alaska	27	07/05/20
76	Hawaii	18	07/09/20
77	Greece	18	06/20/20
78	Latvia	16	07/13/20
79	Slovakia	5	07/16/20

Source: https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases for Europe and https://github.com/nytimes/covid-19-data/blob/master/us-states.csv for the US, downloaded on July 12, 2020; we ignore Brexit and include the UK in the EU

Table 2: Descriptive Statistics

	All		US		EU	
Variables	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Deaths at 50 days	2190.71	5082.91	1401.80	3623.30	3550.90	6780.09
Deaths at 50 days per capita	190.42	275.59	225.07	319.99	130.68	162.92
Deaths at 100 days	3709.22	8011.99	2413.38	4833.19	5943.41	11391.78
Deaths at 100 days per capita	328.74	417.31	406.99	479.54	193.82	230.03
US	0.63	0.49	1	0	0	0
Population	9.85	15.98	4.91	5.54	18.38	23.21
Coresidence	37.64	13.73	31.22	6.19	48.72	16.04
Population over 65 (%)	0.18	0.02	0.17	0.02	0.19	0.02
Urban (%)	72.78	13.71	73.59	14.57	71.39	12.22
GDP pc	51375.47	20545.45	58721.74	11067.72	38709.49	26438.62
Rental prices	1543.33	628.66	1642.54	577.25	1372.27	685.50
Days since onset	31.77	8.96	33.48	7.52	28.83	10.52
Days since onset, squared	1088.76	561.74	1176.28	523.84	937.86	601.29
Days to lockdown	6.43	8.31	7.68	8.48	4.28	7.67
No lockdown	0.30	0.46	0.12	0.33	0.62	0.49
Tests pc at 36 days	0.02	0.01	0.02	0.01	0.02	0.01
Test pc at 86 days	0.08	0.04	0.09	0.04	0.06	0.04
Hospital beds pc	3.48	1.62	2.63	0.72	4.95	1.71

Note: Deaths50 and Deaths100 refer to the number of cumulative deaths 50 and 100 days after the first death in a nation/state. We measure Intergenerational co-residence using the share of 18-34 year-olds living with their parents. Days to lockdown reflects the number of days from the first COVID-related death to lockdown. It is missing for those countries/states without lockdown. Population is expressed in millions of citizens.

Table 3. The US-EU Differential in Log of Cumulative Covid-19 Deaths

VARIABLES	(1) Deaths 50	(2) Deaths 100	(3) Deaths 50	(4) Deaths 100	(5) Deaths 50	(6) Deaths 100	(7) Deaths 50	(8) Deaths 100
US	0.506	0.919**	0.323	0.795*	0.795**	1.265***	0.192	0.800
	(0.360)	(0.359)	(0.431)	(0.429)	(0.372)	(0.359)	(0.595)	(0.614)
Political variables								
Leftist government			1.052**	0.984**	0.455	0.430	0.160	0.239
			(0.444)	(0.475)	(0.536)	(0.519)	(0.661)	(0.692)
Leftist gov.*US			-0.186	-0.269	-0.265	-0.401	0.0139	-0.227
			(0.617)	(0.642)	(0.613)	(0.603)	(0.711)	(0.709)
Demo-economic								
Population	0.0763***	0.0828***	0.0747***	0.0815***	0.0563***	0.0563***	0.0597***	0.0579***
	(0.0125)	(0.0134)	(0.0110)	(0.0122)	(0.0146)	(0.0139)	(0.0146)	(0.0144)
Coresidence					0.0333**	0.0293**	0.0303*	0.0246
					(0.0134)	(0.0130)	(0.0156)	(0.0161)
% over 65					4.649	1.721	6.899	3.752
					(8.661)	(8.687)	(9.627)	(9.630)
% Urban					0.0278**	0.0292**	0.0239*	0.0261*
					(0.0125)	(0.0125)	(0.0130)	(0.0138)
GDP pc					7.20e-06	-8.65e-07	1.24e-05	1.31e-06
					(1.42e-05)	(1.37e-05)	(1.45e-05)	(1.50e-05)
Rental Prices					0.000395	0.000473*	0.000264	0.000394
					(0.000274)	(0.000258)	(0.000345)	(0.000319)
Covid-related								
Days since onset in FR					0.109**	0.0804	0.144	0.0916
					(0.0511)	(0.0503)	(0.0875)	(0.0941)

Since FR onset, squared					-0.00270***	-0.00251***	-0.00296**	-0.00251*
					(0.000751)	(0.000764)	(0.00122)	(0.00129)
Health Policies								
Lockdown							0.0155	0.0219
							(0.0329)	(0.0328)
No Lockdown							-0.0764	0.0991
							(0.541)	(0.530)
Tests pc							4.417	9.645
							(25.91)	(12.07)
Beds pc							-0.122	0.0309
							(0.216)	(0.216)
Other variables								
France[9]							0.345	-0.0207
							(1.598)	(1.693)
Constant	4.983***	5.230***	4.758***	5.018***	-0.695	1.191	-0.813	0.634
	(0.322)	(0.328)	(0.353)	(0.350)	(2.818)	(2.755)	(3.591)	(3.688)
Observations	79	79	79	79	79	79	79	79
R-squared	0.374	0.403	0.430	0.443	0.660	0.690	0.669	0.698

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[9] France stopped reporting the number of tests after 88 days. We account for it by setting up the value for the number of tests per capita to zero and including a dummy for France as an additional control in our regression.

Appendix Table 1: Data definitions and sources

Variable	EU countries	US states	Year Measured	Downloaded on
Covid deaths	https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases	https://github.com/nytimes/covid-19-data/blob/master/us-states.csv	2020	August 3, 2020
DEMOGRAPHICS				
Total population, and % over 65	https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do	https://data.census.gov/cedsci/table?q=S0102&tid=ACSST1Y2018.S0102	2018	May 11, 2020
% Urban population	https://population.un.org/wup/DataQuery/	https://www.icip.iastate.edu/tables/population/urban-pct-states	2010	May 16, 2020
Intergenerational co-residence (% aged 18-34 living w their parents)	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_lvps08&	https://data.census.gov/cedsci/table?q=Young%20Adults,%2018-34%20Years%20Old,%20Living%20At%20Home%20by%20state&g=0100000US.04000.001&hidePreview=true&tid=ACSDT1Y2018.B09021&vintage=2018&layer=VT_2018_040_00_PY_D1&cid=B09021_008E	2018	April 23, 2020

ECONOMIC VARIABLES				
Rental Prices	https://www.ubs.com/microsites/prices-earnings/en/	https://www.zillow.com/research/data/	2020	May 8, 2020
Gross Domestic or State Product in dollars (per capita)	https://data.worldbank.org/indicator/NY.GDP.PCAP.CD	https://www.bea.gov/ https://www2.census.gov/programs-surveys/popest/tables/2010-2016/state/totals/nst-est2016-01.xlsx	2018	April 29, 2020
HEALTH-RELATED VARIABLES				
Number of tests*	https://ourworldindata.org/grapher/full-list-total-tests-for-covid-19	https://covidtracking.com/api	2020	June 19, 2020
Days from 1st death to lockdown	https://github.com/OlivierLej/Coronavirus_CounterMeasures	https://github.com/OlivierLej/Coronavirus_CounterMeasures	2020	April 25, 2020
Hospital beds (per 1000 inhabitants)***	https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2019_4dd50c09-en	http://ghdx.healthdata.org/record/united-states-hospital-beds-1000-population-state	2017	June 25, 2020

* The number of tests was measured 14 days prior to the number of fatalities.
** Number of days from February 15, when the first Covid death in our sample was reported in France, to the first death in a particular country.
*******Data for Bulgaria, Croatia, Romania and Serbia is from https://ourworldindata.org/