

State-level variation of initial COVID-19 dynamics in the United States: The role of local government interventions

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Introduction

The global COVID-19 (caused by the SARS-CoV-2 virus) outbreak began in Wuhan, China in late 2019 (WHO 2020). As of April 29th, 3,172,287 cases have been reported across 187 countries and regions.

Results and Discussion

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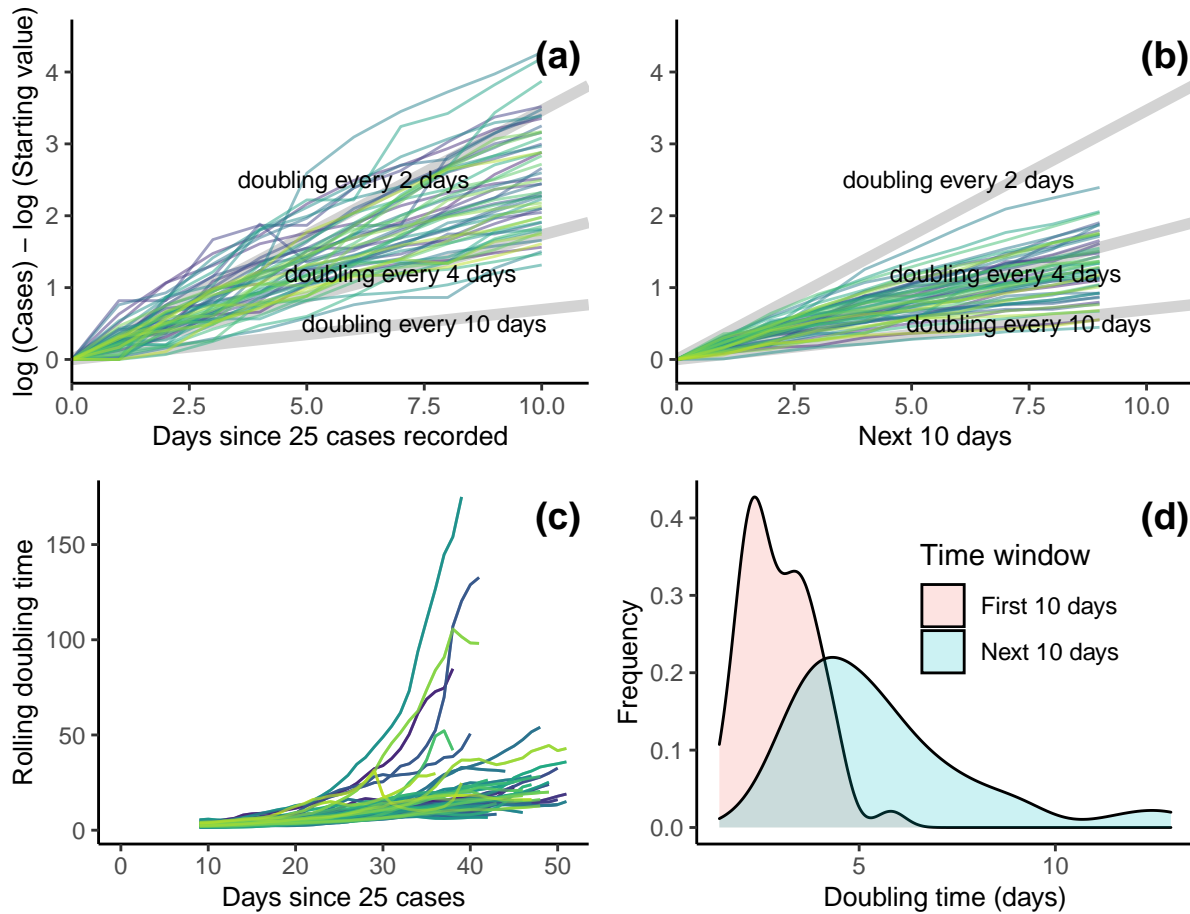


Figure 1: (a) The log number of cases over time for each individual state for the 10 days since their first day of 25 total cases. (b) The log number of cases over time for each individual state for the next 10 days. The light grey diagonal lines represent the growth trajectory for doubling times of 2, 4, and 10 days. The log number of the starting value (initial number of cases on first day when at least 25 cases were recorded) had to be subtracted on the y-axis to standardize the graph across states. (c) Rolling doubling times calculated over 10-day windows for each individual states. (d) Distributions of state-level doubling times early and more recent in the course of the outbreak.

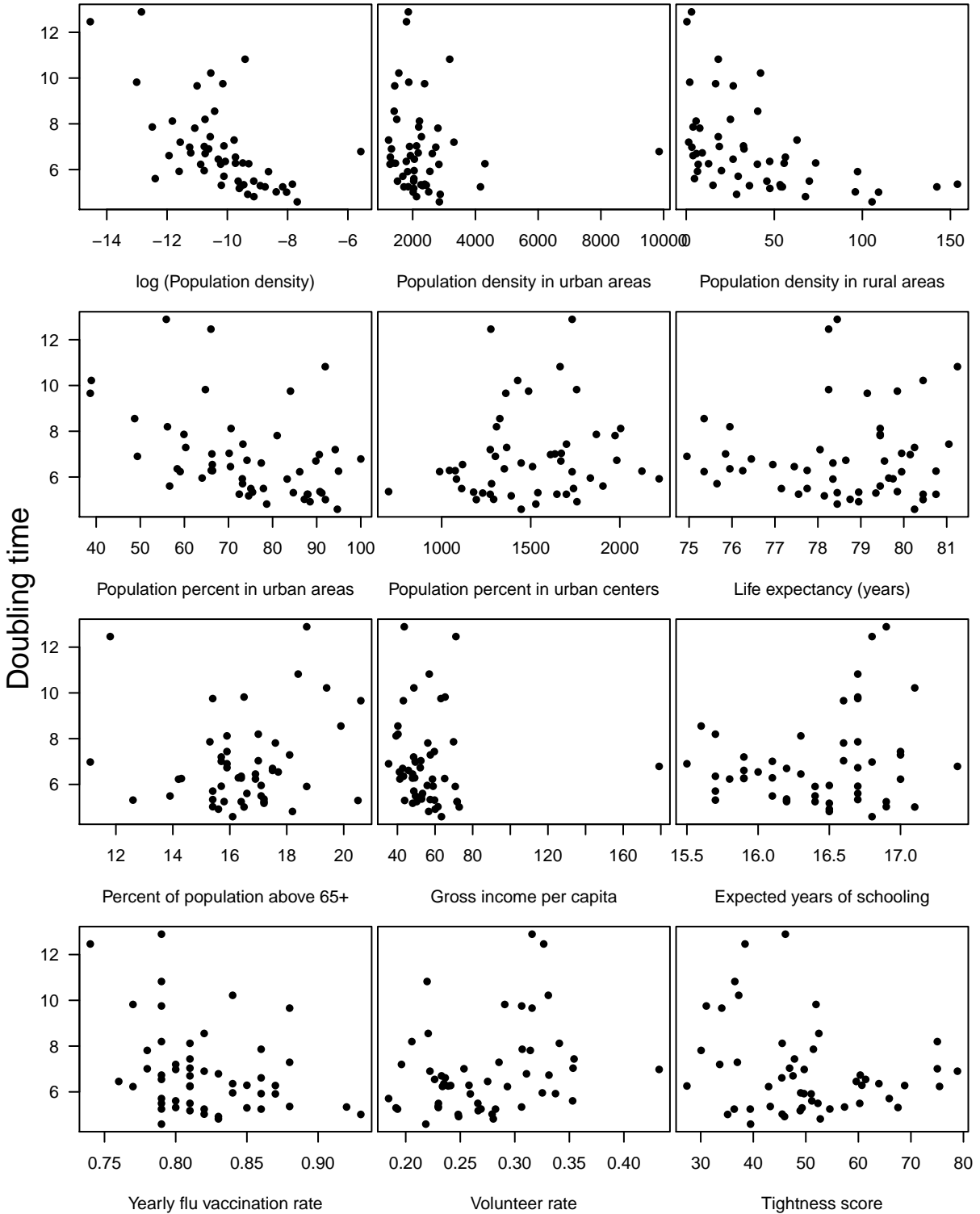


Figure 2: Doubling time (in number of days) versus (a) log (population density), (b) population density in urban areas, (c) population density in rural areas, (d) population percent in urban areas, (e) population percent in urban centers, (f) life expectancy (years), (g) percent of population above age 65, (h) gross income per capita (in 1000s USD), (i) expected years of schooling, (j) yearly flu vaccination rate, (k) volunteer rate, and (l) tightness score.

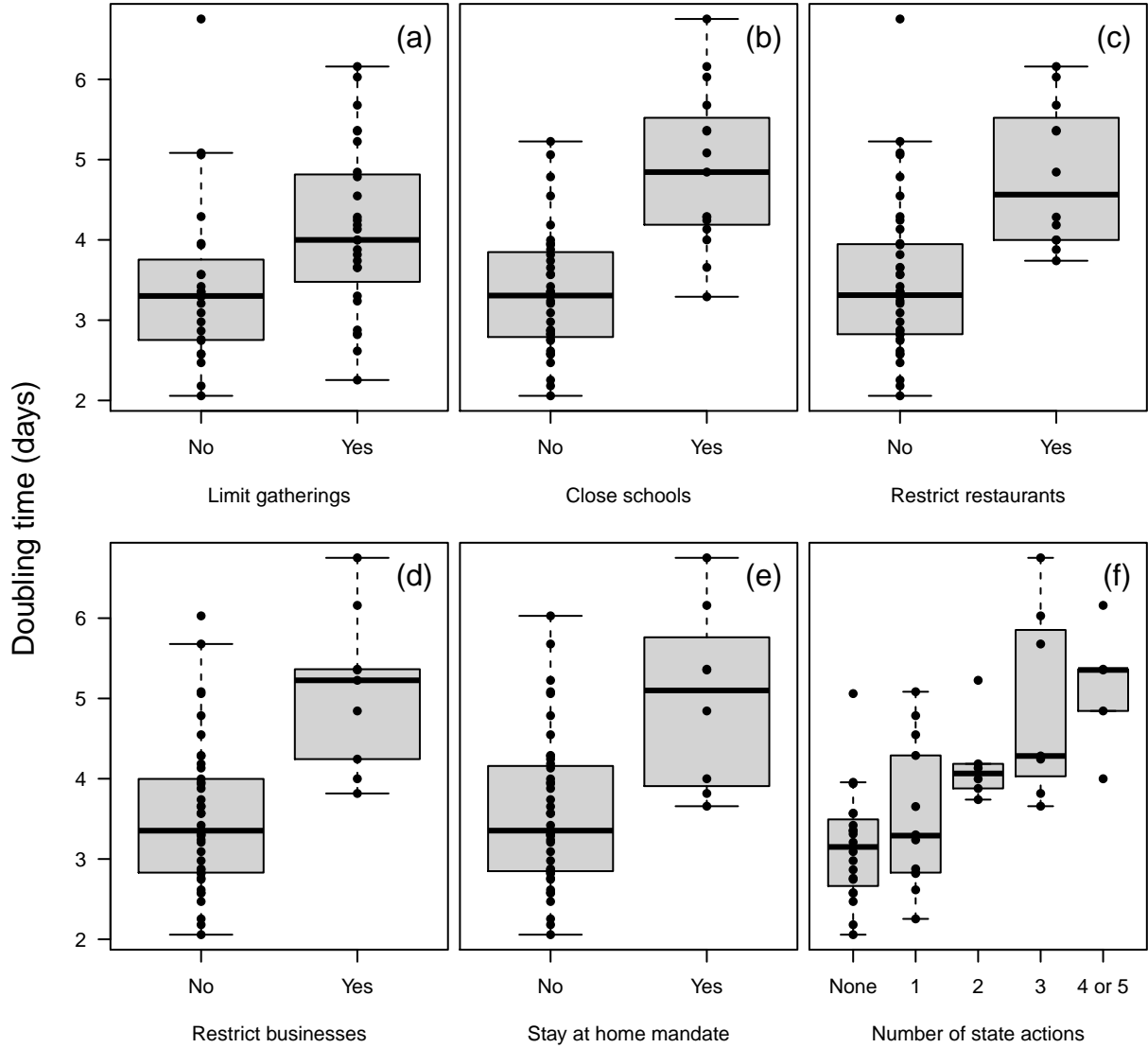


Figure 3: Doubling time (in number of days) across the US states for five different statewide government restrictions: (a) limit gatherings (usually to less than 10 people) by first day of 25 cases, (b) close public schools by first day of 25 cases, (c) restrict restaurants by first day of 25 cases, (d) restrict non-essential businesses by first day of 150 cases, (e) stay at home order by first day of 150 cases, and (f) total number of restrictions before number of cases threshold.

Table 1: Best fitting linear models (according to AIC) and corresponding parameter estimates for the doubling time both early (first 7 days since 25 cases) and for the entire time period.

	<i>Dependent variable:</i>	
	Early doubling time	Overall doubling time
Close schools		0.492** (0.037, 0.948)
Restrict restaurants		0.707*** (0.231, 1.184)
log (Population density)	−0.342*** (−0.467, −0.218)	−0.395*** (−0.540, −0.249)
Vaccination rate	11.308*** (6.914, 15.702)	
GNI per capita	0.037*** (0.021, 0.054)	
Population percent in rural areas		0.015** (0.001, 0.030)
Tightness score		−0.020*** (−0.035, −0.006)
Constant	−12.041*** (−16.384, −7.697)	0.057 (−1.520, 1.634)
Observations	50	50
R ²	0.554	0.766
Adjusted R ²	0.525	0.740
<i>Note:</i> *p<0.1; **p<0.05; ***p<0.01		

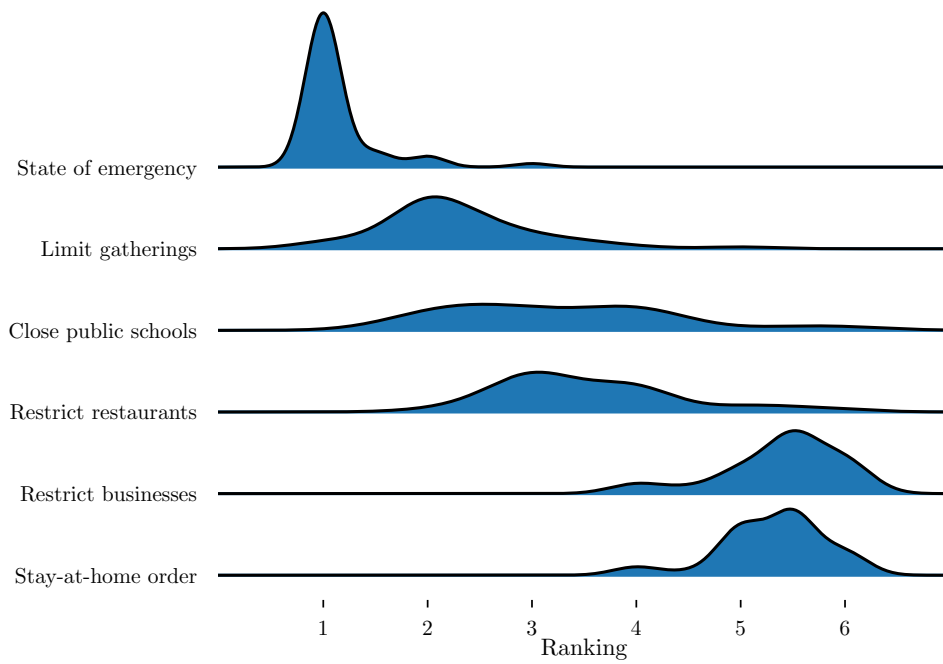


Figure 4: Rank distribution of different interventions. Per state, every intervention is given a rank from 1 to 6 depending on when it was implemented (1 being the first put into place) and ties are given an average rank (e.g. 2.5 for tied 2nd and 3rd rank).

Supplemental figures

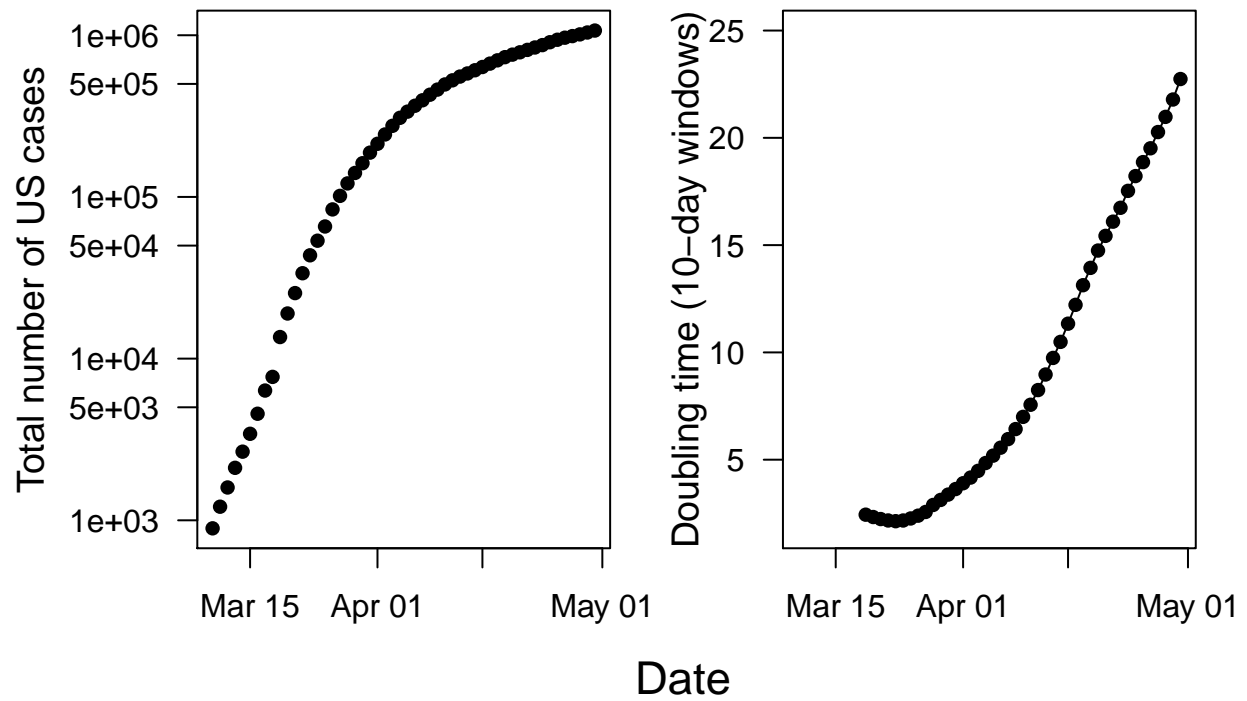


Figure S1: (Left panel) Cases versus time for the whole United States. (Right panel) Log number of cases versus time for the whole United States. The red, dashed line is the line of best fit for all the data and the blue, solid line is the line of best fit since February 29th.

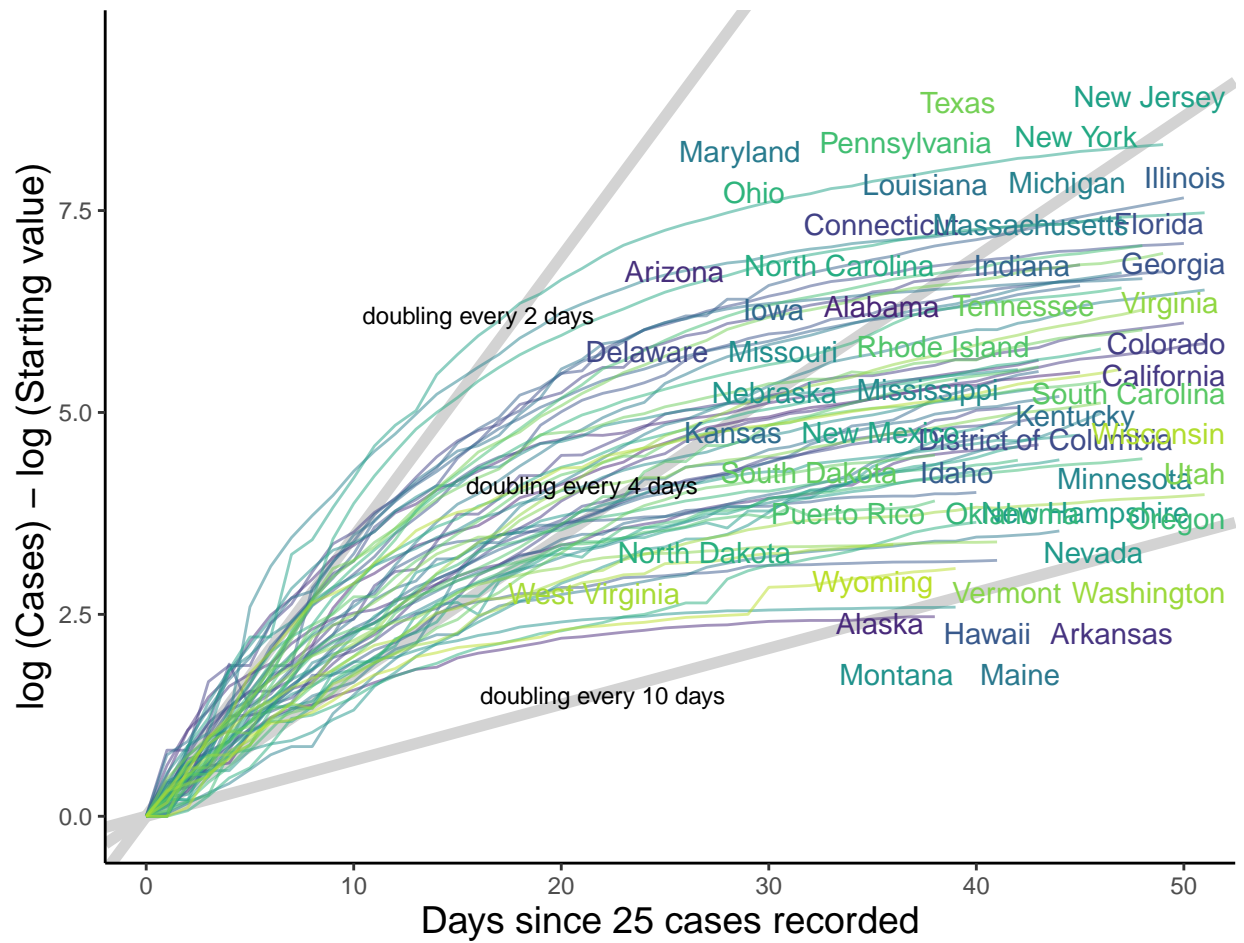
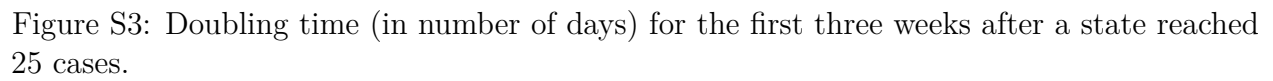


Figure S2: The log number of cases over time for each individual state that recorded more than 25 cases over at least three days. The light grey diagonal lines represent the growth trajectory for doubling times of 2, 4, and 10 days. The log number of the starting value (initial number of cases on first day when at least 25 cases were recorded) had to be subtracted on the y-axis to standarize the graph across states.



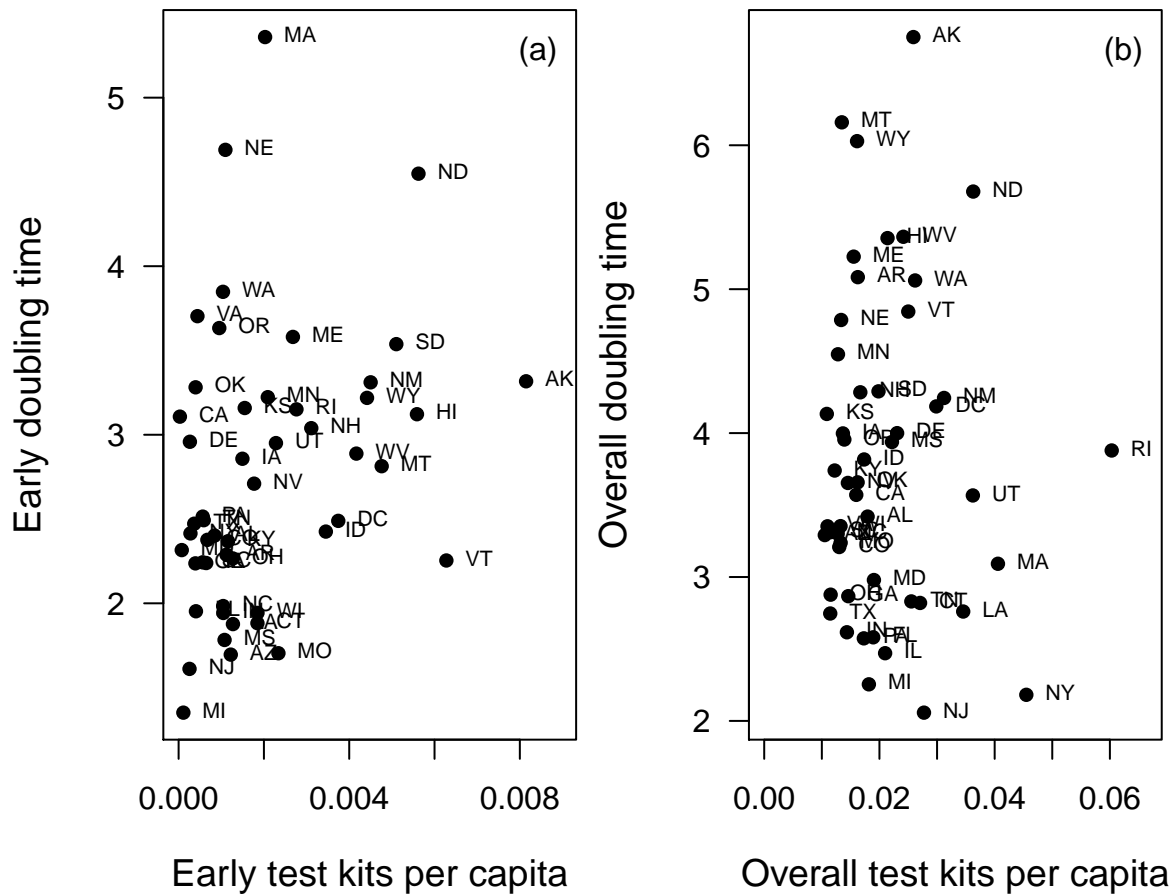


Figure S4: Doubling time (in number of days) for each US state according to their per-capita testing rates (a) early in the outbreak state (within the first week since 25 cases) and (b) for the entire time series.

WHO. (2020). *Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19)*.