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EFFECTIVENESS OF STAY-IN-PLACE-ORDERS DURING COVID-19 PANDEMIC: EVIDENCE FROM US BORDER COUNTIES

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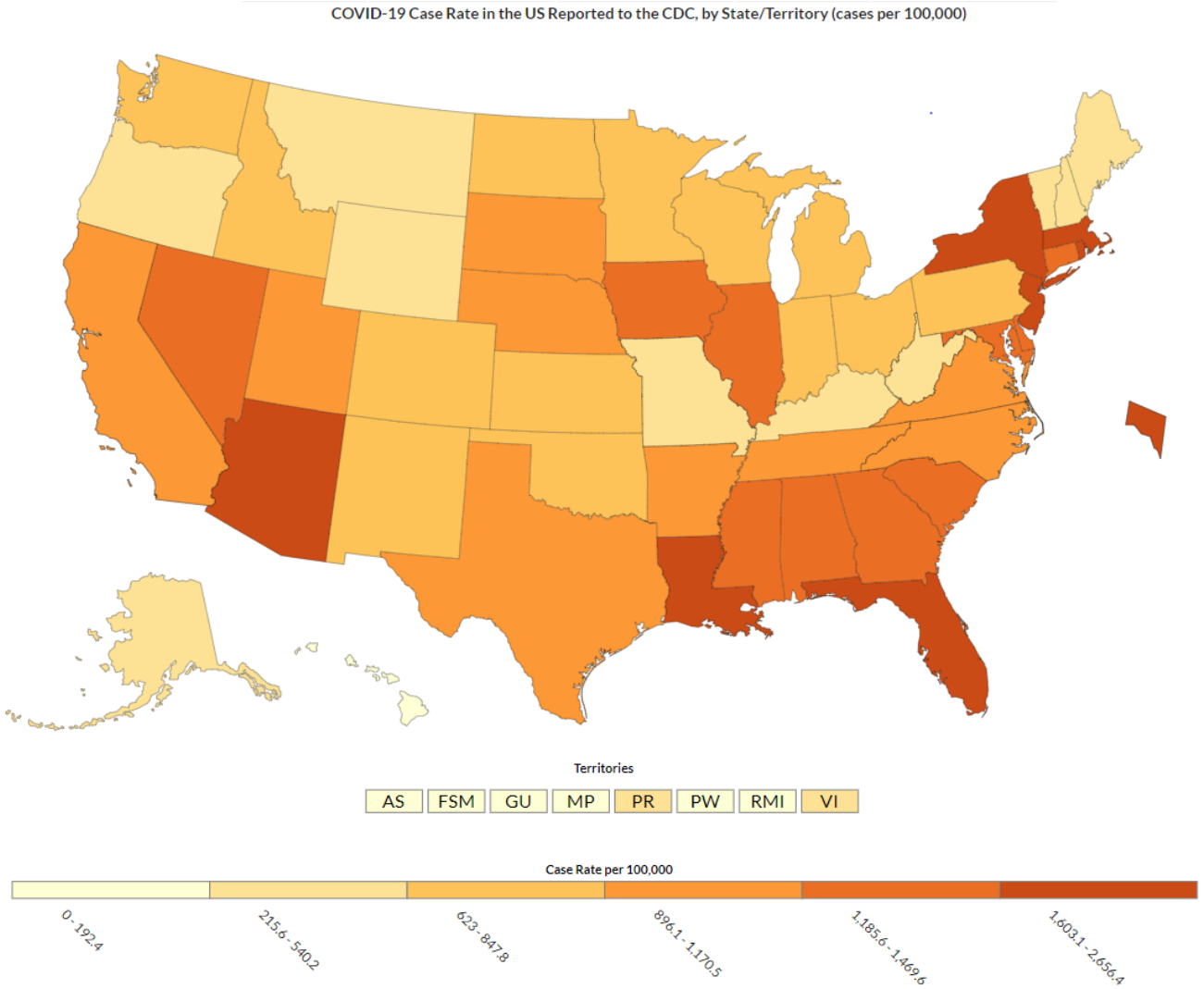
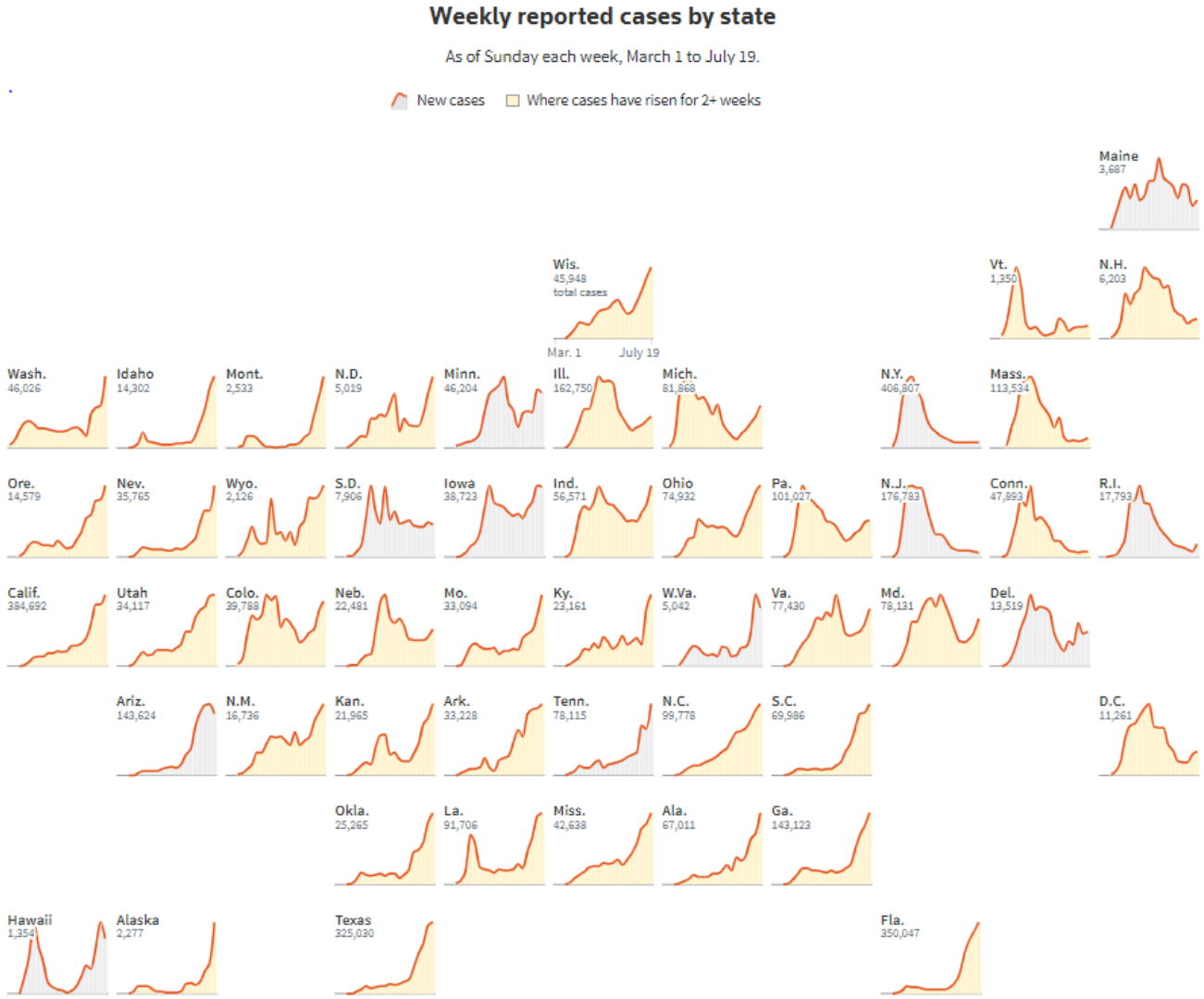
COVID-19 incidence rates by state



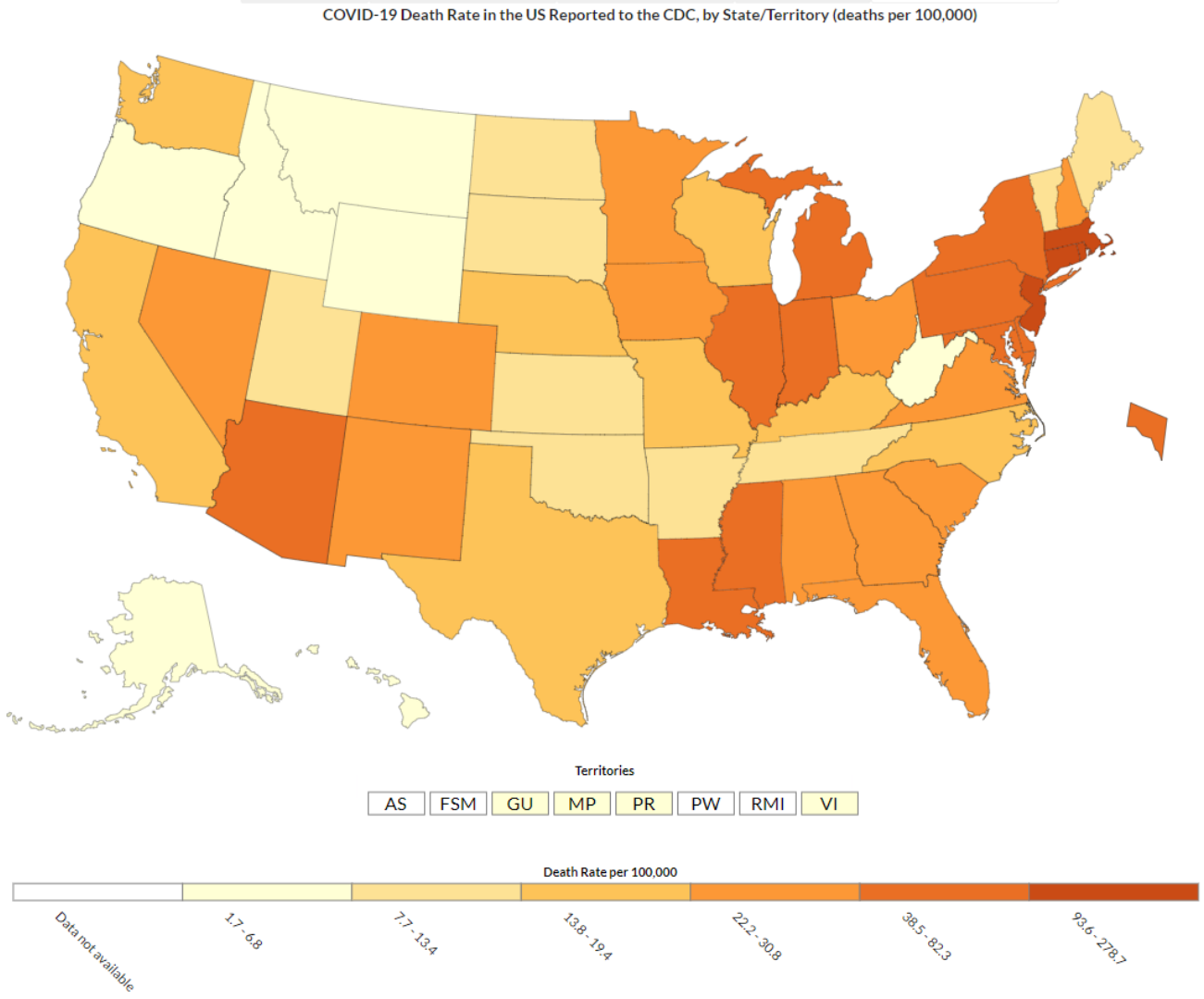
Source: CDC (as of June 20, 2020)

COVID-19 reported cases trends by state



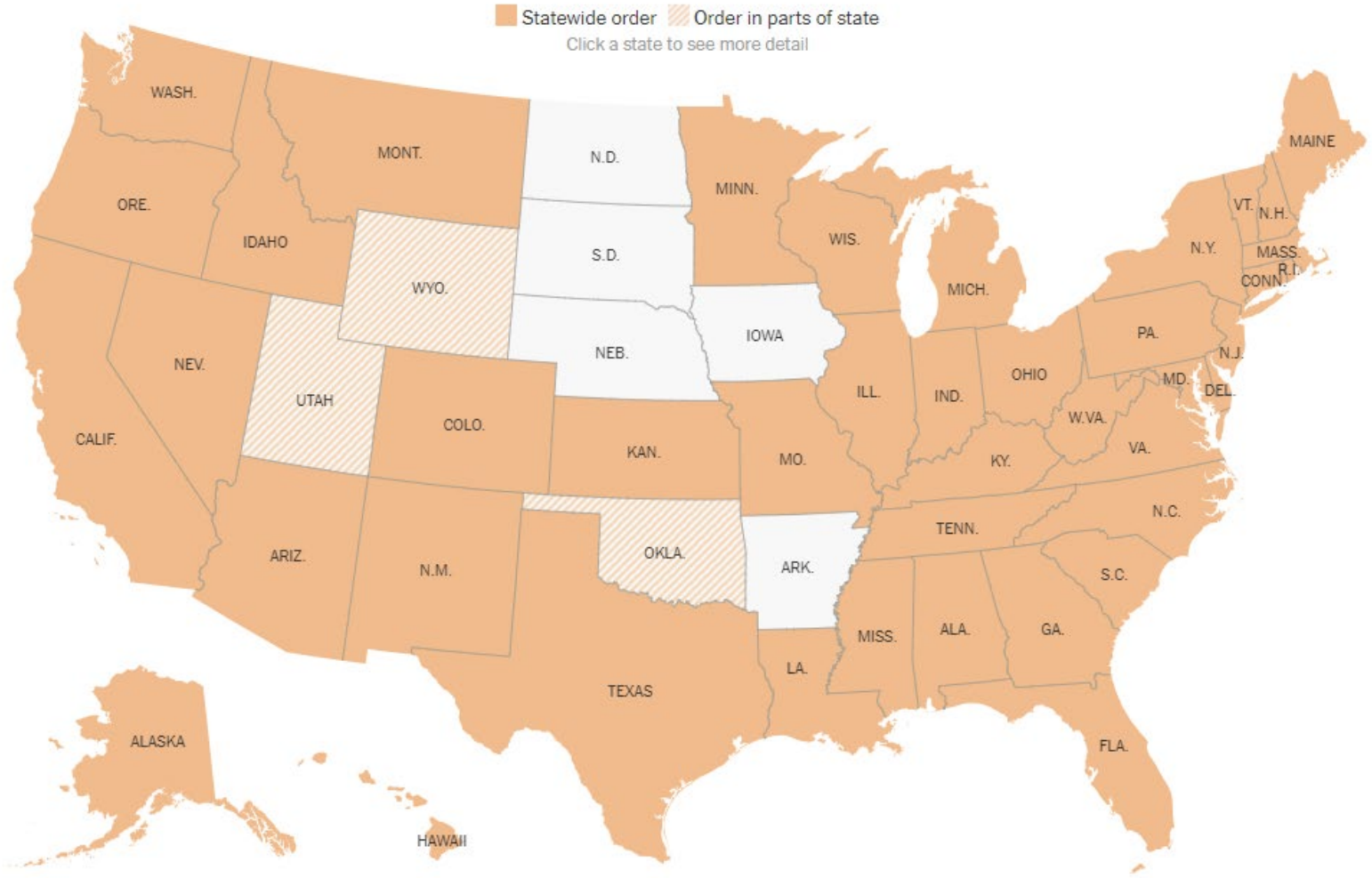
Source: Reuters (as of July 19, 2020)

COVID-19 death rates by state



Source: CDC (as of June 20, 2020)

Stay-In-Place-Orders (SIPO) by state



Source: New York Times (as of April 20, 2020)

Existing literature on effectiveness of SIPO

State-level studies

- COVID-19 cases fell 44% three weeks after SIPO (Dave et al., 2020)
- No evidence of case decline (Orazem, 2020 and Reilly, 2020)
- Decline in daily growth rate by 0.8% four days after SIPO (Sledner, 2020)
- One month after SIPO in California, COVID-19 cases declined by 125 to 219 per 100,000 population using synthetic control method (Friedson et al., 2020)

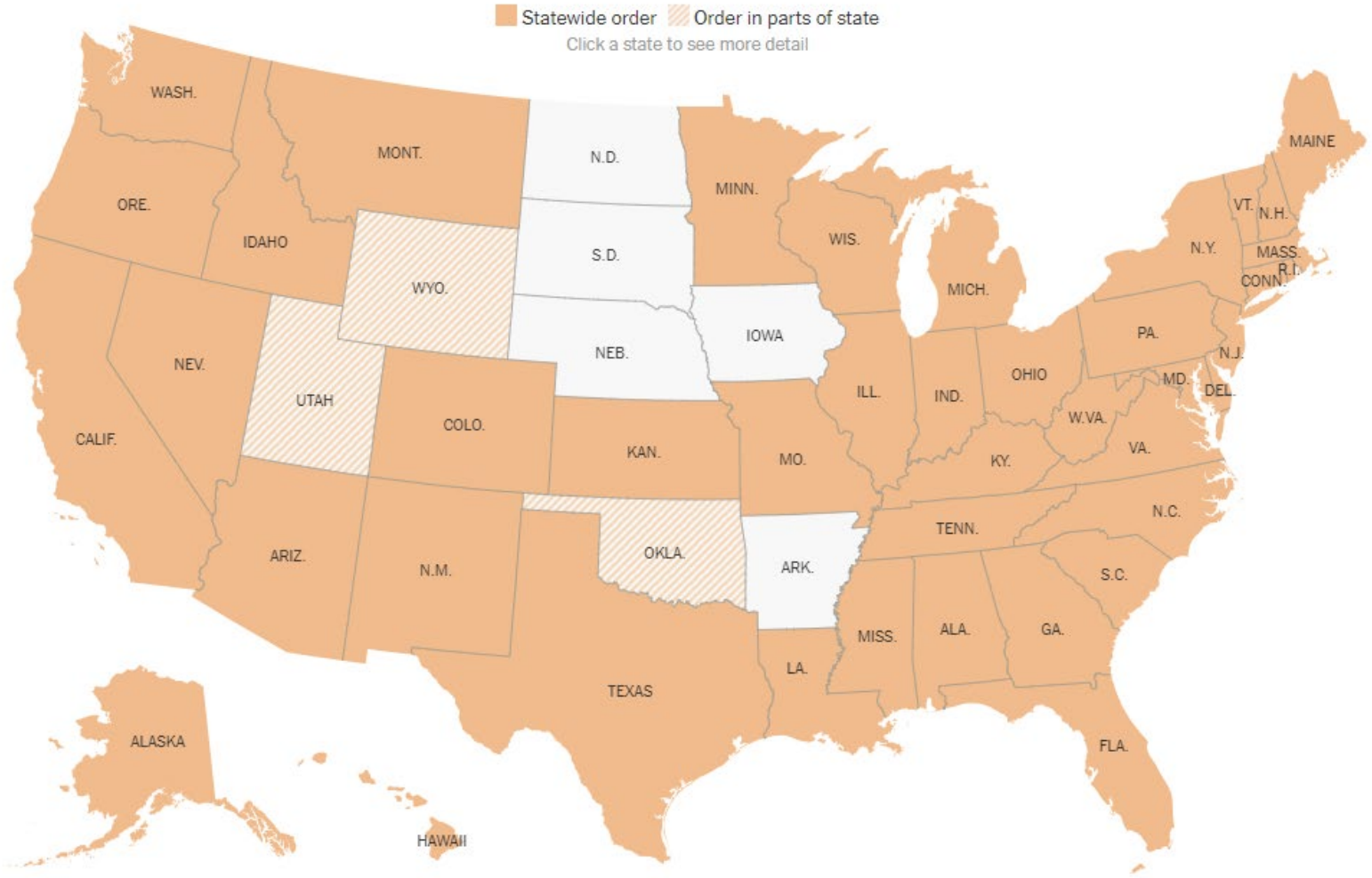
Existing literature on effectiveness of SIPO

County-level studies

- Using densely populated counties in Texas, decline of 19 to 26 percentage in daily growth, 2 ½ weeks following adoption (Dave et al. 2020)
- Using county data, SIPO lowered daily growth rate by 5.4, 6.8, 8.2, and 9.1 percentage points after 1–5 days, 6–10 days, 11–15 days, and 16–20 days respectively (Courtemanche et al., 2020)
- Using border counties in Iowa and Illinois, SIPO in IL was associated with reduction in cases by −0.51, −1.15, and −4.71 per 10,000 residents after 10, 20, and 30 days, respectively.

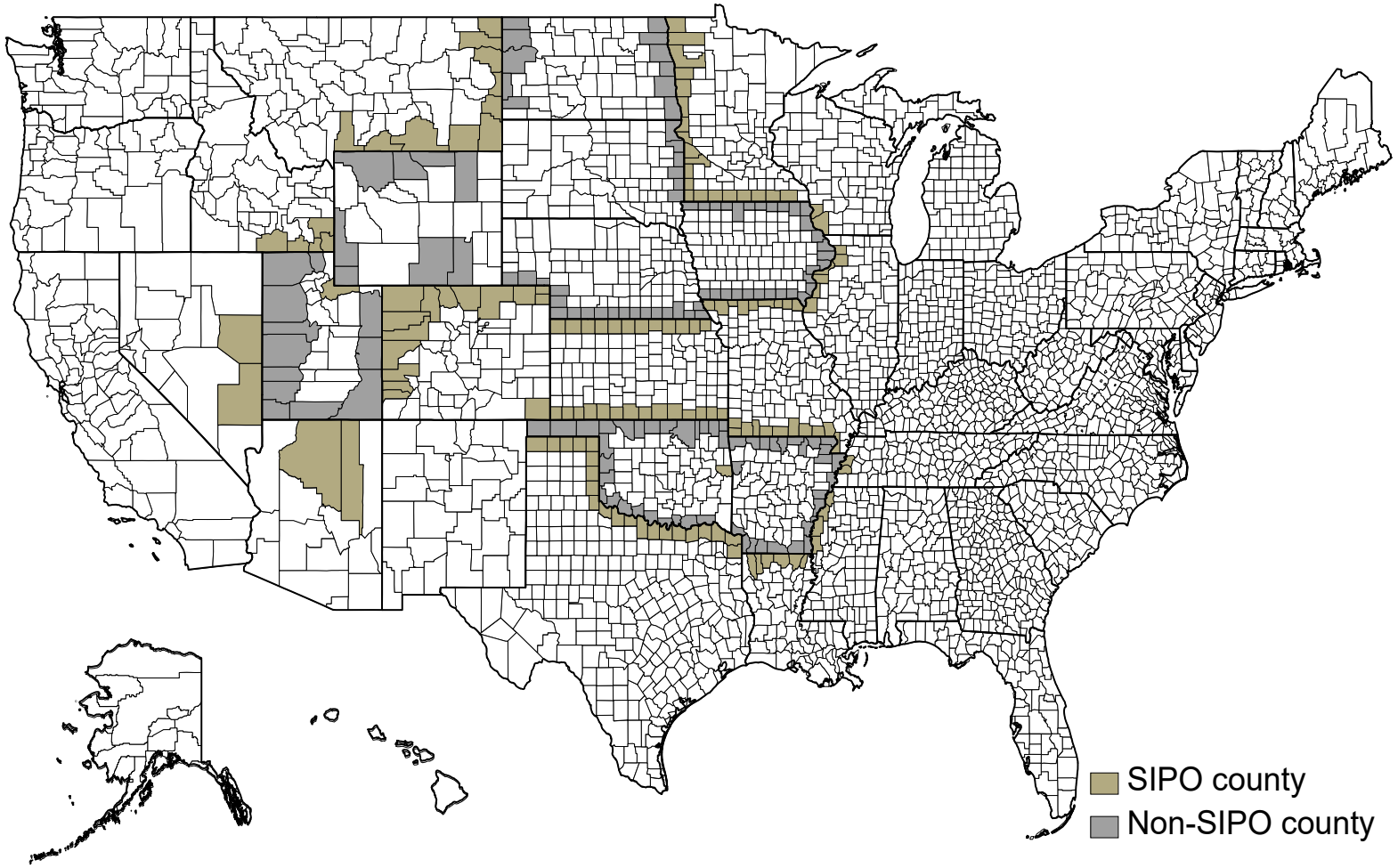
Overall, studies till date have focused on state- ,county-, and high population density counties with effect sizes varying across studies

Stay-In-Place-Orders (SIPO) by state



Source: New York Times (as of April 20, 2020)

Empirical design – Border county pair analysis



Treated (SIPO) states include Arizona, Colorado, Idaho, Illinois, Kansas, Louisiana, Minnesota, Missouri, Mississippi, Montana, Nevada, Tennessee, Texas, Wisconsin. We also include Sequoyah county (Oklahoma) and Summit County(Utah) in treated group as they implemented SIPO

Control (non-SIPO) states include Arkansas, Iowa, North Dakota, Nebraska, Oklahoma (rest of border counties), South Dakota, Utah (rest of border counties), Wyoming.

Data and Sample

- Daily COVID-19 incidence rate at county level from USAFacts
- SIPO effective dates from New York Times COVID-19 portal
- Economic / Demographic / Health variables from County Health Rankings, BEA, ACS
- Balanced panel of counties from March 1st 2020 to April 25th 2020
- Treated group – Counties from states that implemented SIPO
- Control group – Counties from non-SIPO state that borders with at least one treated state
- We create 182 county pairs and 15,568 county-day observations

Empirical model - Controls for spatial heterogeneity between county pairs

Following Dube, Lester, and Reich (2010) and Peng, Guo, and Meyerhoefer (2019), we use the following specification:

$$\Delta Y_{(cm),d} = \alpha_1 \, SIPO_{(cm),d} + \alpha_2 X_{(cm)} + County\ pair_{(cm)} + \lambda_d + \varepsilon_{(cm)d} \qquad (1)$$

Where c is the county, m is the adjacent county across the state border, and d is the day.

Following Courtemanche et al. (2020), our outcome variable, ΔY, represents change in natural log of COVID-19 cumulative incidence cases in a county between day d (current day) and previous (day d-1).

$X_{(cm),t}$ is a vector of county-level economic, demographic, and health related control variables.

We include county-pair fixed effects ($County\ pair_{(cm),t}$) and day fixed effects (λ_d)

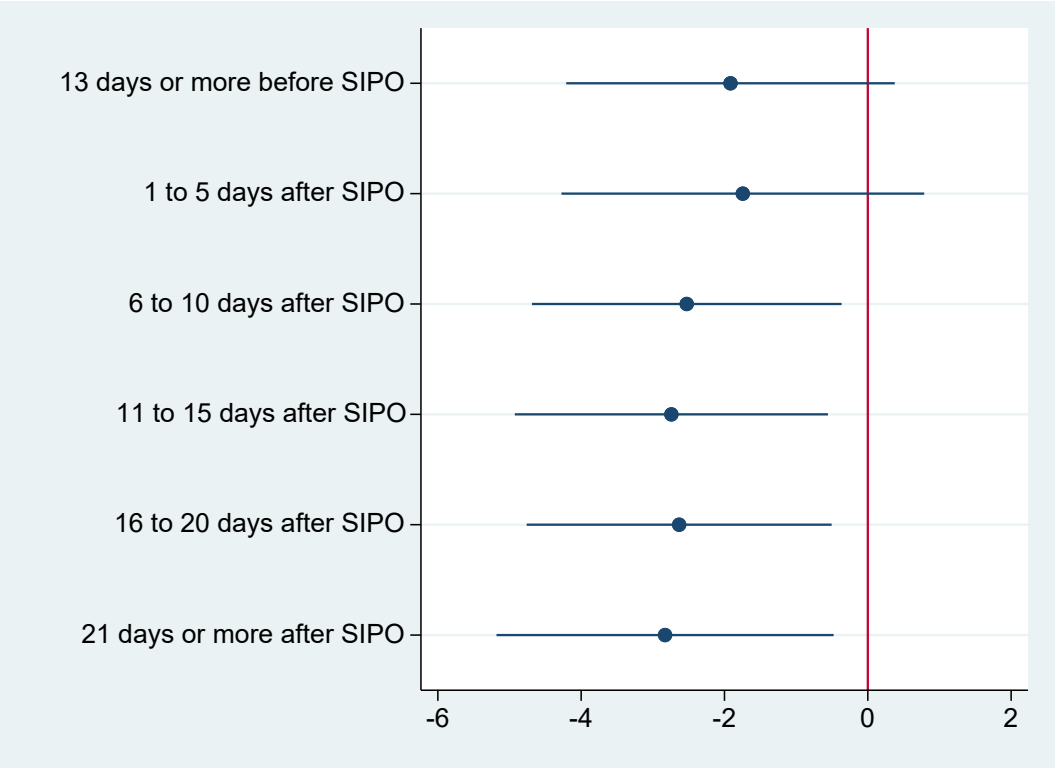
We cluster our standard errors by county-pair × state × day

Empirical model to find effects by different cut-offs:

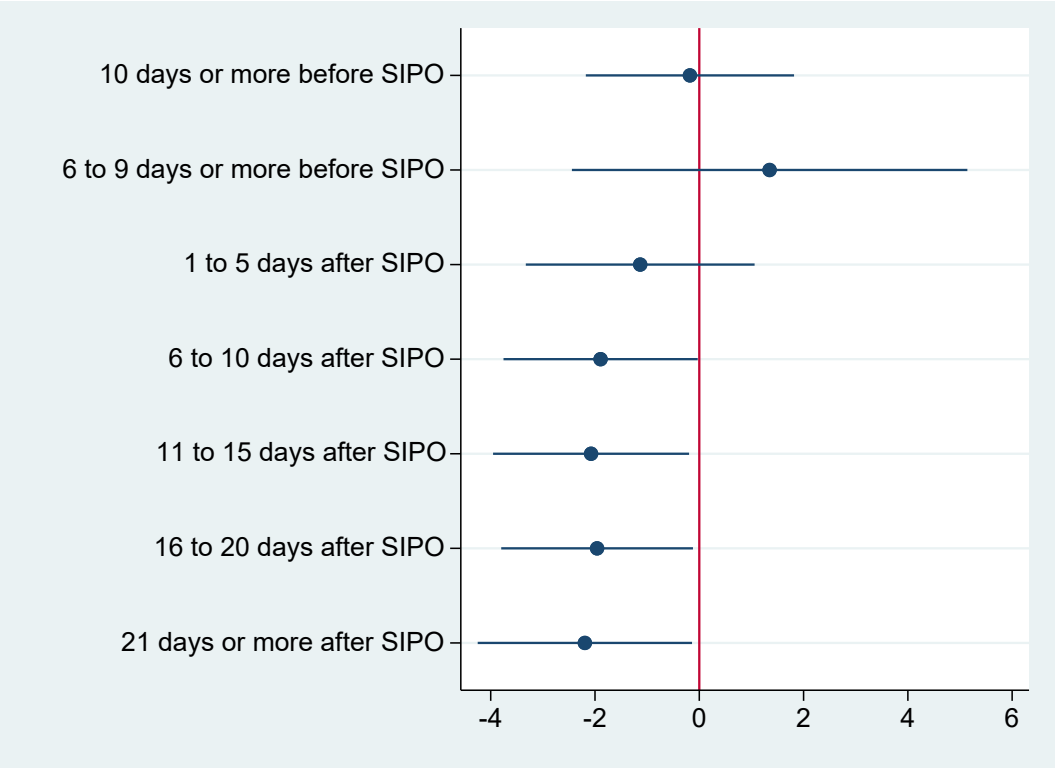
$$\Delta Y_{(cm),d} = \pi_1 \, SIPO_{(cm),1d\leq 5d} + \pi_2 \, SIPO_{(cm),6d\leq 10d} + \pi_3 \, SIPO_{(cm),11d\leq 15d}$$
$$+\pi_4 \, SIPO_{(cm),16d\leq 20d} + \pi_5 \, SIPO_{(cm),\geq 21d} + \delta_6 X_{(cm)} + County\ pair_{(cm)} + \lambda_d + \mu_{(cm)d}$$

(2)

Event study: 1 to 12 days before SIPO as reference



Event study: 1 to 5 days before SIPO as reference



Descriptive statistics

Variables	Non-SIPO state (N=7,560 county days)		SIPO state (N=8,008 county days)	
	Mean	Std. Dev.	Mean	Std. Dev.
Daily COVID-19 exponential incidence growth rate	3.3554	12.7239	3.5858	13.1542
Log of Real GDP in 2018	13.3499	1.1248	13.2146	1.1585
Unemployment rate in 2018	3.2611	1.0485	3.6404	1.3727
Log of Median Household Income in 2018	10.8222	0.1888	10.8064	0.1994
GINI inequality Index 2018	0.4377	0.0353	0.4385	0.0331
Share of population age 65 and over in 2018	19.7745	4.4273	20.0742	4.4175
Share of Black/African American population in 2018	5.1087	11.7445	5.6495	13.9133
Share of the Hispanic population in 2018	6.9834	6.6186	9.8735	11.4788
Share of female population in 2018	49.7384	1.6119	49.6649	1.8486
Share of population in rural areas in 2010	64.6238	29.6709	69.2361	28.8301
Social association rate in 2017	13.6083	7.3380	15.3052	8.9737
Share of uninsured in 2017	11.5696	5.0811	13.1217	5.7985
Percentage fair or poor health in 2017	16.9711	4.8152	17.2410	4.7445
Share of smokers among the population in 2017	16.7252	3.2169	16.9307	3.5984
Share of adults who are obese in 2016	33.9037	4.6683	32.0881	5.8326

Main results: Effect of SIPO on COVID-19 daily incidence growth rate

VARIABLES	(1) Daily growth rate	(2) Daily growth rate	(3) Daily growth rate	(4) Daily growth rate
SIPO state	-1.662**	-1.702**	-1.928**	-1.994**
	(0.751)	(0.782)	(0.816)	(0.835)
County-pair fixed effects	Yes	Yes	Yes	Yes
Day fixed effects	Yes	Yes	Yes	Yes
Regional Economic controls	No	Yes	Yes	Yes
Regional demographic controls	No	No	Yes	Yes
Regional health controls	No	No	No	Yes
Standard errors clustered by:				
County-pair × State × Day	Yes	Yes	Yes	Yes
Observations	15,568	15,568	15,568	15,568
R-squared	0.141	0.143	0.144	0.144

Robust standard errors clustered by County-pair × State × Day in parentheses. All models are weighted by county population.
*** p<0.01, ** p<0.05, * p<0.1

Effects by cut-offs post -SIPO

VARIABLES	(1) Daily growth rate
1-4 days after SIPO	-1.247
	(1.220)
6-10 days after SIPO	-1.967**
	(0.988)
11-15 days after SIPO	-2.142**
	(0.983)
16-20 days after SIPO	-2.027**
	(0.949)
21 or more days after SIPO	-2.274**
	(1.093)
Observations	15,568
R-squared	0.144

Robust standard errors clustered by County-pair × State × Day in parentheses. All economic, demographic, and health controls are included. Models are weighted by county population.
*** p<0.01, ** p<0.05, * p<0.1

Robustness tests

VARIABLES	(1) *Original model Mar 1st to Apr 25th* Daily growth rate	(2) *Feb 15th to Apr 25th* Daily growth rate	(3) *Mar 15th to Apr 25th* Daily growth rate	(4) *Jan 22nd to Apr 25th* Daily growth rate	(5) *Original model* Inverse hyperbolic sine daily growth rate	(6) *Original model* Inverse hyperbolic sine daily growth rate
SIPO state	-1.994**	-1.423**	-2.393**	-1.007*	-2.249**	
	(0.835)	(0.661)	(1.112)	(0.552)	(1.015)	
1-5 days after SIPO						-1.396
						(1.509)
6-10 days after SIPO						-2.303*
						(1.194)
11-15 days after SIPO						-2.467**
						(1.155)
16-20 days after SIPO						-1.977*
						(1.150)
21 or more days after SIPO						-2.442*
						(1.296)
Observations	15,568	19,738	11,676	26,132	15,568	15,568
R-squared	0.144	0.164	0.123	0.181	0.129	0.129

Robust standard errors clustered by County-pair × State × Day in parentheses. All economic, demographic, and health controls are included. Models are weighted by county population.
*** p<0.01, ** p<0.05, * p<0.1

Other tests

- Estimates do not vary much by differences in demographic/economic/health infrastructure
  - No heterogeneity in outcomes by prior income inequality or prior unemployment rates. Suggestive evidence of SIPO in higher GDP counties had lower COVID-19 incidence rates.
  - Negligible effects across regional demographic characteristics (Race/Elderly population/prior social association rates)
  - Net interaction of regional health had negligible effects on COVID_19 incidence (prior primary care physician availability / prior death rates / prior preventable hospitalizations)
- Analysis with census division yielded consistent results

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Summary

- Implementation of SIPO was associated with a 1.99 percentage points reduction in day-to-day growth rate of COVID-19 incidence relative to vross-border county without SIPO
- We find negative, but smaller effects compared to existing studies
- Our empirical design makes it feasible to include only states from southern, mid-west, and mountain regions in the US
- Our study further adds to the ongoing evidence on SIPO and COVID-19 decline rates to further improve the generalizability of the estimates

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Working paper can be downloaded from:
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3614187