

Most of these states have thus far experienced a relatively low number of [infections and deaths](#), so their vulnerabilities haven't been exposed. However, Louisiana's may soon become apparent because the number of coronavirus in the state is rising quickly.

States with the highest incidence of coronavirus look less structurally vulnerable, but their approaches to virus containment can amplify or reduce the risks from underlying vulnerabilities. New York's score is relatively low, though its urban population – mainly in the New York City metro area – and the high number of small firms are sources of risk. New Jersey, which has the nation's second-highest number of coronavirus cases, is also relatively well-positioned. Its vulnerabilities are mainly connected to its high exposure to global supply chains and its urban population. California's vulnerabilities are centered around its urban population, the prevalence of small businesses, and relatively low hospital bed capacity. However, state and local policymakers' decision to enact stricter measures than other states to contain the virus' spread (and sooner) may mitigate the risks of California's structural vulnerabilities.

Table 1: US state structural vulnerability scorecard

OE US State Structural Epidemic Vulnerability Scorecard												
State	Trade openness	Share of population 65+	Share of hospitality and tourism	Share of retail	Share of manufacturing	Share of self-employed	Share of small firms	Internet access*	Hospital beds/1,000 people*	Urban population	Average z-score	
Maine	-0.69	2.19	0.54	1.93	-0.38	2.48	2.15	0.00	0.14	-2.42	0.60	
Nevada	-0.64	-0.45	5.72	0.90	-1.33	-1.09	0.08	0.01	0.71	1.43	0.53	
Vermont	0.37	1.74	0.99	1.50	-0.41	1.99	0.76	-0.16	0.71	-2.41	0.51	
Florida	-0.48	2.10	0.82	1.17	-1.19	0.33	0.27	-0.05	0.00	1.22	0.42	
Oregon	0.00	0.61	0.01	-0.84	0.54	1.50	1.41	-1.00	1.41	0.51	0.42	
South Carolina	2.01	0.63	0.18	0.64	0.98	-0.60	-0.73	1.05	0.28	-0.51	0.39	
Louisiana	2.05	-0.56	0.08	0.34	1.74	-0.41	-0.15	1.76	-0.99	-0.03	0.38	
Idaho	-0.72	-0.31	-0.15	1.80	-0.05	0.52	1.30	0.49	0.99	-0.21	0.37	
Montana	-0.56	1.25	0.34	0.52	-0.95	2.82	1.87	0.43	-0.99	-1.23	0.35	
Hawaii	-1.44	1.01	2.77	0.57	-1.83	-0.16	0.61	-0.65	0.99	1.27	0.31	
Washington	0.26	-0.56	-0.30	2.34	-0.01	0.08	0.32	-1.68	1.27	0.73	0.25	
Michigan	2.20	0.37	-0.37	0.18	1.45	-0.80	-1.21	0.08	0.14	0.07	0.21	
Arizona	-0.32	0.56	0.18	1.06	-0.62	-0.02	-0.61	-0.64	0.99	1.12	0.17	
California	0.20	-1.16	-0.03	-0.74	-0.15	0.67	1.39	-1.11	1.13	1.48	0.17	
Mississippi	0.84	-0.33	0.08	1.90	0.97	-0.85	-0.02	2.58	-1.98	-1.68	0.15	
Rhode Island	0.66	0.41	0.26	-0.47	-0.60	-0.85	0.38	-0.42	0.71	1.19	0.13	
Kentucky	2.83	-0.07	-0.29	-0.04	1.32	-0.90	-0.77	0.90	-0.85	-1.05	0.11	
Arkansas	-0.58	0.18	-0.53	1.02	0.71	-0.60	0.22	2.64	-0.85	-1.21	0.10	
Tennessee	1.64	-0.10	0.61	0.75	0.72	-1.14	-1.73	1.11	-0.42	-0.50	0.09	
New Hampshire	0.20	0.83	0.37	0.63	0.01	0.18	0.34	-1.45	0.71	-0.92	0.09	
Minnesota	-0.38	-0.36	-0.43	-0.50	0.54	0.96	1.73	-0.81	0.14	-0.02	0.09	
New Mexico	-0.93	0.57	-0.15	-0.23	-1.43	-0.31	0.20	1.71	1.13	0.26	0.08	
Indiana	1.18	-0.43	-0.33	-0.39	3.15	-0.75	-1.88	0.37	-0.14	-0.08	0.07	
Alabama	0.51	0.25	-0.54	0.96	1.09	-1.39	-0.56	1.57	-0.71	-1.01	0.02	
New Jersey	0.94	-0.19	-0.44	-0.26	-0.60	-0.65	0.26	-0.85	0.28	1.46	0.00	
Wisconsin	-0.30	0.25	-0.57	-0.32	1.44	-0.51	-0.83	-0.17	0.71	-0.24	-0.05	
North Carolina	-0.10	-0.13	-0.30	-0.75	1.27	-0.36	-0.88	0.47	0.71	-0.52	-0.06	
Missouri	-0.77	0.21	-0.15	-0.07	0.16	0.33	0.20	0.36	-0.71	-0.22	-0.07	
Iowa	-0.59	0.28	-0.70	-0.65	1.23	1.31	-0.42	0.09	-0.57	-0.67	-0.07	
Connecticut	-1.07	0.35	-0.47	-0.84	-0.13	0.52	-0.06	-0.87	0.85	1.00	-0.07	
West Virginia	-0.60	1.86	-0.29	0.69	-0.20	-0.80	0.26	1.68	-1.70	-1.73	-0.08	
Texas	1.89	-2.11	-0.38	-0.35	0.34	-0.16	-1.64	0.09	0.42	0.77	-0.11	
Illinois	0.91	-0.47	-0.11	-1.06	0.20	-0.65	-0.87	-0.26	0.14	1.03	-0.11	
Colorado	-1.31	-1.24	0.35	-0.72	-0.89	1.45	0.22	-1.48	0.99	0.87	-0.17	
Wyoming	-1.14	0.11	0.03	-0.44	-1.11	1.01	2.21	-0.60	-1.27	-0.61	-0.18	
Kansas	-0.38	-0.34	-0.64	0.12	0.97	0.57	-1.33	0.13	-0.99	0.04	-0.18	
Ohio	0.05	0.30	-0.34	-0.14	0.99	-0.70	-2.06	-0.01	-0.28	0.30	-0.19	
Oklahoma	-0.96	-0.42	-0.45	-0.42	-0.46	1.01	-0.31	0.87	-0.28	-0.51	-0.19	
Utah	0.08	-2.87	-0.48	0.89	-0.09	-0.36	-0.24	-1.23	1.13	1.18	-0.20	
New York	-0.58	-0.04	0.02	-1.55	-1.40	-0.26	0.99	-0.16	-0.14	0.99	-0.21	
South Dakota	-1.41	0.04	-0.26	0.84	-0.31	1.89	0.76	0.38	-3.11	-1.17	-0.23	
Georgia	0.73	-1.42	-0.52	-0.47	-0.15	-0.31	-0.98	0.05	0.28	0.10	-0.27	
Pennsylvania	-0.07	0.91	-0.44	-1.11	0.05	-0.99	-1.31	0.10	-0.42	0.35	-0.29	
Delaware	0.15	1.16	-0.75	-2.03	-0.96	-1.53	0.08	-0.65	0.57	0.67	-0.33	
Massachusetts	-0.73	-0.01	-0.14	-1.88	-0.43	-0.85	0.08	-1.10	0.42	1.28	-0.34	
Nebraska	-0.90	-0.40	-0.77	-0.50	-0.10	-0.11	0.32	-0.22	-1.41	-0.03	-0.41	
Maryland	-0.64	-0.59	-0.24	-0.98	-1.08	-0.85	-0.61	-1.17	0.99	0.94	-0.42	
Virginia	-0.95	-0.55	-0.48	-0.87	-0.58	-0.90	-0.18	-0.72	0.71	0.13	-0.44	
North Dakota	0.06	-0.63	-0.87	-0.52	-0.85	0.62	0.08	-0.05	-2.40	-0.95	-0.55	
Alaska	-0.48	-2.43	-0.45	-1.61	-1.59	-0.41	0.91	-1.39	0.57	-0.53	-0.74	

* Z-score sign flipped to align with other categories so that higher number means more vulnerable
 ** Z-scores are normalized to between 0 and 1 to ease interpretation
 Note: shading reflects value (level of z-score) for each category relative to other states
 Source: Oxford Economics/Haver Analytics/BLS/National Center for Education Statistics/Kaiser Family Foundation/Iowa State University

Technical appendix: methodology

Z-scores: To ensure that the variables are comparable, we normalize the data into z-scores in each category. Z-scores thus measure relative differences across the states, making sure the values are comparable. Z-scores are calculated as $z - score = (x - \bar{x})/\sigma$, where x is the value of each state in the respective category, \bar{x} is the average value in each category, and σ denotes the standard deviation of the values in each category.

We assess the individual states' vulnerability based on the following categories:

- **Trade openness:** sum of exports and imports relative to GDP
 - Rationale: states with high exposure to supply chains will take larger hit from their disruptions due to the outbreak
- **Share of population 65+:** those aged over 65 years on total population
 - Rationale: mortality rates of COVID-19 are significantly higher for people of higher age (current estimates of case fatality rate range from 3.6% for 60-69y to 14.8% for 80y+)
- **Share of hospitality and tourism:** share of gross value added (GVA) in hotel, restaurants, and tourism of total GVA
 - Rationale: tourism and hospitality services will take a significant hit as people suspend their travel plans and social activities
- **Share of retail:** share of GVA in retail trade of total GVA
 - Rationale: retail will be hard hit by plunge in consumer discretionary outlays
- **Share of manufacturing:** share of GVA in manufacturing of total GVA
 - Rationale: manufacturing will be the most hit by supply-chain disruptions
- **Share of self-employed:** share of self-employed workers of the total number of employed workers
 - Rationale: self-employed workers don't earn wages when they self-isolate or contract the virus, leading to an immediate consumption hit
- **Share of small firms:** share of firms with 0-49 employees relative to the total number of private firms
 - Rationale: small firms are at a higher risk of bankruptcy due to lower cash buffers and more restricted access to credit
- **Internet access:** share of households with internet access
 - Rationale: as containment measures such as lockdowns are imposed, many people (especially in services) will have to work from home
- **Hospital beds for acute care:** number of curative (acute) beds per 1,000 people
 - Rationale: proxy for the capacity of the health care system to deal with a large-scale outbreak
- **Urban population:** Percentage of the total population in urban areas
 - Rationale: transmission of the coronavirus from person to person may occur more easily in urban areas