May 29, 2020 11:20 AM GMT

alphawise α

MORGAN STANLEY & CO. LLC

Matthew Harrison
EQUITY ANALYST
Matthew.Harrison@morganstanley.com +1 212 761-8055

Kostas Biliouris, Ph.D.
RESEARCH ASSOCIATE
Kostas.Biliouris@morganstanley.com +1 +1-212-761-1648

Zhen Zeng, Ph.D.
RESEARCH ASSOCIATE
Zhen.Zeng@morganstanley.com +1 +1-212-761-2745

Connor Meehan
RESEARCH ASSOCIATE
Connor.Meehan@morganstanley.com +1 212 761-8266

Biotechnology

North America
IndustryView **In-Line**

Biotechnology | North America

COVID-19: Reopening Tracker

We provide tracking metrics for US States and Ex-US countries which are re-opening. As we have highlighted, open States have a flat or increasing number of new cases compared with closed States and European countries. Aggregate plots are below while individual State/Country plots are inside.

Reopening regions and how are their metrics tracking

United States

Below we provide the list of which states are open or closed. We acknowledge that some judgement is required, but generally speaking states where the stay-at-home order has expired or been replaced with a "stay safer" order, we have noted as open. We have noticed a particular uptick in the number of non-essential businesses switching from 'Partially open with limits' (yellow) to 'Open with few restrictions' (green), and continued opening of bars and restaurants with occupancy limits (yellow green). We also note the extension of the State of Emergency order does not necessarily mean a state is closed.

Exhibit 1: U.S. State-level Reopening Status Tracker

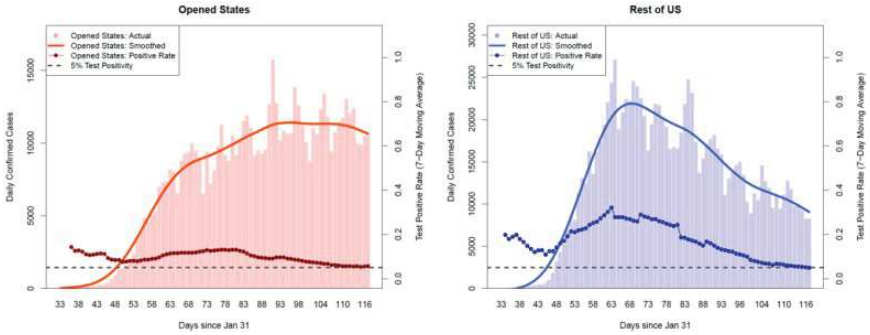
Jurisdiction	Open/Closed	Schools	Public Gatherings	Non-Essential Businesses	Parks/Public Facilities	Bars and Restaurants	Expiry of Most Recent Order
Alabama	Open						7/3/2020
Alaska	Open						Indefinitely
Arizona	Open						Indefinitely
Arkansas	Open						Indefinitely
Colorado	Open						6/1/2020
Connecticut	Open						Indefinitely
Florida	Open						Indefinitely
Georgia	Open						6/12/2020
Hawaii	Open						5/31/2020
Idaho	Open						Indefinitely
Indiana	Open						6/13/2020
Iowa	Open						6/25/2020
Kansas	Open						6/10/2020
Kentucky	Open						Indefinitely
Maryland	Open						Indefinitely
Minnesota	Open						Indefinitely
Missouri	Open						6/15/2020
Montana	Open						Indefinitely
Nebraska	Open						5/31/2020
Nevada	Open						5/30/2020
New Hampshire	Open						5/31/2020
North Carolina	Open						6/26/2020
North Dakota	Open						Indefinitely
Ohio	Open						5/29/2020
Oklahoma	Open						5/30/2020
Rhode Island	Open						5/31/2020
South Carolina	Open						Indefinitely
South Dakota	Open						5/31/2020
Tennessee	Open						6/30/2020
Texas	Open						6/3/2020
Utah	Open						6/5/2020
Vermont	Open						6/15/2020
Virginia	Open						6/10/2020
West Virginia	Open						Indefinitely
Wisconsin	Open						Invalidated
Wyoming	Open						5/31/2020
California	Closed						Indefinitely
Delaware	Closed						6/1/2020
District of Columbia	Closed						6/8/2020
Illinois	Closed						5/30/2020
Louisiana	Closed						6/5/2020
Maine	Closed						5/31/2020
Massachusetts	Closed						Indefinitely
Michigan	Closed						6/12/2020
Mississippi	Closed						6/1/2020
New Jersey	Closed						Indefinitely
New Mexico	Closed						5/31/2020
New York	Closed						5/28/2020
Oregon	Closed						7/6/2020
Pennsylvania	Closed						6/4/2020
Washington	Closed						5/31/2020

Open with few Restrictions
Partially Open with Limits
Closed
Open with Occupancy Limit

Source: Morgan Stanley Research

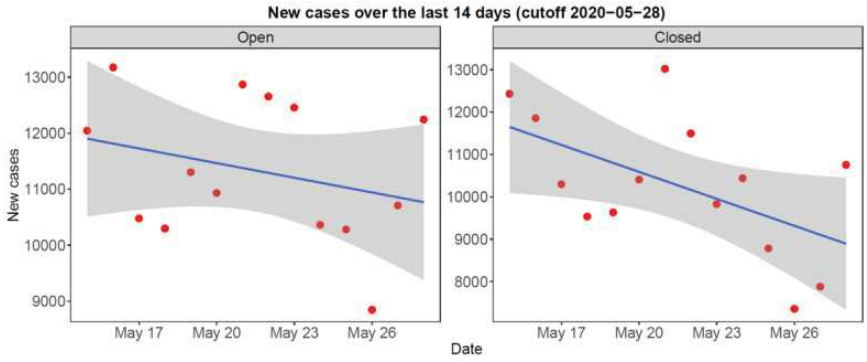
Daily cases, testing positivity rate, and volume of tests: By comparing the opened states vs. closed states in the US, daily new cases appear to be in plateau in opened states, while a clear decreasing trend is observed among the closed states. This remains a concern as we noted previously (see here). Although the daily testing positivity rate among both opened and close States is close to the ideal level of ~5%, the volume of tests has decreased over the course of this week, and the decrease is more dramatic in the opened States. The daily testing positivity rate in the opened States is now above 5% again. We note that there are still a number of States reporting increasing daily new cases over the past 7 days (see States in red Exhibit 30). ***Importantly, most of the reopened States have experienced another bump or a prolonged flat period in daily cases after initial reopening date. We note that 4-6 weeks after the reopening is needed to fully assess any trends.*** We provide regional plots for each US state in the Individual plots for each region section.

Exhibit 2: Daily cases and testing positivity rate of the US opened states vs. closed states (aggregated)



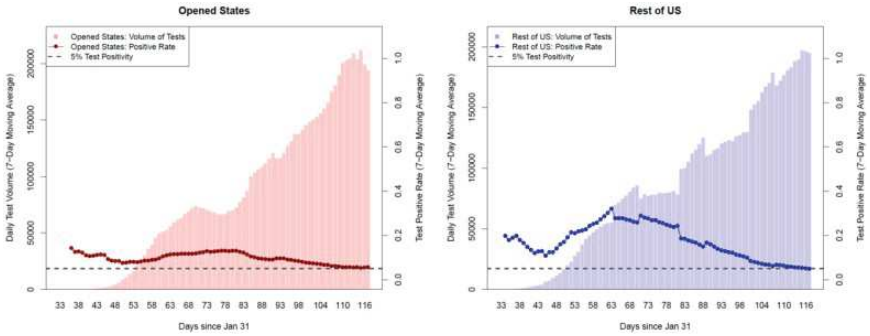
Source: Morgan Stanley Research, https://covidtracking.com/, NY Times.

Exhibit 3: Number of new cases for open (left) versus closed (right) US states. The red dots represent the real data, while the blue line reflects a smoothing line through the data and the gray area shows the confidence intervals.



Source: Morgan Stanley, The COVID Tracking Project

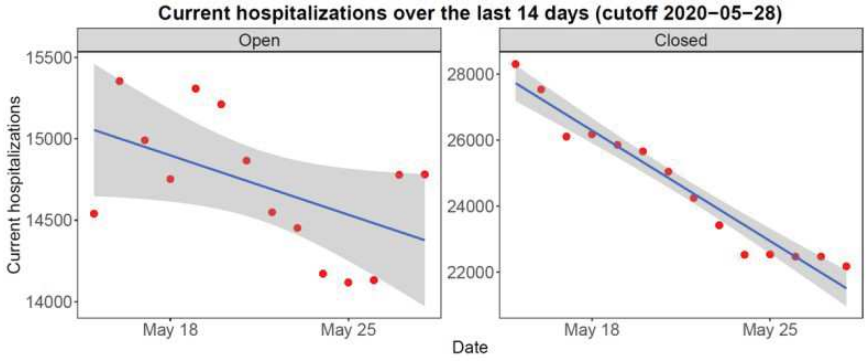
Exhibit 4: Volume of tests and testing positivity rate of the US opened states vs. closed states (aggregated)



Source: Morgan Stanley Research, https://covidtracking.com/.

Number of current hospitalizations: The number of current hospitalizations in open states (left) is declining slower compared to closed states (right). Recall that the current hospitalization of closed states was exhibiting an upward trend last week (our note here). We highlight that states with an increasing trend in the number of hospitalized patients over the past 7 days include AR, AZ, KY, ME, MN, NC, ND, NM, OK, SD, VT, WA, WI, and WY (see plots inside). Note that some states do not make hospitalization data available.

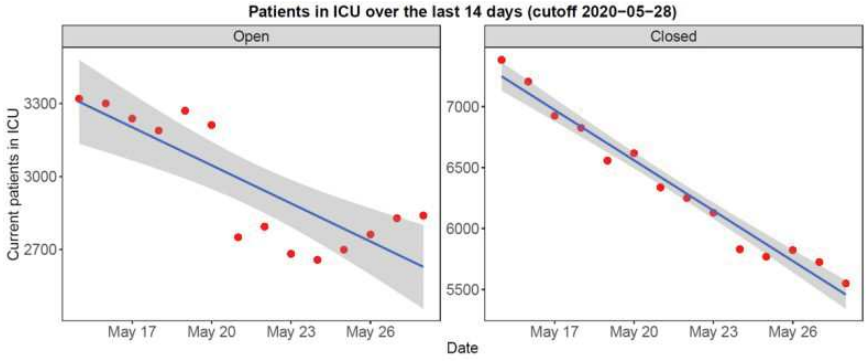
Exhibit 5: Number of current hospitalizations for open (left) versus closed (right) US states. The red dots represent the real data, while the blue line reflects a smoothing line through the data and the gray area shows the confidence intervals.



Source: Morgan Stanley, The COVID Tracking Project

Number of patients in ICU: In open states, the number of ICU patients appears lower that 14 days ago, although it has remained nearly unchanged over the last 8 days. On the other hand, in the closed states the number of ICU patients is declining rapidly and the variability around the data is low. We highlight that states with an increasing trend in the number of ICU patients over the past 7 days include AZ, CA, ME, MN, OK,and WI (see plots inside). Note that most of the states do not make ICU data available.

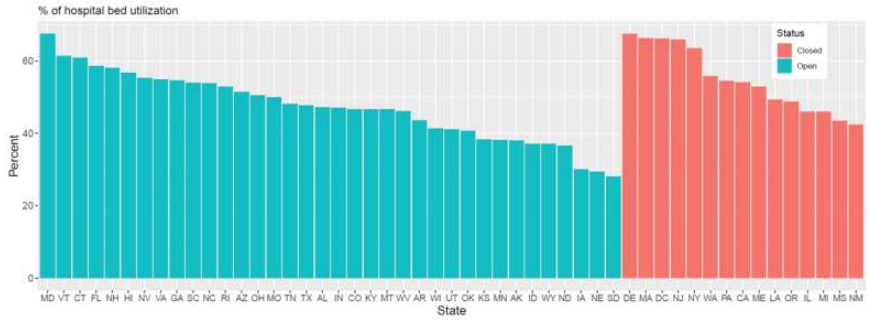
Exhibit 6: Number of patients in ICU for open (left) versus closed (right) US states. The red dots represent the real data, while the blue line reflects a smoothing line through the data and the gray area is the confidence interval.



Source: Morgan Stanley, The COVID Tracking Project

Percentage of hospital bed utilization: Overall, opened States demonstrate a lower level of hospital bed utilization compared to closed States. While only 3 opened States, MD, VT and CT have more than 60% hospital bed utilization, 5 closed States, DE, MA, DC, NJ and NY have more than 60% hospital bed utilization.

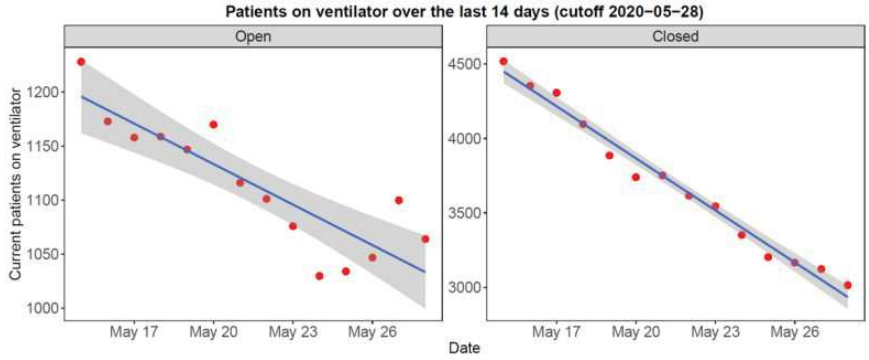
Exhibit 7: Percentage of hospital bed utilization for open (left) versus closed (right) US States.



Source: Morgan Stanley Research, AlphaWise, University of Maryland COVID-19 Impact Analysis Platform.

Number of patients on ventilator: The number of patients on ventilator in Exhibit 8 appears to be decreasing in both the open and closed states, although we note that the rate of decrease in closed states is faster (and less variable) than the open states. We underscore that states with an increasing trend in the number of patients on ventilator over the past 7 days include AR, AZ, ME, and OR (see plots inside). Recall that most of the states do not make ventilator data available.

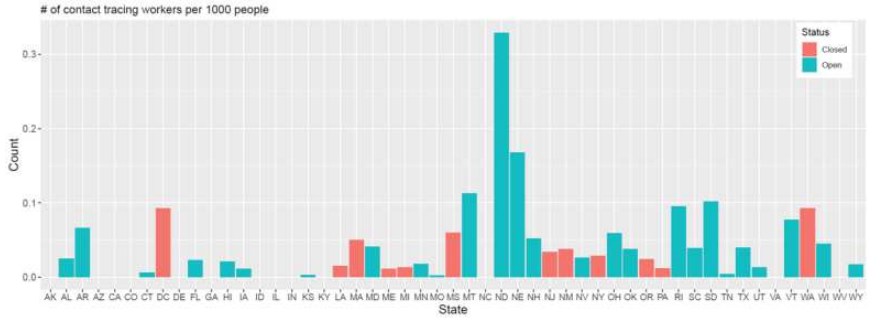
Exhibit 8: Number of patients on ventilator for open (left) versus closed (right) US states. The red dots represent the real data, while the blue line reflects a smoothing line through the data and the gray area is the confidence interval.



Source: Morgan Stanley, The COVID Tracking Project

Number of contact tracing workers per 1,000 people: Overall, opened States appear to have a higher number of contact tracing workers per capita compared to closed States. However, we highlight the large heterogeneity observed across the States and the un-availability of data for 13 States.

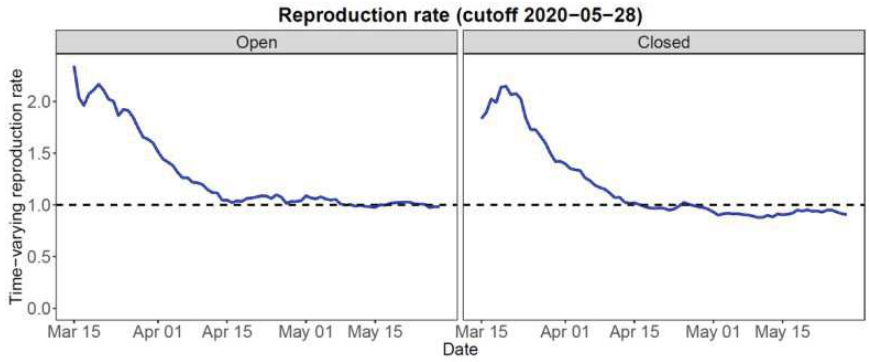
Exhibit 9: Number of contact tracing workers per 1,000 people for closed (orange) versus open (cyan) US states. Blank indicates the data is not available for the corresponding States.



Source: Morgan Stanley Research, AlphaWise, University of Maryland COVID-19 Impact Analysis Platform.

Time-varying reproduction rate: The R value of the open states is ~1, suggesting that the spread is at the threshold of containment, while the R value of the closed states is <1 which reflects containment of the spread. Note that the current R value for the entire US is ~0.94. For states with an increasing trend in R over the past 5 days see Exhibit 28 (curves in red). We will be monitoring changes in the R trend across all states to identify signals of a second wave of infections. As a note our prior calculation of R included a smoothing to account for differences in testing and reporting which we no longer feel is necessary.

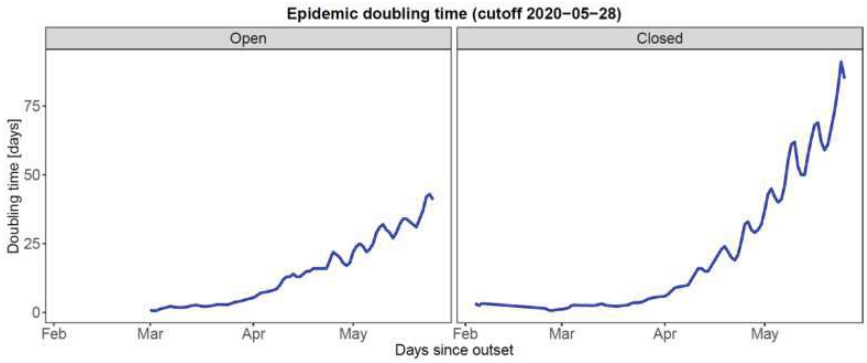
Exhibit 10: Time varying reproduction rate for open (left) versus closed (right) US states.



Source: Morgan Stanley, The COVID Tracking Project

Epidemic doubling time: The epidemic doubling time of the closed states is nearly double (~80 days) compared to the open states (~40 days), hinting to an overall slower increase in cases in the closed states than in open states. Recall that the higher the doubling time, the better is the containment of the spread as the cases need longer time to double. The current epidemic doubling time for the entire US is ~60 days and we highlight (Exhibit 29, red color) the states with a decreasing trend in doubling time over the past 10 days. We underline that the epidemic doubling time is characterized by high variability and it should, therefore, be used with other metrics.

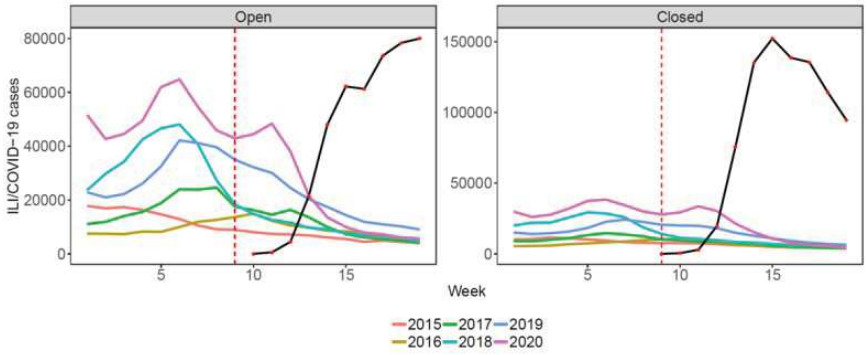
Exhibit 11: Epidemic doubling time for open (left) versus closed (right) US states.



Source: Morgan Stanley, The COVID Tracking Project

Cases of Influenza-like illness (ILI) and COVID-19 cases: Exhibit 12 illustrates weekly ILI data in the US during 2015-2020 and COVID cases in open vs closed states. We note that the ILI dynamics of both the open and the closed states have been similar, and specifically the number of ILI cases has been declining from week 11 to week 19 in all states. We will be monitoring the number of ILI cases as they could provide early signals of a potential second wave of infections. For state-level ILI plots as well as for ILI/CLI emergency department visits data see inside.

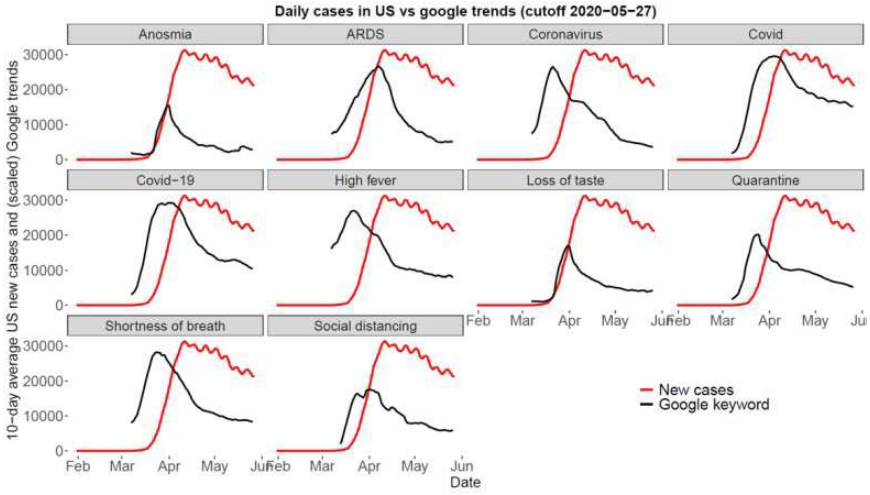
Exhibit 12: ILI cases from 2015-2020 (different colors) vs COVID-19 cases (black color) in closed (left) and open (right) states. The red dashed line (vertical) represents the timing of the COVID-19 outbreak.



Source: Morgan Stanley, COVIDView, ILINet, Johns Hopkins CSSE.

Google trends: Exhibit 13 provides the overlap between google trends key words and the number of new cases in the US. Overall, we underscore that (1) The rate at which COVID-19 keywords are searched on Google recapitulates the trend of new cases in the US, and especially the keyword "Covid"; and (2) The Google trends constitute a leading factor of the new cases. Taken together, we believe that Google trends can be leveraged toward potentially seeing an early signal of a second wave of infections.

Exhibit 13: Google trends for keywords related to COVID-19 and new COVID-19 cases in the US.



Source: Google, Johns Hopkins CSSE.

Restaurant reservations trends: Restaurant reservation rates can be employed as a means to gauge the extent of reopening in a state. We have retrieved restaurant reservations data from OpenTable to assess the rate at which reservations are made in reopening states. We observe two key trends: (1) The reservation rate dropped by ~100% over the past ~2 months due to the pandemic and the lockdown rules in most of the states; and (2) Interestingly, in open states there is a ~50% raise in bookings, suggestive that the bookings rate is now nearly half of the pre-pandemic season, while in closed states we see only a slight increase in bookings of ~10-15%. This trend reflects the rise in the various activities that are ongoing in states that are progressively reopening. For state-level plots see inside.

Exhibit 14: Restaurant reservations rate in open (left) vs closed (right) states based on data from ~20,000 restaurants.

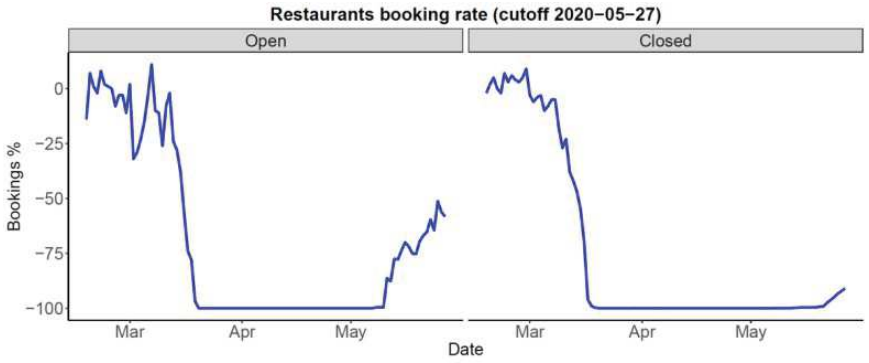


Exhibit 15:

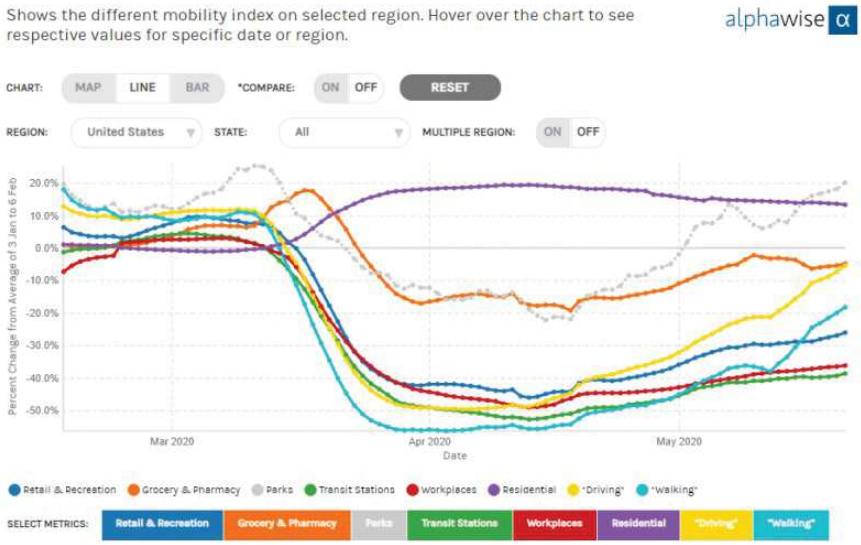
Source: Morgan Stanley Research, OpenTable

Mobility indices: We work with AlphaWise to track two sets of metrics from Google and Apple for the level of social activities in each of the US States and also in other key countries. The scores measure change in overall mobility with respect to the pre-outbreak level from various aspects. Comparing with the rest

of US, we note that opened States clearly demonstrate higher levels of recent outdoor activities in virtually all categories except for the residential activity. See the interactive panel below or Individual plots for each region for Google and Apple mobility indices for specific regions of interest.

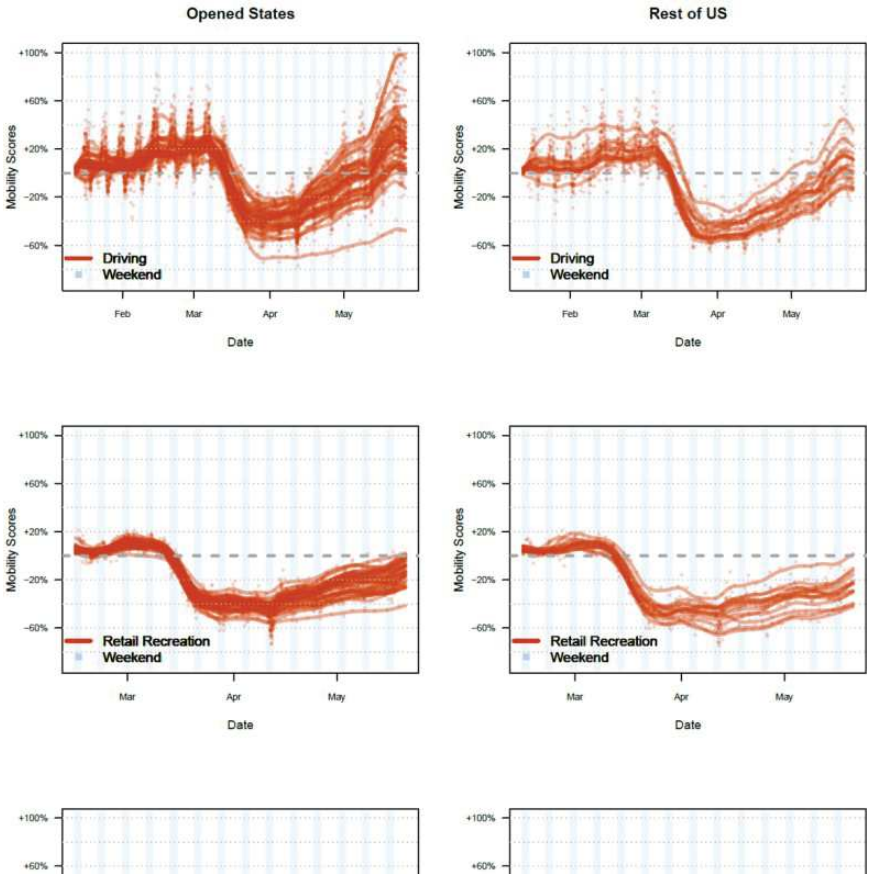
Interactive panel for regional mobility data (red vertical line in an individual US state indicates its initial reopening date):

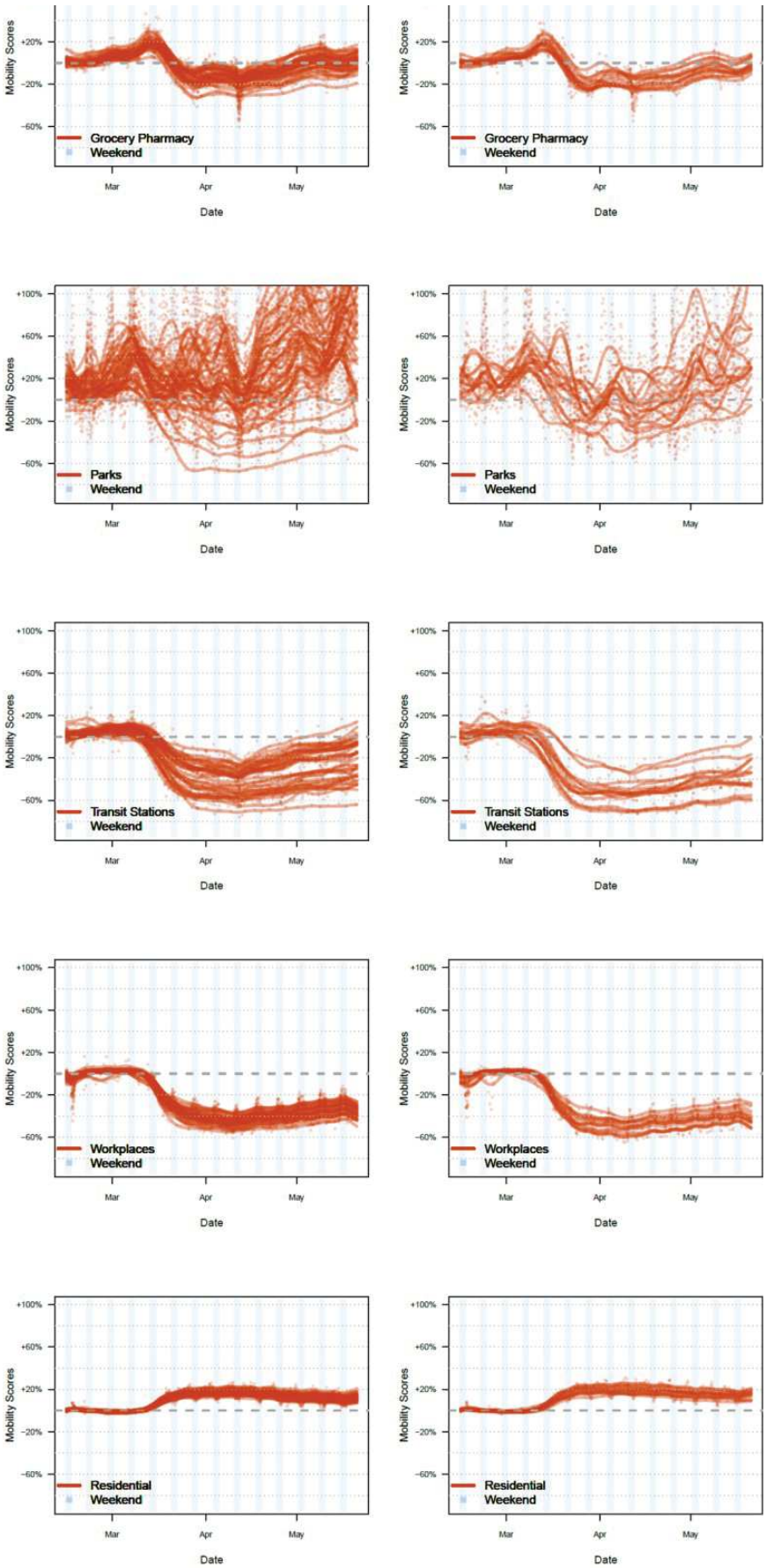
AlphaWise COVID-19 Dashboard



AlphaWise, Google LLC "Google COVID-19 Community Mobility Reports.", Apple Mobility Data, Morgan Stanley Research

Exhibit 16: Social activities of the US open States vs. closed States

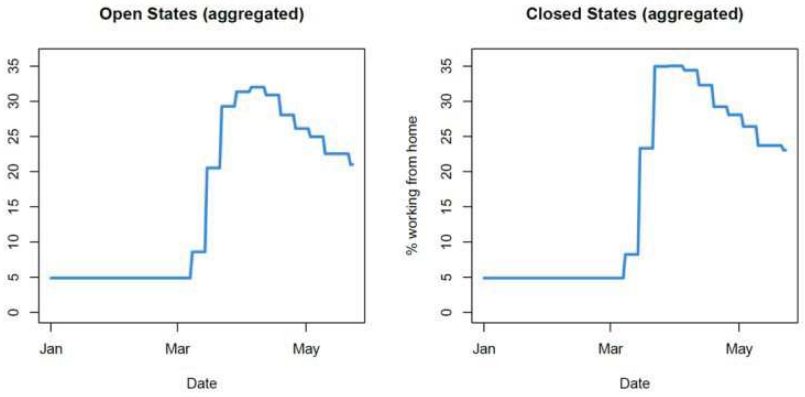




Source: Morgan Stanley Research, https://www.google.com/covid19/mobility/, https://www.apple.com/covid19/mobility..

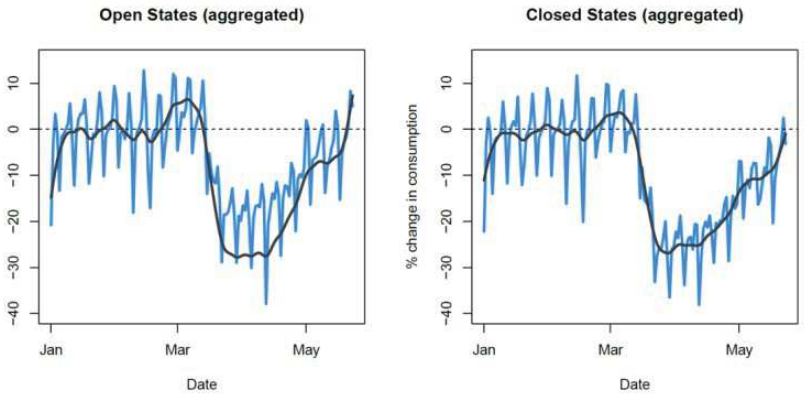
Economic indicators: We track University of Maryland COVID-19 Impact Analysis Platform for percent working from home and percent change in consumption in each of the US States, which are indicative of changes in economic activities over time. Although the working from home was more prevalent in closed States, the current percentages are similar between open and closed States. In terms of consumption level, the open States were slightly less impacted and appear to recover faster than the closed States.

Exhibit 17: Percent working from home for open (left) versus closed (right) US states. Data are aggregated across States and weighed by population.



Source: Morgan Stanley Research, AlphaWise, University of Maryland COVID-19 Impact Analysis Platform.

Exhibit 18: Percent change in consumption for open (left) versus closed (right) US states. Dark grey lines indicate the trend after smoothing. Data are aggregated across States and weighed by population.



Source: Morgan Stanley Research, AlphaWise, University of Maryland COVID-19 Impact Analysis Platform.

Outside the United States

We have provided a similar, though abridged, heatmap for select ex-U.S. locations below. The same color-coding applies.

Exhibit 19: Ex-U.S. Reopening Status Tracker

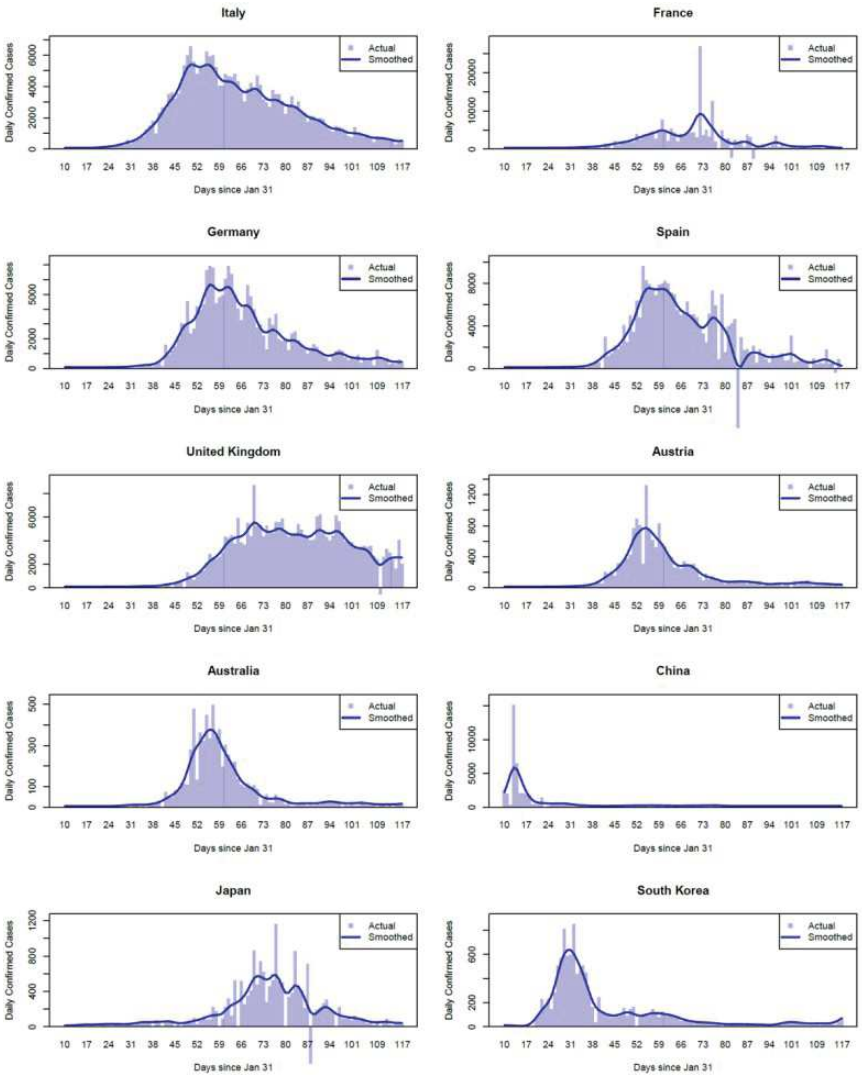
Country	Start of National Lockdown	Non-Essential Production	Non-Essential Shops/Retail	Restaurants / Cafes	Schools
China	1/23/2020				
Italy	3/10/2020				
Spain	3/16/2020				
Austria	3/16/2020				
France	3/17/2020				
Belgium	3/18/2020				
Portugal	3/20/2020				
Germany	3/22/2020				
Netherlands	3/23/2020				
Greece	3/23/2020				
New Zealand	3/23/2020				
Australia	3/23/2020				
UK	3/24/2020				
Ireland	3/27/2020				
Singapore	4/3/2020				
Japan	4/7/2020 (SOE)				
South Korea	N/A				

Open with few Restrictions
Partially Open with Limits
Closed

Source: Morgan Stanley Research

Daily cases: For most key EU and Asia/Pacific countries currently open or about to reopen, the daily case numbers have dropped to a remarkably low level. We highlight the UK and South Korea, where the UK started to plateau during the past week and South Korea reported a new clusters of cases again.

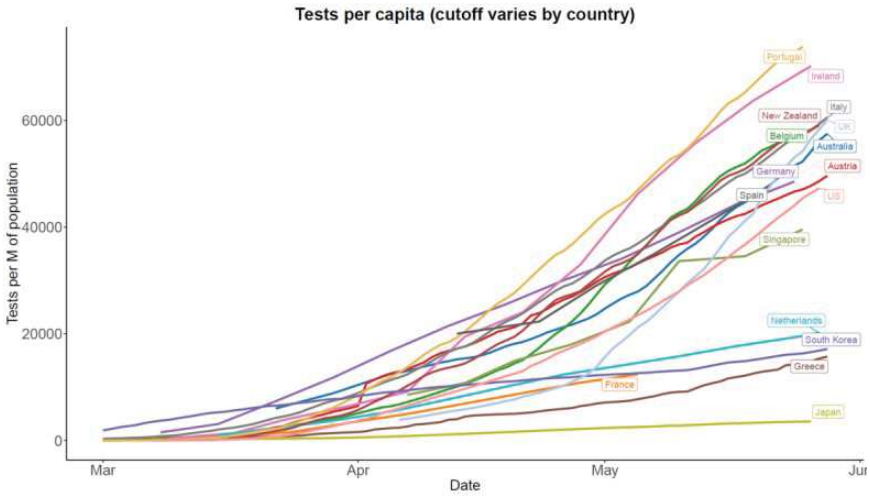
Exhibit 20: Actual daily cases of the key countries in reopening.



Source: Morgan Stanley Research, https://www.apple.com/covid19/mobility.

Number of cumulative tests per capita: Note that the data presented here stems from different sources, which may be incomplete (may only capture data from public and not private labs), but we believe that the overall trend is representative of each country's capacity for testing. We highlight that countries with a high number of tests per capita include Portugal, Ireland, Italy and New Zealand, while countries with relatively low number of tests per capita include Japan, Greece, and France. We note that US has performed ~46K tests per million people to date.

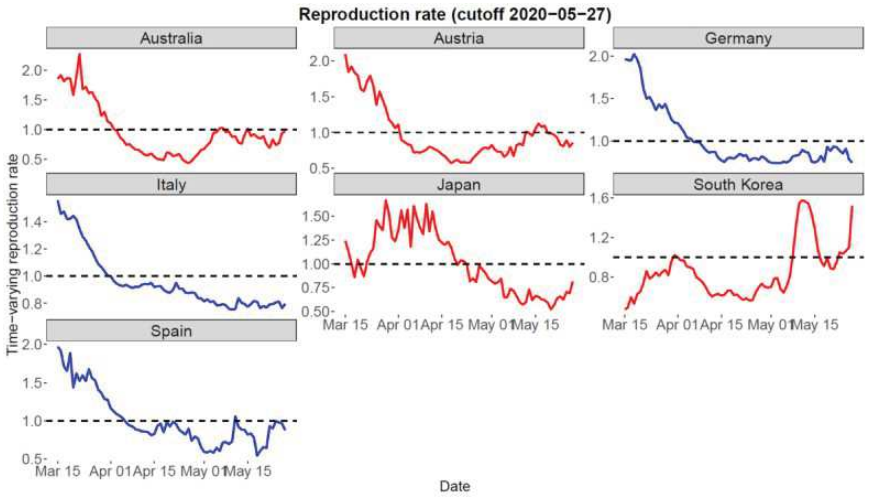
Exhibit 21: Number of tests per million people for various countries.



Source: Morgan Stanley, The COVID Tracking Project, Johns Hopkins CSSE, The World in Numbers, Wikipedia.

Time-varying reproduction rate: A positive slope in R is indicative of an R value that is overall trending upward implying acceleration of the spread and potentially a second wave of infections. Australia, Austria, Japan and S. Korea exhibited an overall increasing trend in R over the past 5 days (red curve), while other countries with an increasing R over the past 5 days include China, Greece, Ireland, Portugal, Singapore, and UK (Exhibit 37). However, we note that the aforementioned countries, except from S. Korea, currently have an R value less or around 1, which reflects containment of the spread.

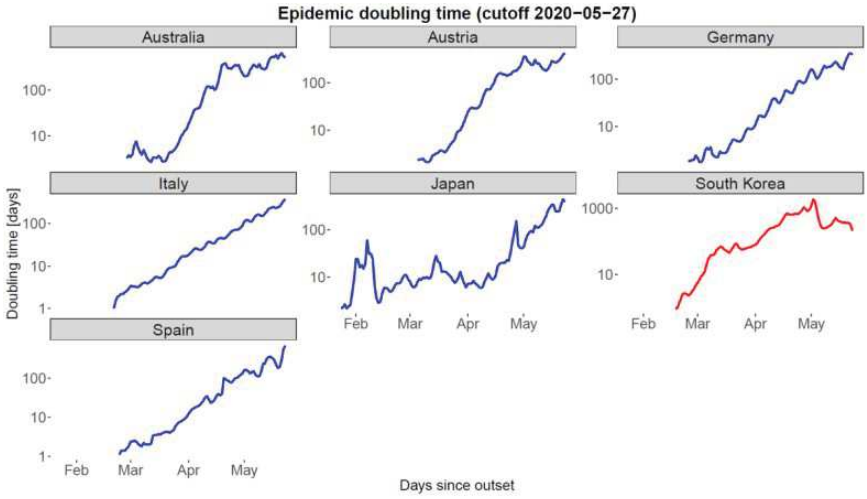
Exhibit 22: Time-varying effective reproduction number. The black dashed line represents R=1.



Source: Morgan Stanley Research, JHU CSSE, NY Times Github.

Epidemic doubling time: Among the countries shown below, S. Korea has a negative slope in doubling time over the past 10 days, suggesting acceleration of the new cases, while other countries include China, and Netherlands (Exhibit 38). We note that the doubling time is highly variable and, therefore, should be used in combination with other metrics.

Exhibit 23: Epidemic doubling time for various countries.



Source: Morgan Stanley, The COVID Tracking Project, Johns Hopkins CSSE.

Recent COVID-19 research

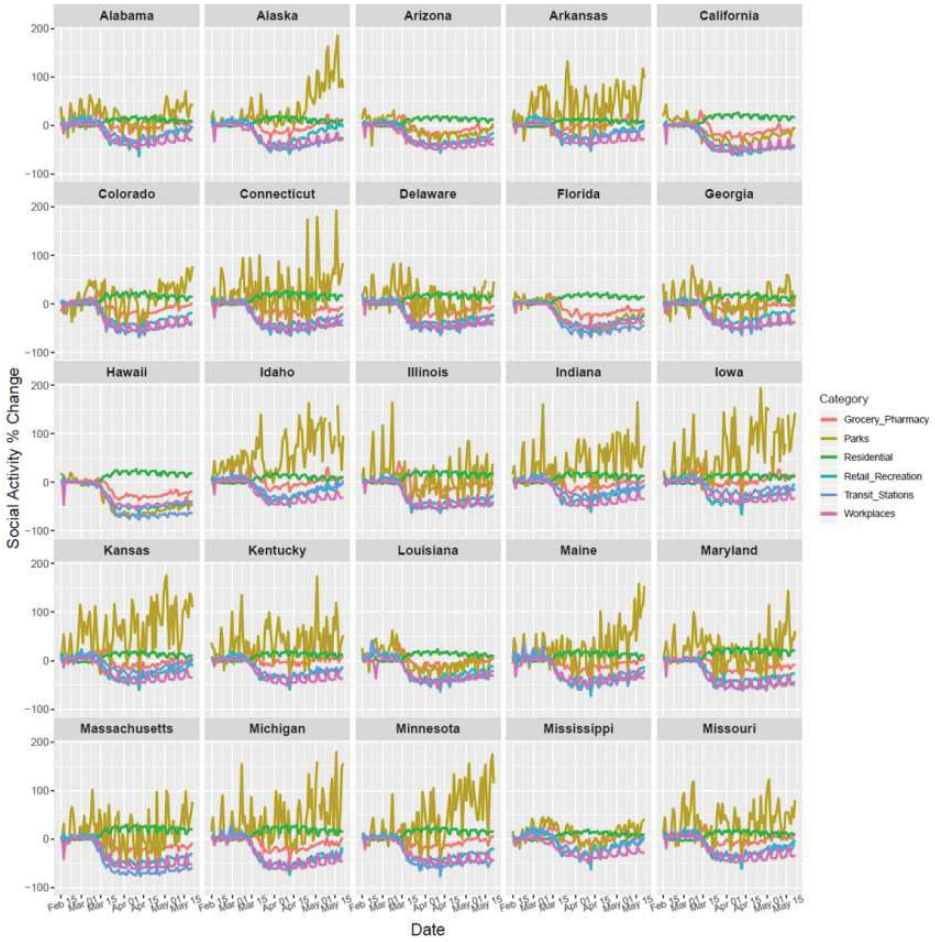
- Biotechnology: COVID-19: US Plateau In New Cases Raises Concern As Reopening Starts (8 May 2020)
- Biotechnology: COVID-19: When Do US States Meet Criteria For Phase One Reopening And What Are The Risks (23 Apr 2020)
- Biotechnology: COVID-19: Weekly Update To US State-Level Outbreak Models and Epidemiological Variables (17 Apr 2020)
- Biotechnology: COVID-19: US State-Level Modeling Confirms Long Tail, ~1.4M Total Cases (13 Apr 2020)
- Biotechnology: COVID-19: Detailed US State Level Epidemiological Variables and Comparison With Key Countries (13 Apr 2020)
- Biotechnology: COVID-19: A Prescription To Get The US Back To Work (3 Apr 2020)
- Biotechnology: Overview of Potential COVID-19 Therapies in Development (2 Apr 2020)
- Biotechnology: COVID-19: Updating US Forecast For Greater Spread, Potentially Worse Trajectory Than Italy (30 Mar 2020)
- Biotechnology: COVID-19 Cases Growing Faster Than Tests As US Capacity Is Still Too Low (29 Mar 2020)

- Biotechnology: COVID-19: New Detailed Italy Model Calls For Sustainable Decline In New Case Growth In ~10 Days (25 Mar 2020)
- Biotechnology: What's The Most Complete COVID-19 Dataset? (20 Mar 2020)
- Biotechnology: Introducing Two Key Epidemiologic Variables in Our COVID-19 Reports (17 Mar 2020)
- Gilead Sciences Inc.: Is Remdesivir A Market Catalyst? (17 March 2020)
- Moderna Inc: First Patient Dosed in COVID-19 Vaccine Trial (16 March 2020)
- Biotechnology: Potential U.S. COVID-19 Outbreak Dynamics (15 March 2020)
- Biotechnology: COVID-19 Outbreak Dynamics - An Update On Actuals Vs Our Model + New EU Countries (9 Mar 2020)
- Biotechnology: Current Status of COVID-19 Diagnostics (5 Mar 2020)
- Moderna Inc: COVID-19 Vaccine Patient Dosing Expected Soon (4 Mar 2020)
- Biotechnology: Key Takeaways From COVID-19 Expert Call (3 Mar 2020)
- Biotechnology: COVID-19 Potential Outbreak Dynamics - Using China As A Model (2 Mar 2020)
- Moderna Inc: Next Steps For COVID-19 Vaccine Development (1 Mar 2020)
- Biotechnology: COVID-19 Potential Therapeutic Options from Ongoing Clinical Trials (28 Feb 2020)

Individual plots for each region

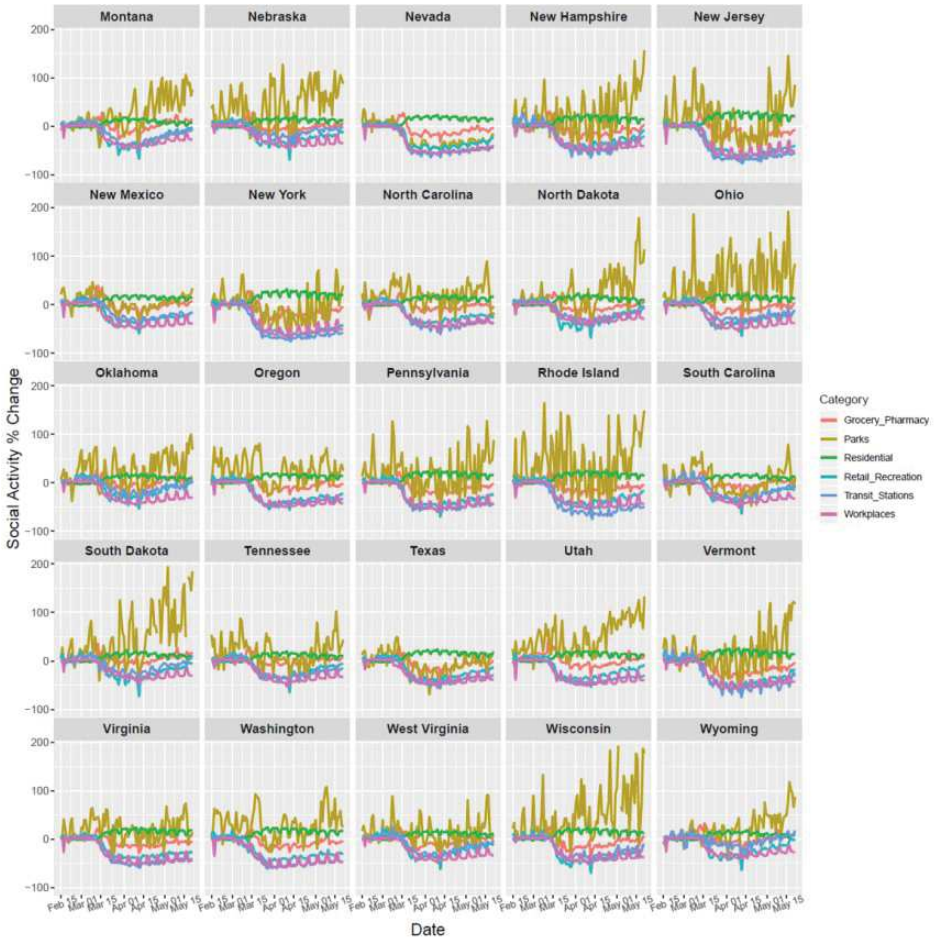
Mobility and economic indicators: We provide panel plots for each state in the US and each country that we are tracking below.

Exhibit 24: Google mobility data for each of the US States - (Part 1 of 2)



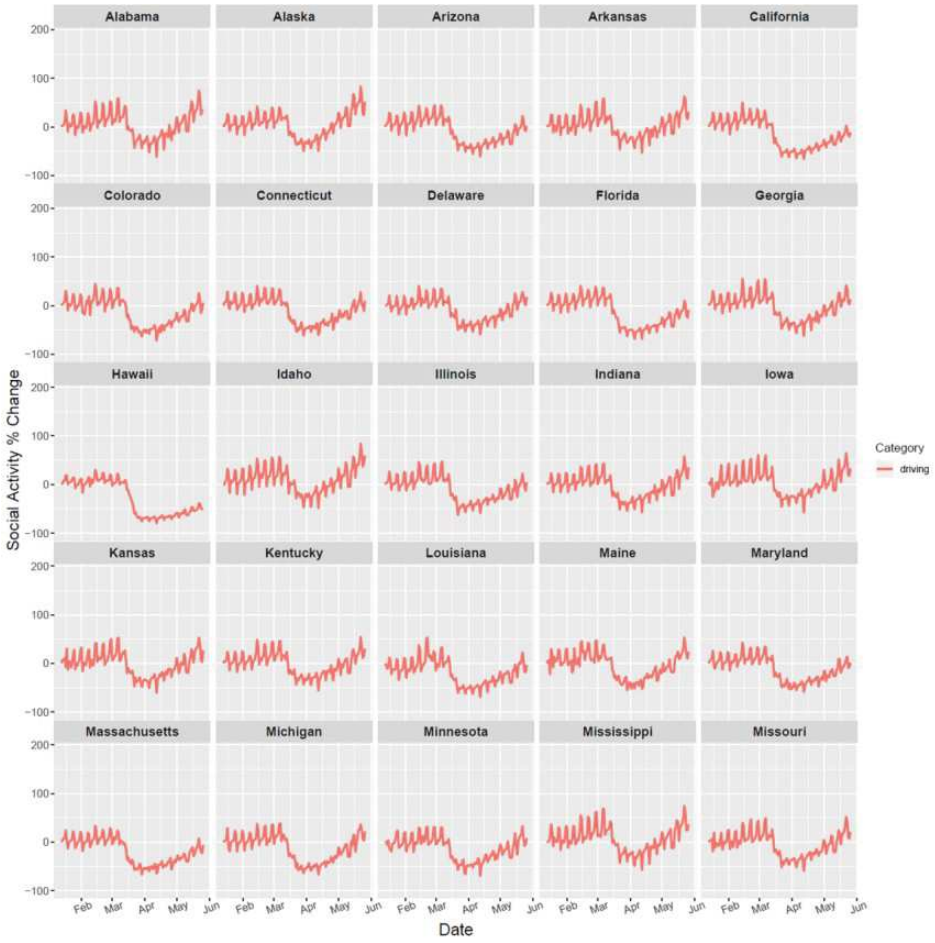
Source: Morgan Stanley Research, https://www.google.com/covid19/mobility/.

Exhibit 25: Google mobility data for each of the US states - (Part 2 of 2)



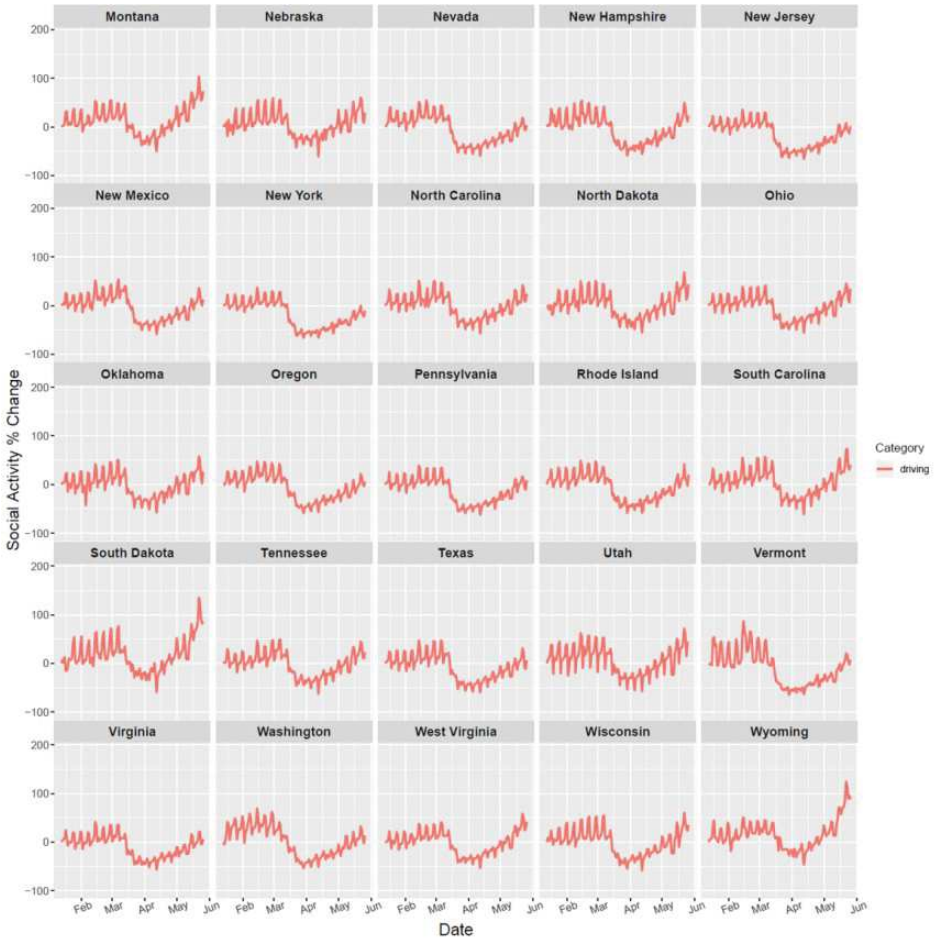
Source: Morgan Stanley Research, https://www.google.com/covid19/mobility/.

Exhibit 26: Apple mobility data for each of the US states - (Part 1 of 2)



Source: Morgan Stanley Research, https://www.apple.com/covid19/mobility.

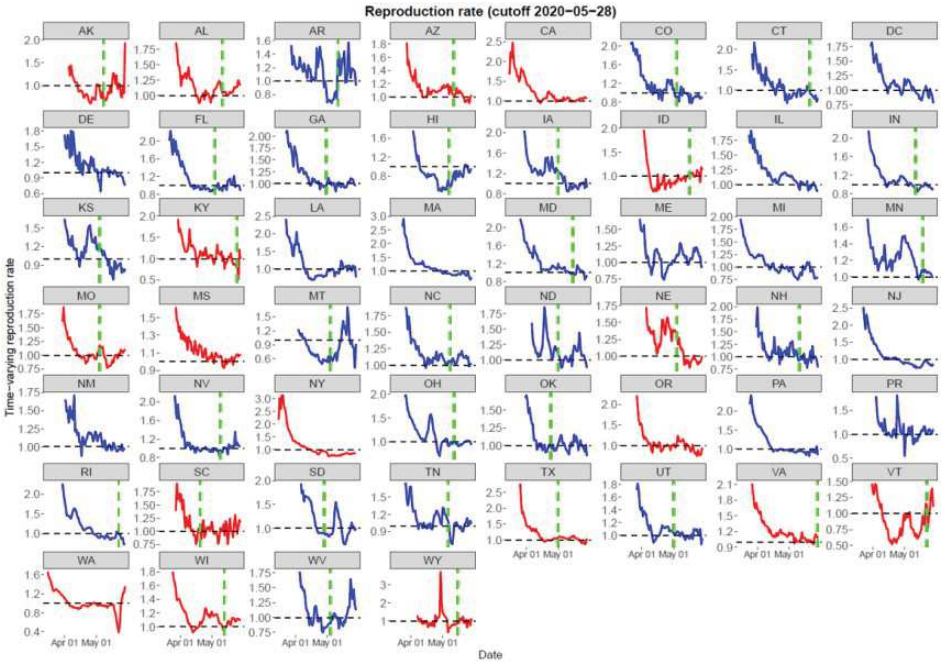
Exhibit 27: Apple mobility data for each of the US states - (Part 2 of 2)



Source: Morgan Stanley Research, https://www.apple.com/covid19/mobility.

Time-varying reproduction rate: In blue are the states wherein R follows a downward trend, while in red we illustrate the states wherein the slope of R over the past 5 days is positive. A positive slope in R is indicative of an R value that is overall trending upward implying acceleration of the spread and potentially a second wave of infections. The green vertical line reflects the opening date of the state.

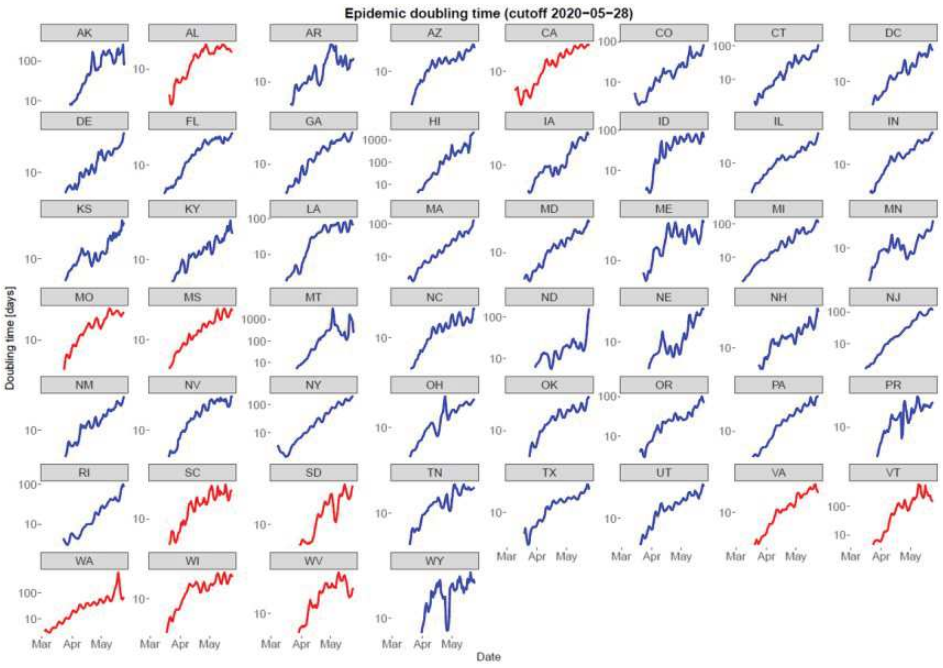
Exhibit 28: Time varying reproduction rate for the US states. The dashed black line represents R value equal to 1 (containment of the spread).



Source: Morgan Stanley, The COVID Tracking Project

Epidemic doubling time: In blue are states wherein the doubling time follows an upward trend, while in red we illustrate the states wherein the slope of the doubling time over the past 10 days has been negative. A negative slope in doubling time is indicative of a doubling time value that is overall trending downward suggesting acceleration of the spread (number of cases doubles faster) and potentially a second wave of infections. Note that the epidemic doubling time is characterized by high variability and it should, therefore, be used with other metrics.

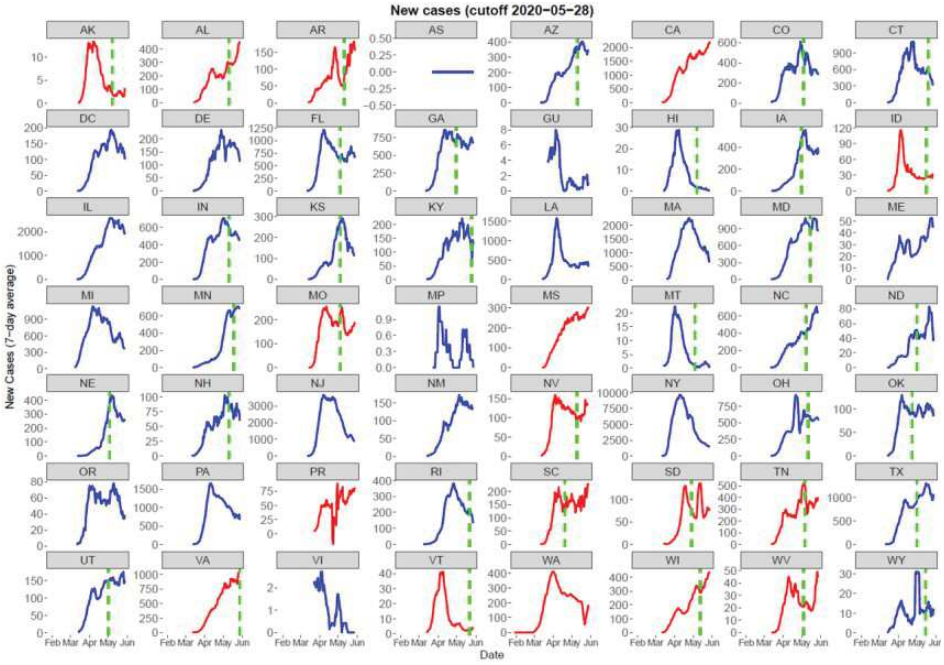
Exhibit 29: Epidemic doubling time for the US states.



Source: Morgan Stanley, The COVID Tracking Project

New cases: In blue are the states wherein the number of new cases follows a downward trend, while in red we illustrate the states wherein the slope of the new cases over the past 7 days has been positive. A positive slope in new cases is indicative of spread acceleration and potentially a second wave of infections. The green vertical line reflects the opening date of the state.

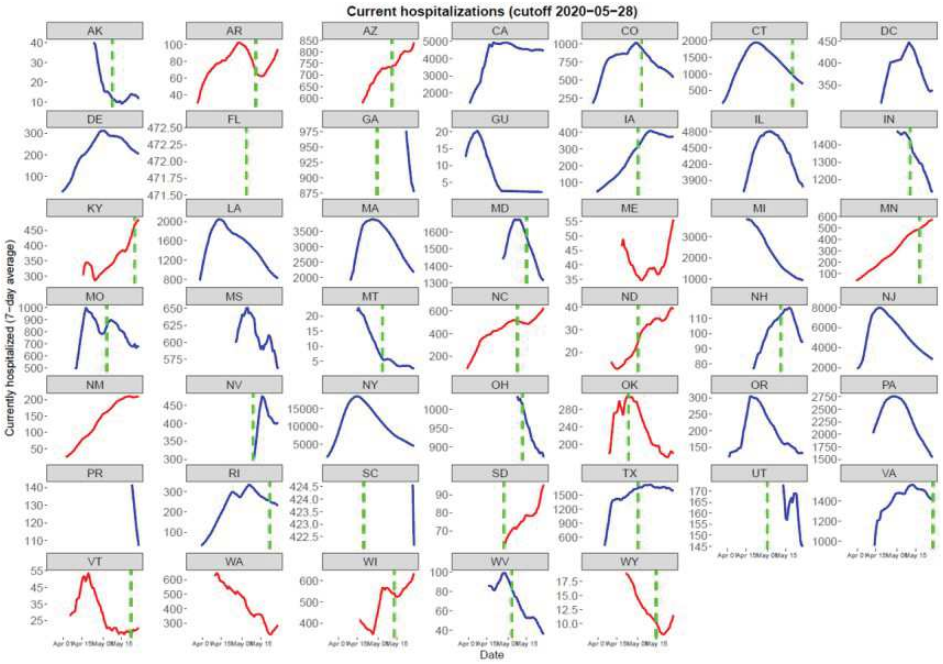
Exhibit 30: Number of new cases for all US states.



Source: Morgan Stanley, The COVID Tracking Project

Number of current hospitalizations: In blue are the states wherein the number of hospitalized patients follows a downward trend, while in red we illustrate the states wherein the slope of the hospitalized patients over the past 7 days has been positive. A positive slope in hospitalized patients may be indicative of spread acceleration and potentially a second wave of infections. The green vertical line reflects the opening date of the state.

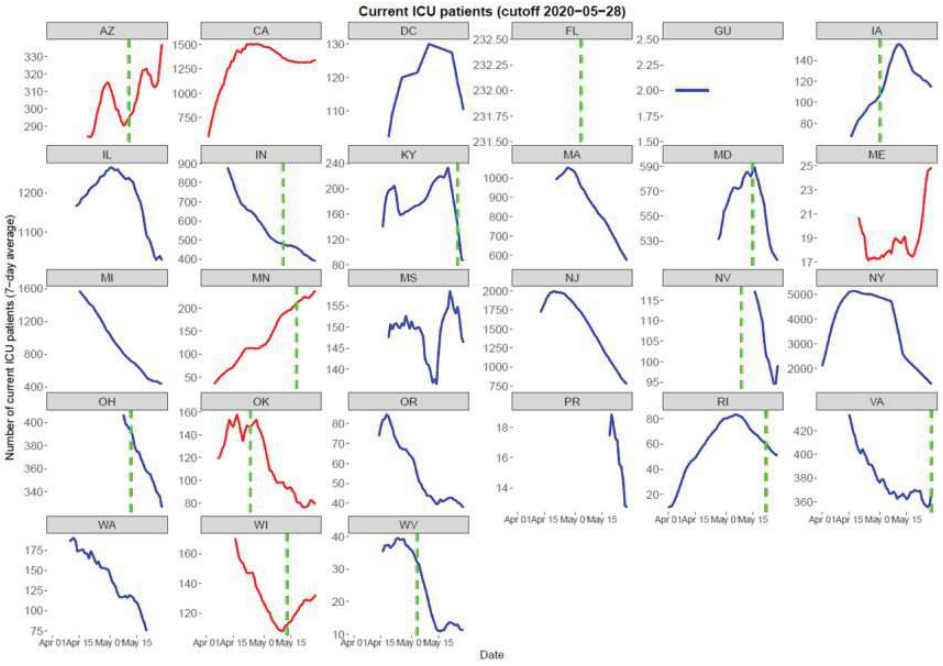
Exhibit 31: Number of current hospitalizations for certain US states.



Source: Morgan Stanley, The COVID Tracking Project

Number of patients in ICU: In red we show states with increasing number of ICU patients over the past 7 days. The green vertical line reflects the opening date of the state.

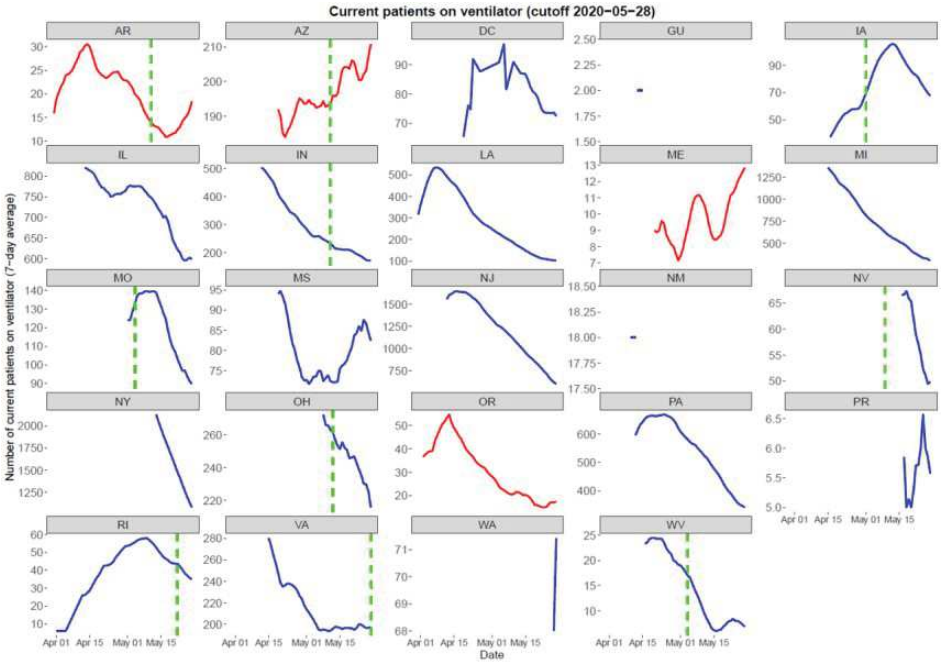
Exhibit 32: Number of patients in ICU for certain US states.



Source: Morgan Stanley, The COVID Tracking Project

Number of patients on ventilator: In red we show states with increasing number of patients on ventilator over the past 7 days. The green vertical line reflects the opening date of the state.

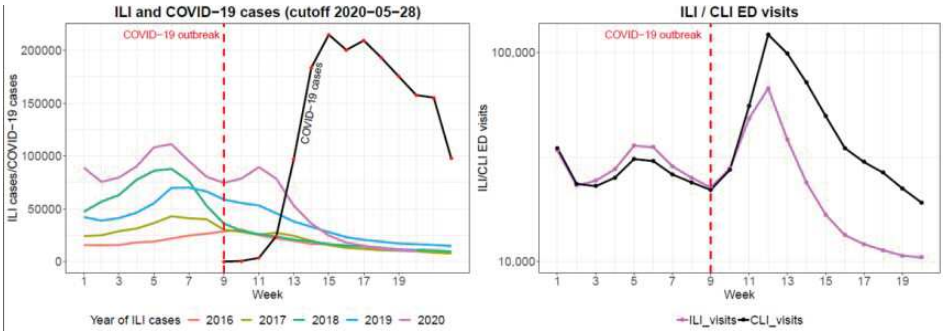
Exhibit 33: Number of patients on ventilator for certain US states.



Source: Morgan Stanley, The COVID Tracking Project

Cases of Influenza-like illness (ILI), COVID-19-like illness (CLI) and pertinent ED visits: Exhibit 12 illustrates weekly ILI data in the US during 2016-2020 (left panel) and ED visits related to ILI or COVID-like illness (CLI, right panel). We highlight 3 main observations: (1) Unlike all previous 4 past years (2016-2019), wherein the number of ILI cases following week 9 decline, in 2020 (pink line left panel) we observe an increase in the number of ILI cases at week 9 that continues until week 11 and is attenuated at week 12 onward to reach very low levels at week 17 (lower than 2019); (2) At week 11 (two weeks after the number of ILI cases began to raise), the number of COVID-19 cases started to ramp up (black line, left panel) while the trajectory of the ILI cases initiated a trend downwards; (3) For the past 7 weeks shown here (right panel), the number of ILI and CLI ED visits has been decreasing. Taken together, this data suggests that the trajectory of the ILI cases may have been a leading indicator of COVID prior to the availability of large testing capacity, and that the overall infection rate has been trending downward. We will continue to monitor the ILI and CLI cases throughout the pandemic. For the ILI-COVID19 data in each state see inside.

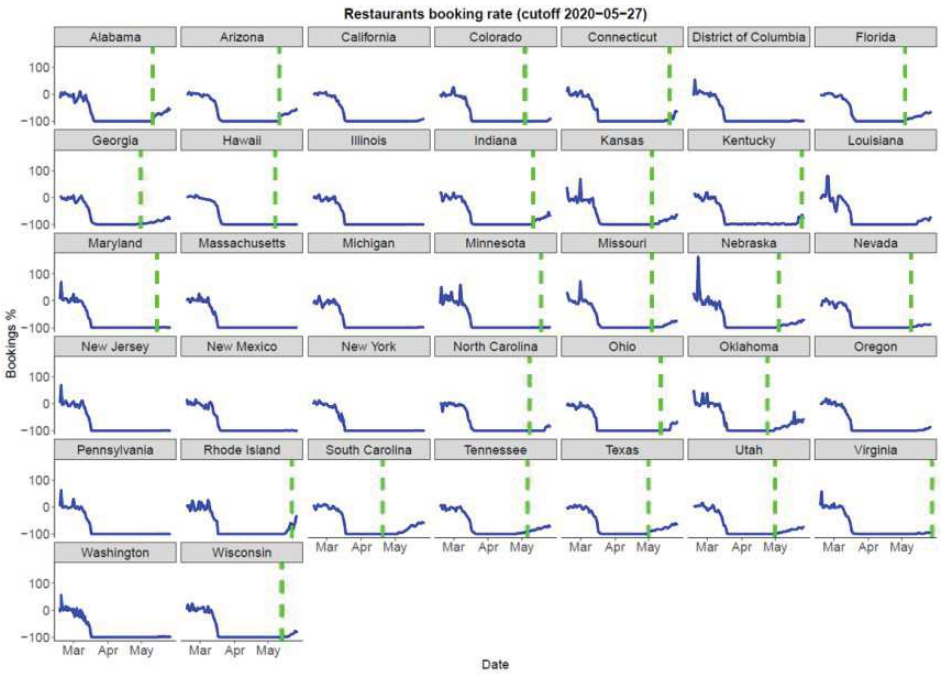
Exhibit 34: ILI cases vs COVID-19 cases (left) and Emergency Department visits related to ILI and Covid-like illness (CLI) (right) in the US.



Source: Morgan Stanley, COVIDView, ILINet, Johns Hopkins CSSE.

Restaurant reservation rates: Broadly, unlike the closed states (plots without a green vertical line), in open states we see an overall increasing trend in the bookings rates which reflects the activity of the reopening.

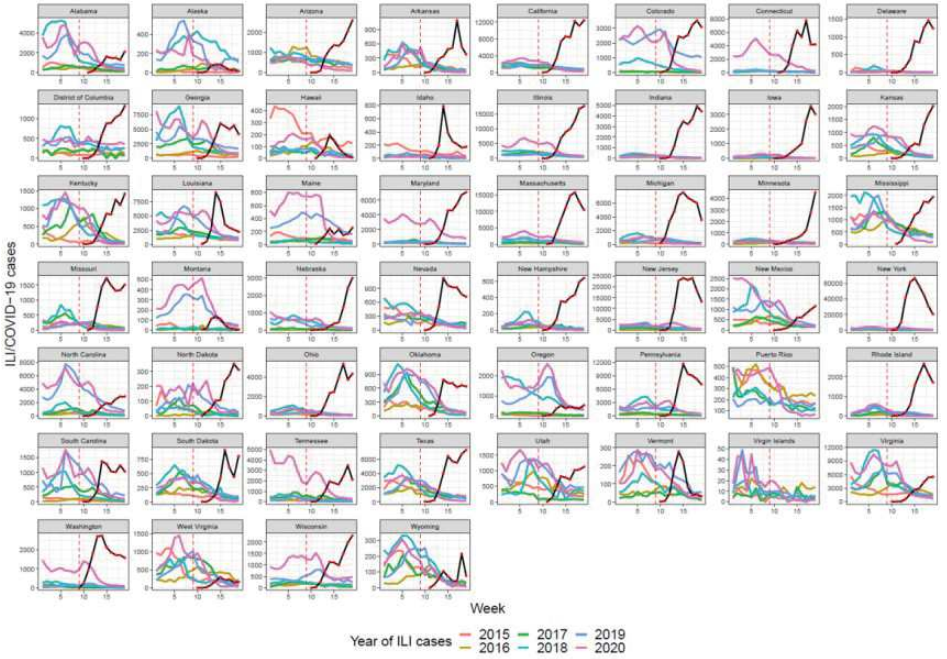
Exhibit 35: Restaurant reservation rates in each state. The green vertical line reflects the opening date of the state.



Source: Morgan Stanley Research, OpenTable.

State-level ILI data: Broadly, unlike the closed states (plots without a green vertical line), in open states we see an overall increasing trend in the bookings rates which reflects the activity of the reopening.

Exhibit 36: ILI cases from 2015-2020 (different colors) vs COVID-19 cases (black color). The red dashed line (vertical) represents the timing of the COVID-19 outbreak.

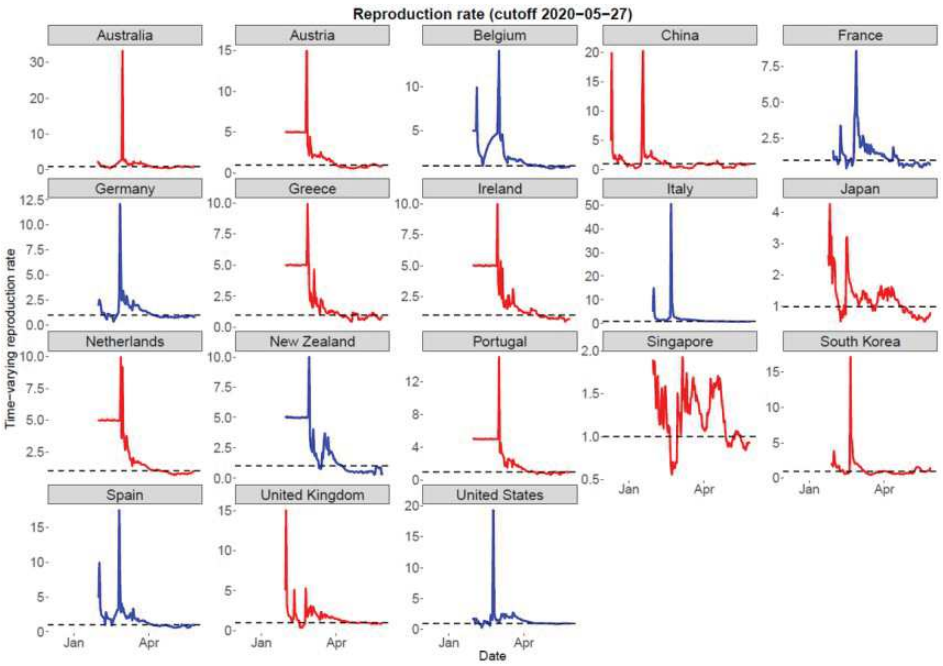


Source: Morgan Stanley, COVIDView, ILINet, Johns Hopkins CSSE.

Data from Outside the US

Time-varying reproduction rate: In blue are the countries wherein R follows a downward trend, while in red we illustrate the countries wherein the slope of R over the past 5 days has been positive. A positive slope in R is indicative of an R value that is overall trending upward implying acceleration of the spread and potentially a second wave of infections.

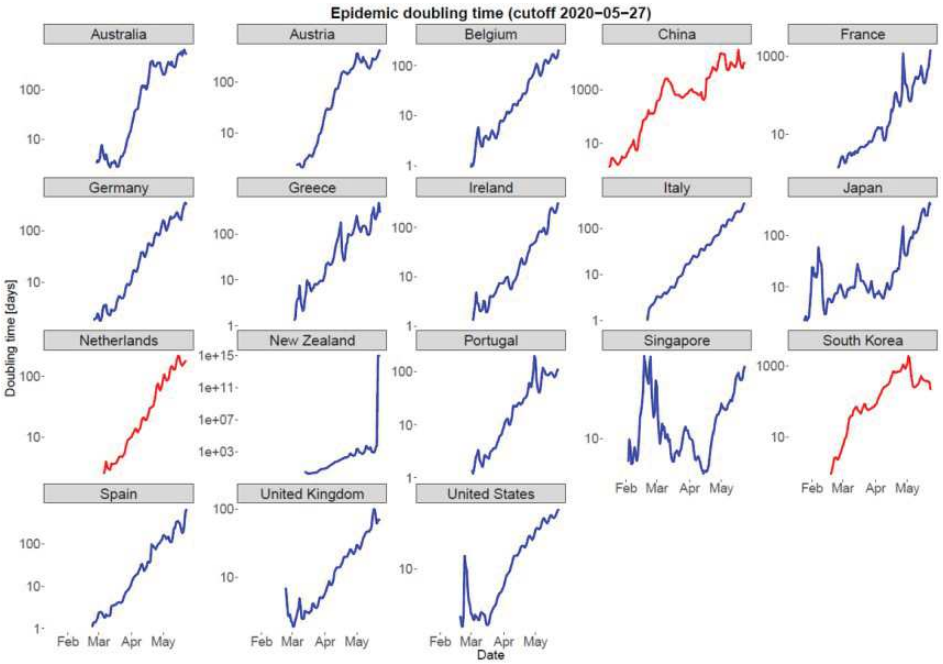
Exhibit 37: Time-varying effective reproduction number.



Source: Morgan Stanley Research, JHU CSSE, NY Times Github.

Epidemic doubling time: Countries shown in red represent countries wherein the doubling time has a decreasing trend (i.e. rate of increase in cases is raising) over the past 10 days. We note that the doubling time is highly variable and, therefore, should be used in combination with other metrics.

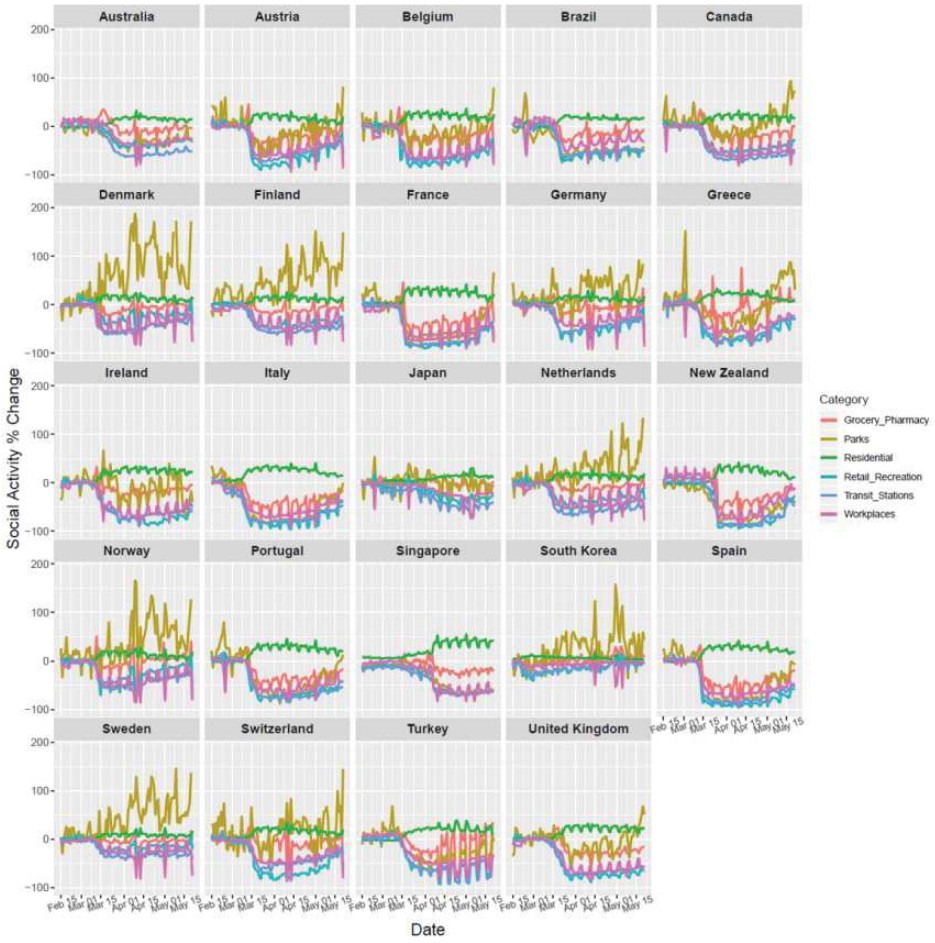
Exhibit 38: Epidemic doubling time for various countries.



Source: Morgan Stanley, The COVID Tracking Project, Johns Hopkins CSSE.

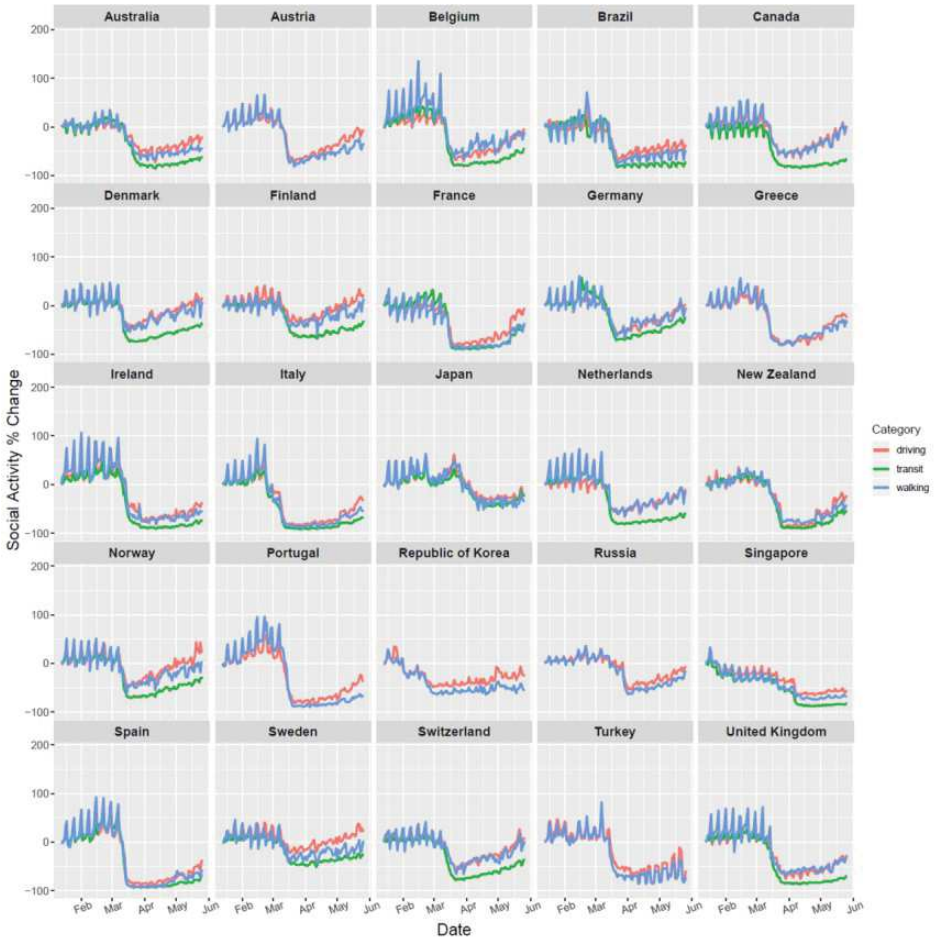
Apple and Google Mobility Data

Exhibit 39: Google mobility data for other countries



Source: Morgan Stanley Research, https://www.google.com/covid19/mobility/.

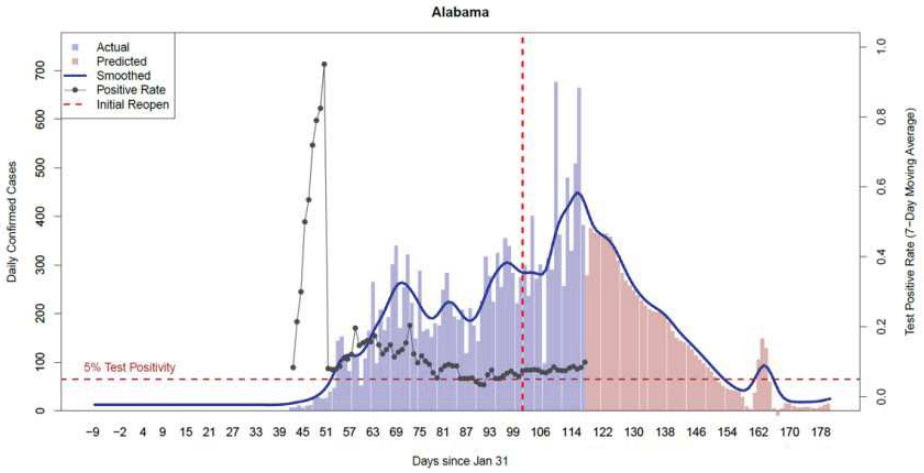
Exhibit 40: Apple mobility data for other countries



Source: Morgan Stanley Research, https://www.apple.com/covid19/mobility.

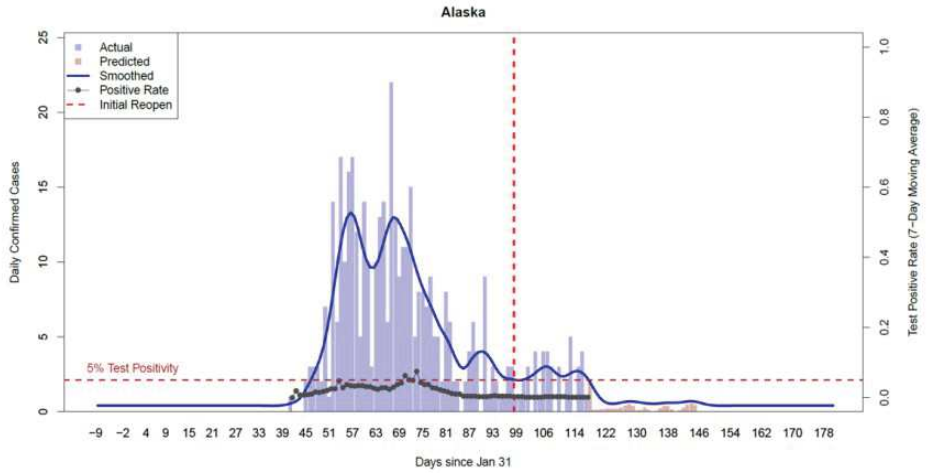
Actual and predicted daily cases from US state-level models:

Exhibit 41:



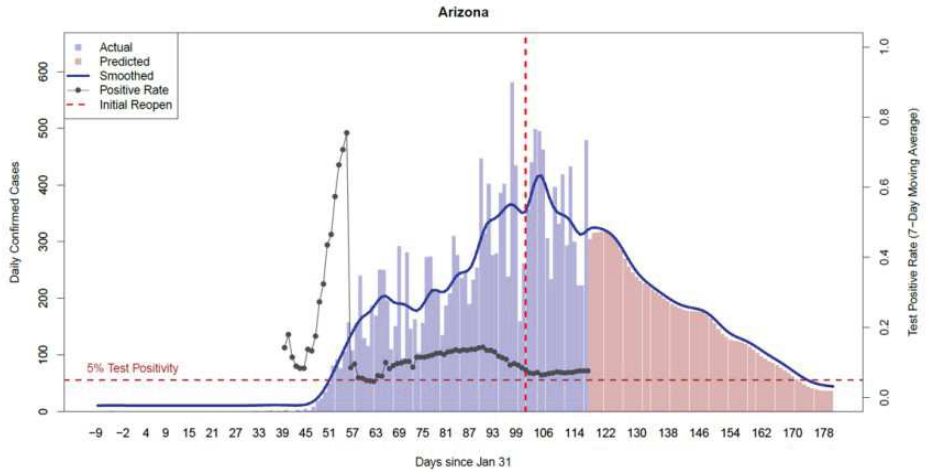
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 42:



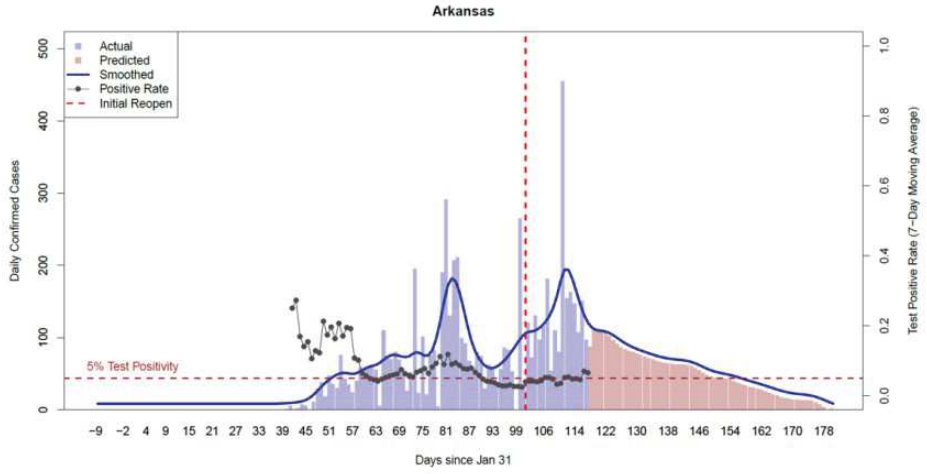
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 43:



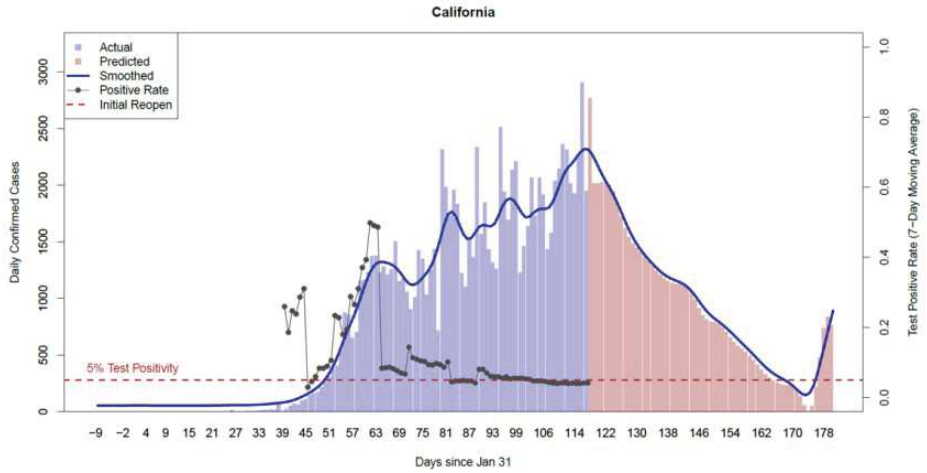
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 44:



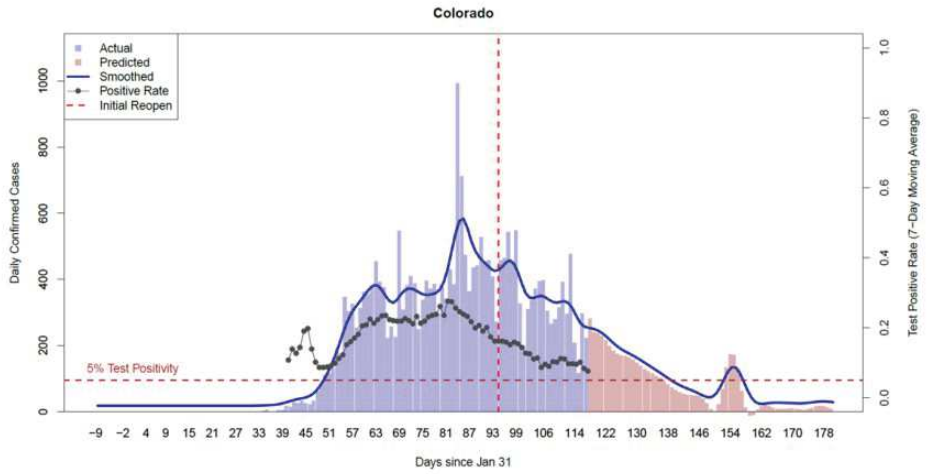
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 45:



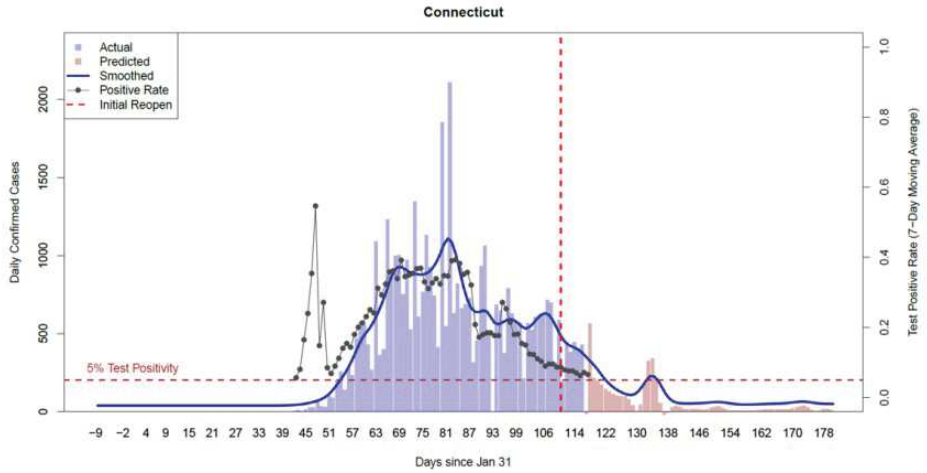
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 46:



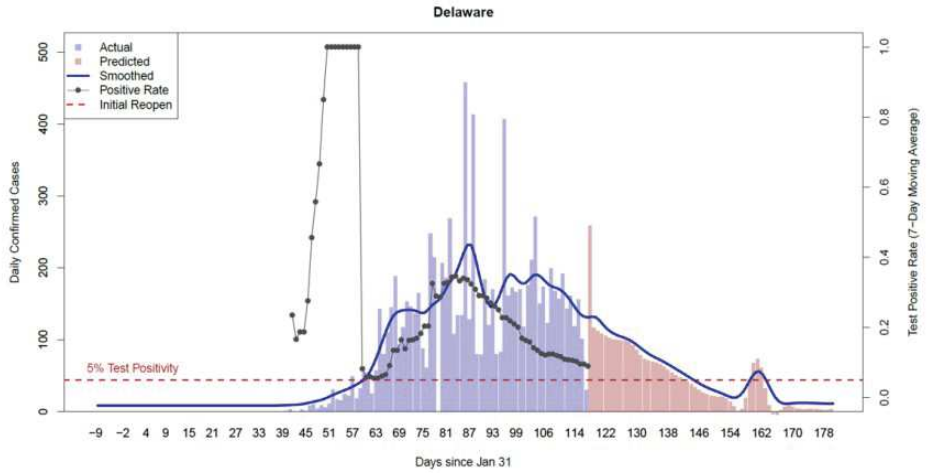
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 47:



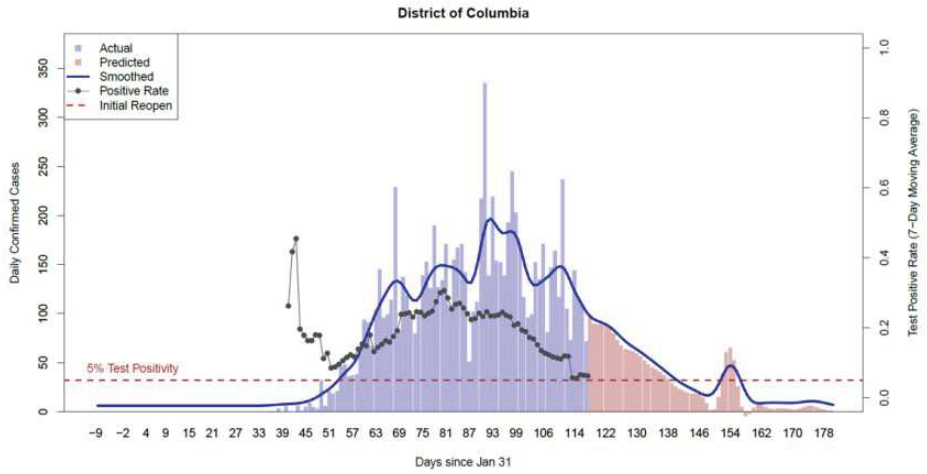
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 48:



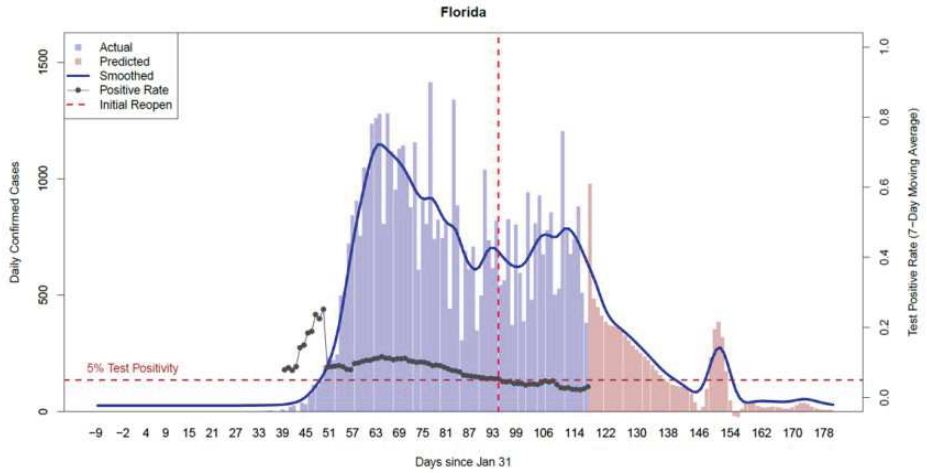
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 49:



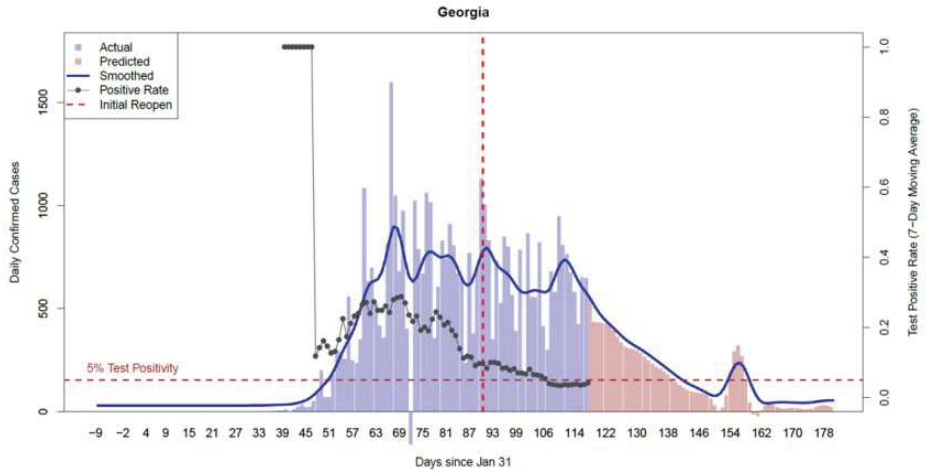
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 50:



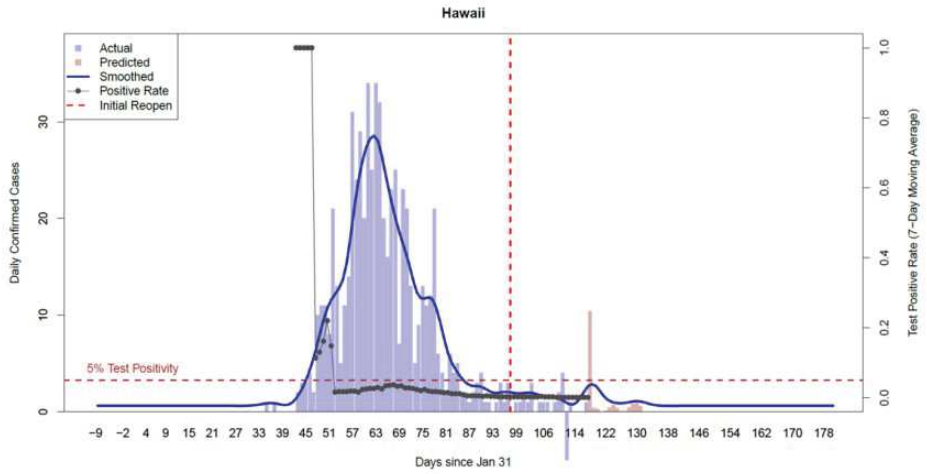
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 51:



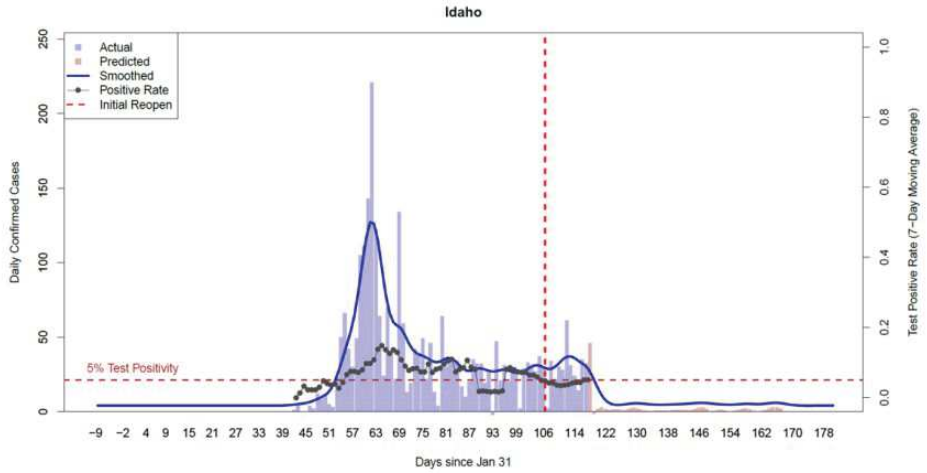
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 52:



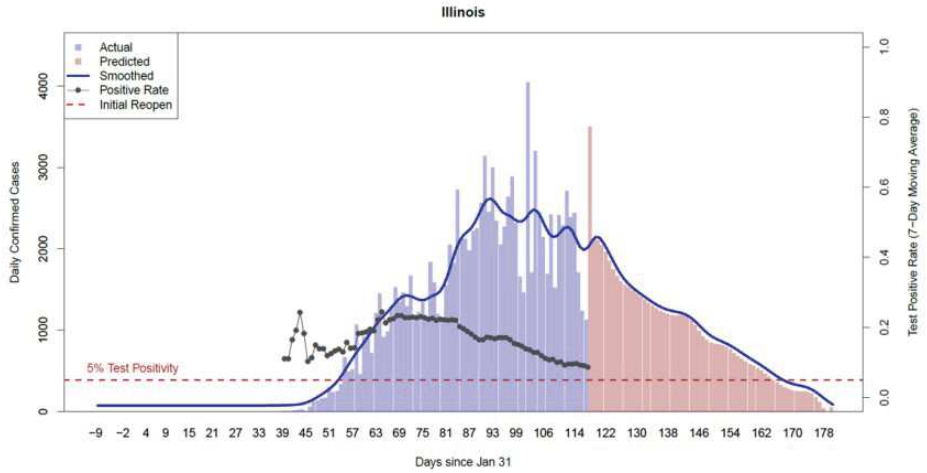
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 53:



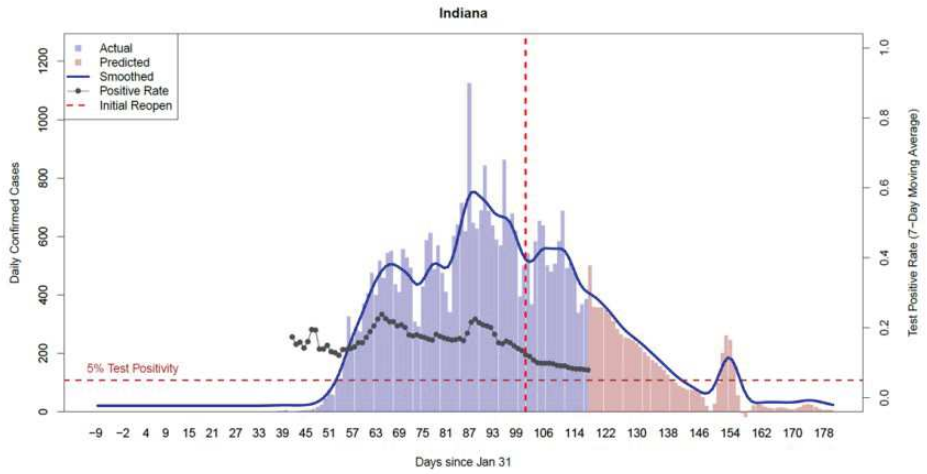
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 54:



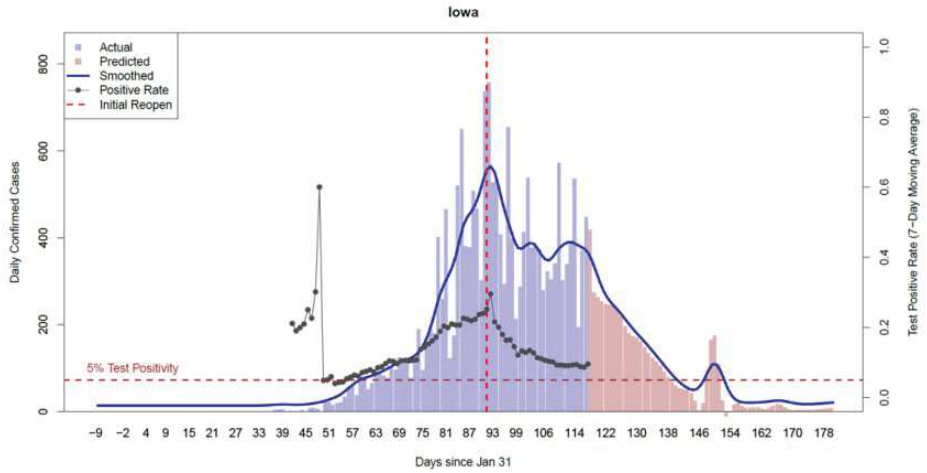
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 55:



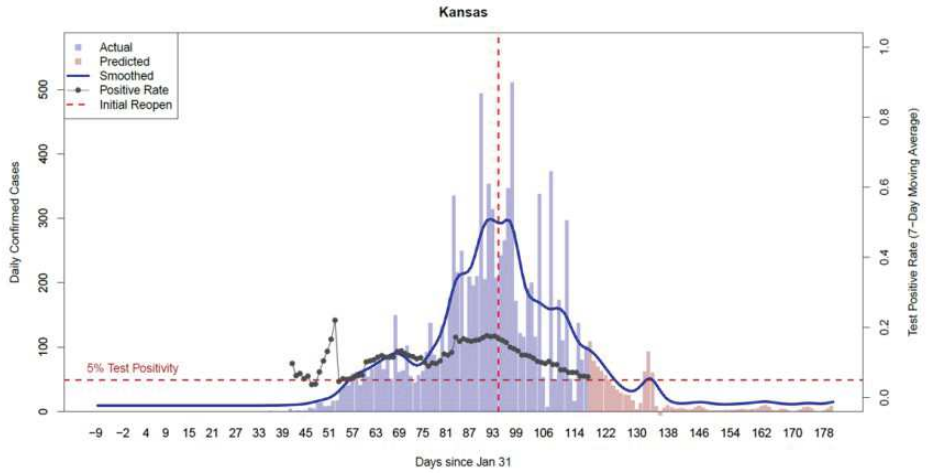
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 56:



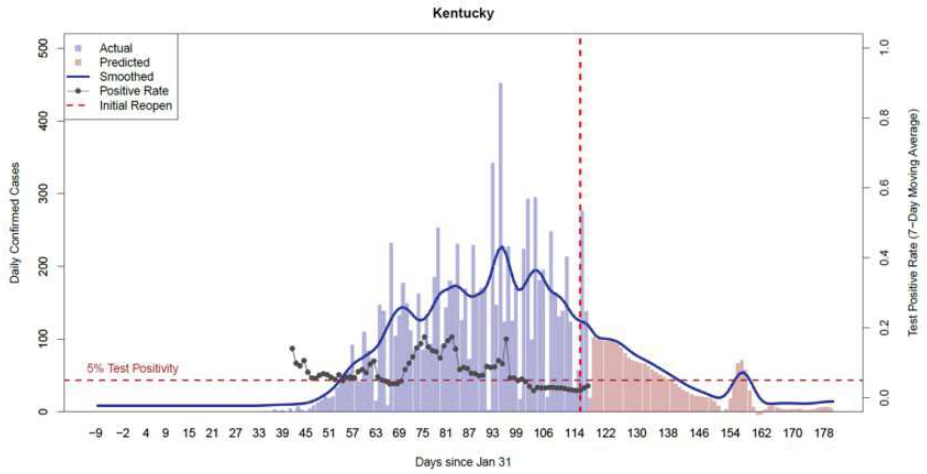
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 57:



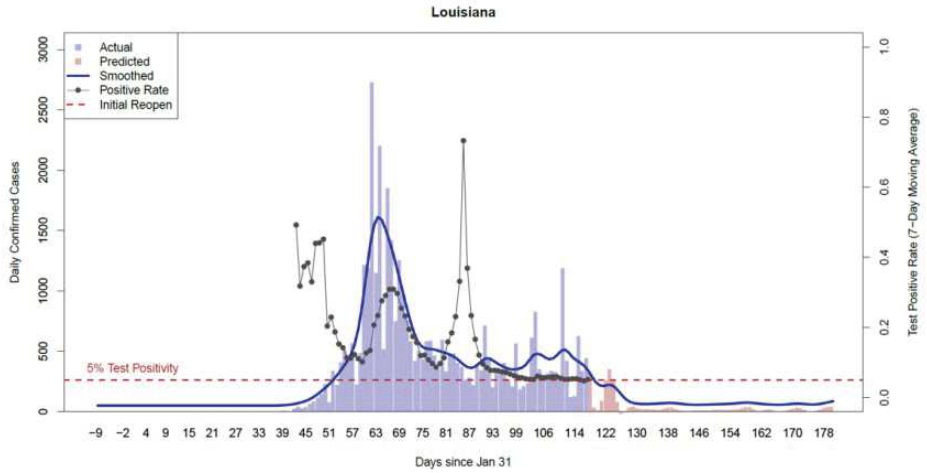
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 58:



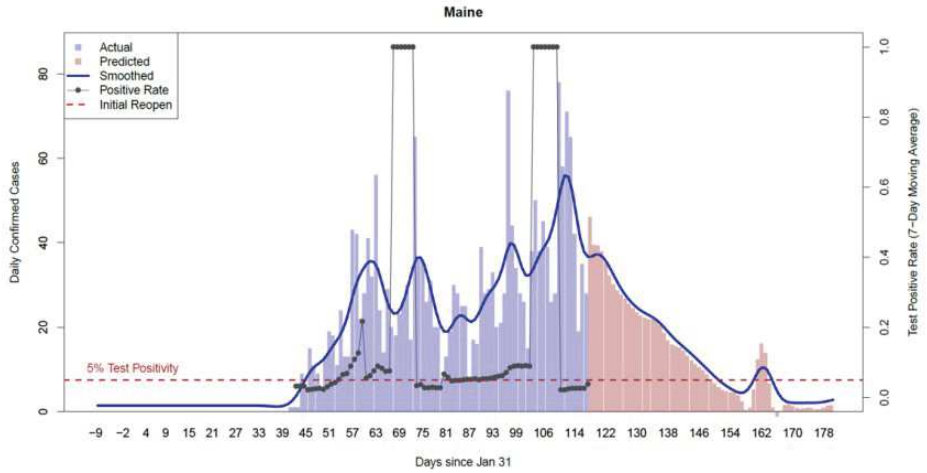
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 59:



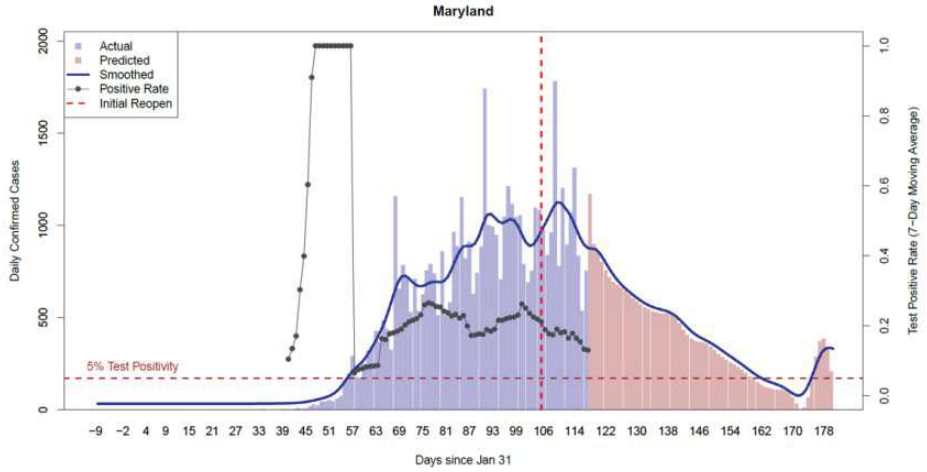
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 60:



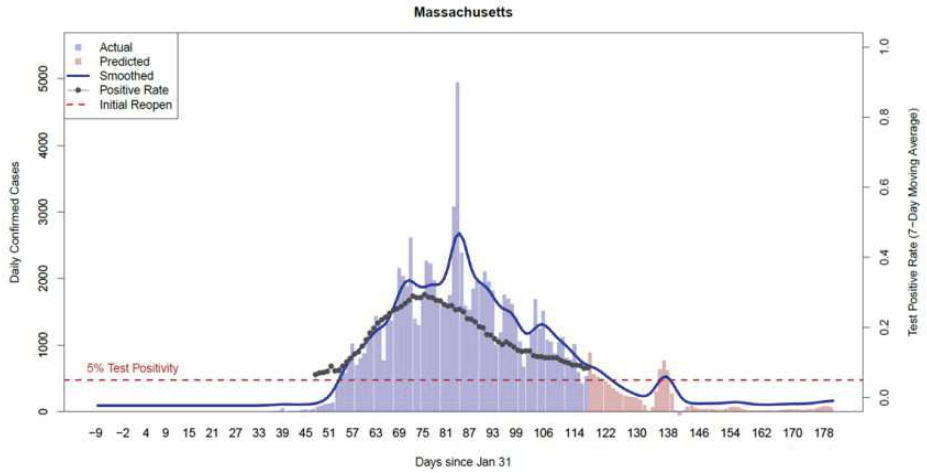
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 61:



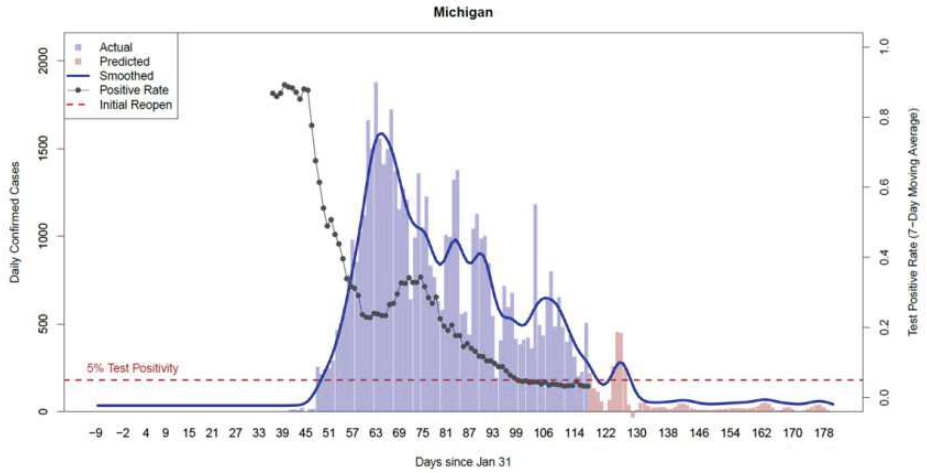
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 62:



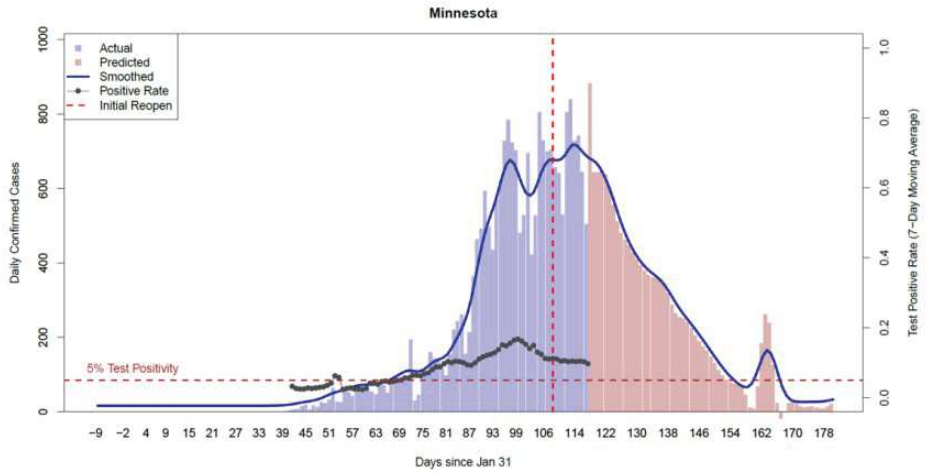
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 63:



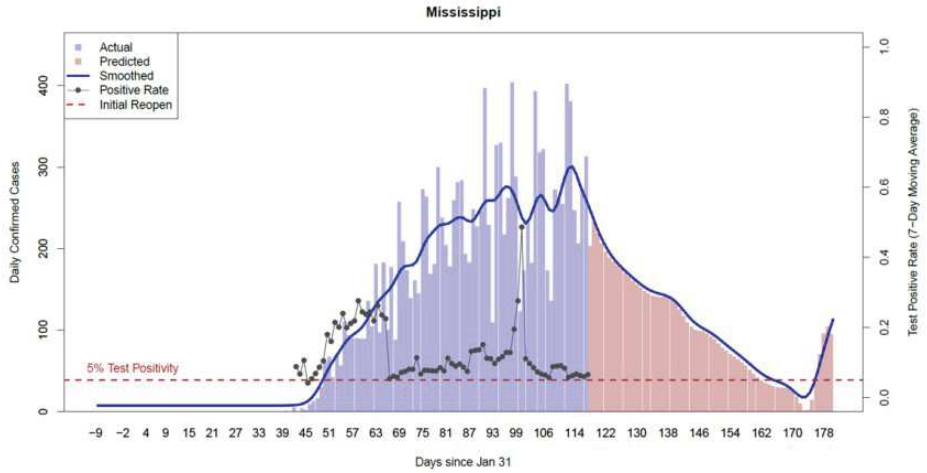
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 64:



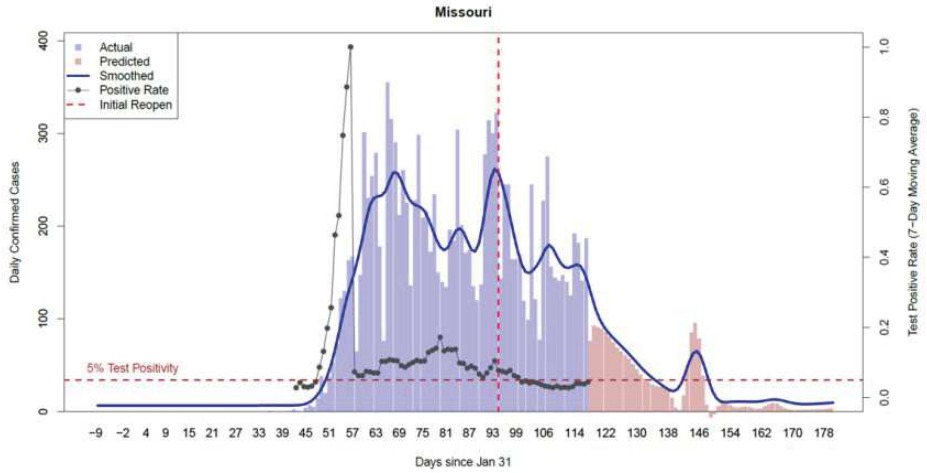
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 65:



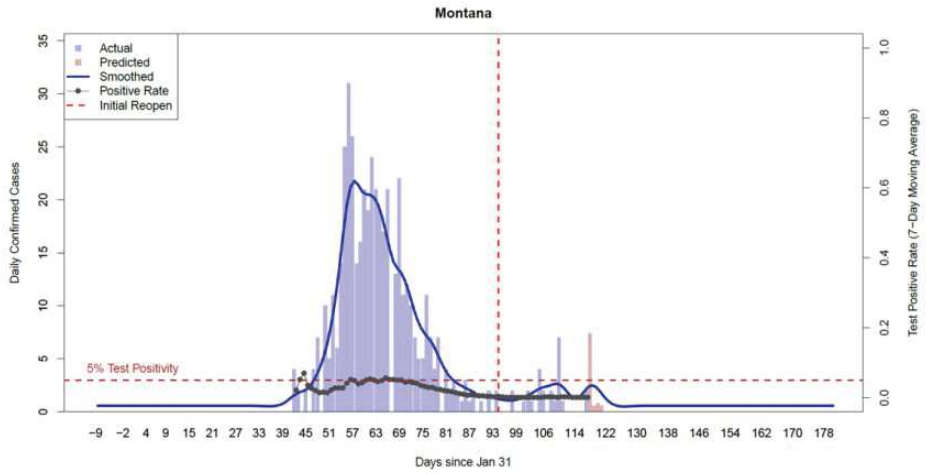
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 66:



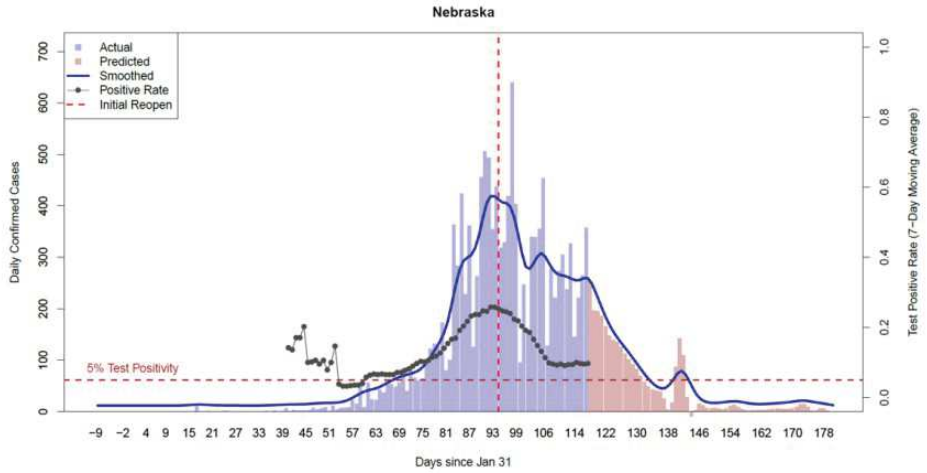
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 67:



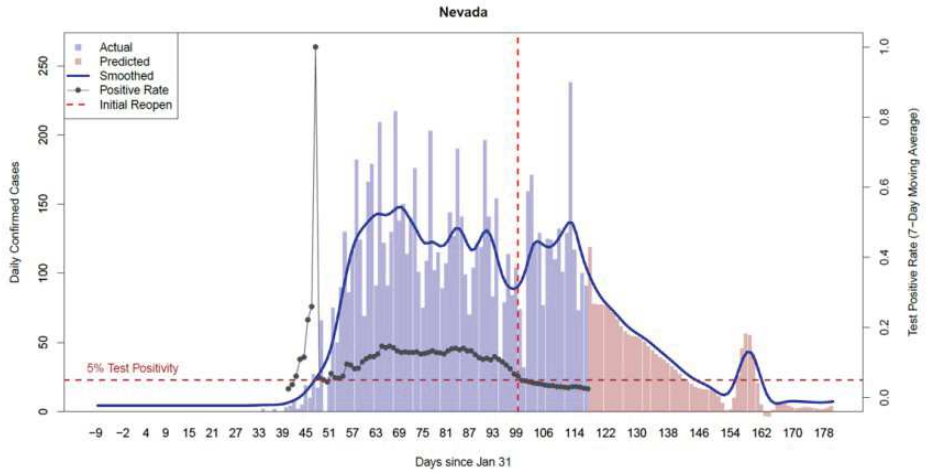
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 68:



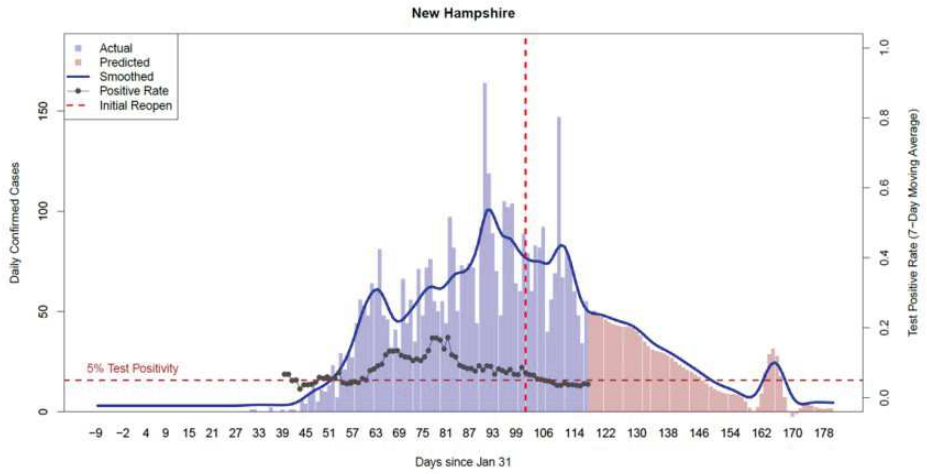
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 69:



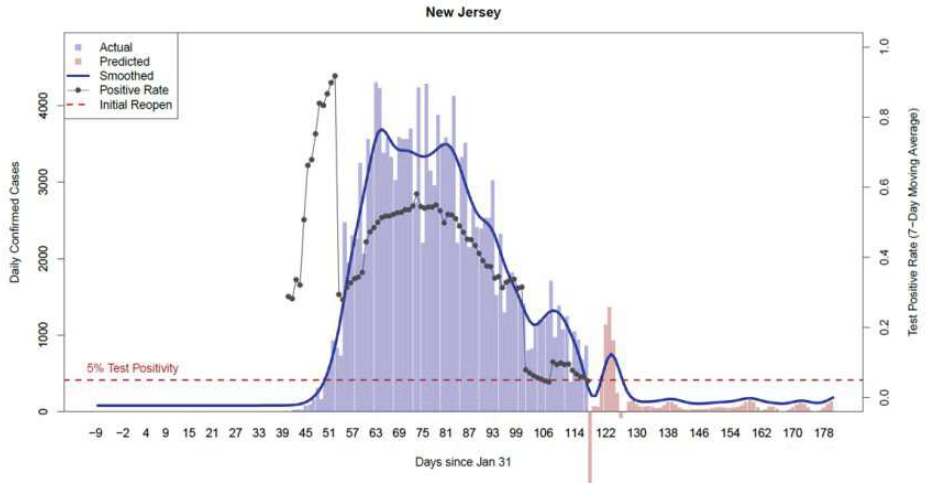
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 70:



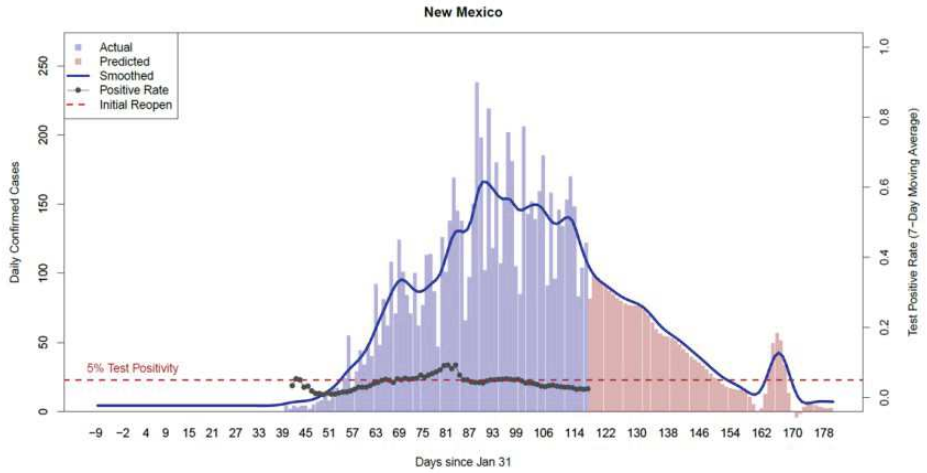
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 71:



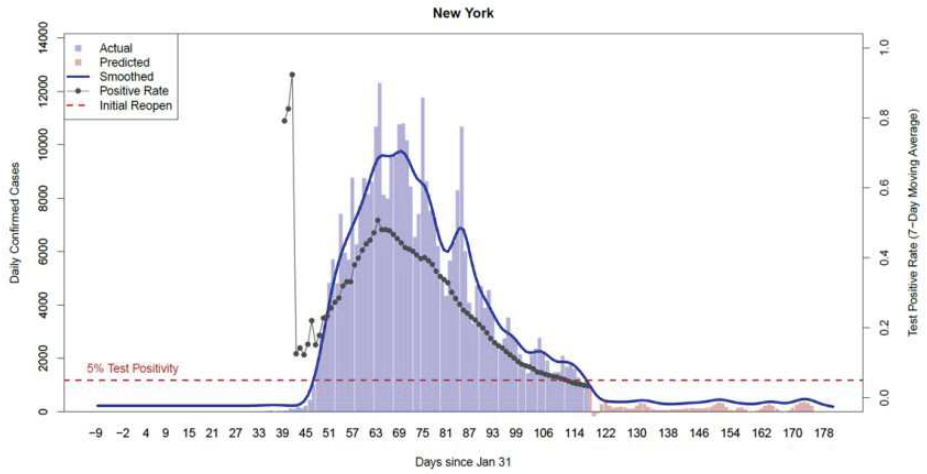
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 72:



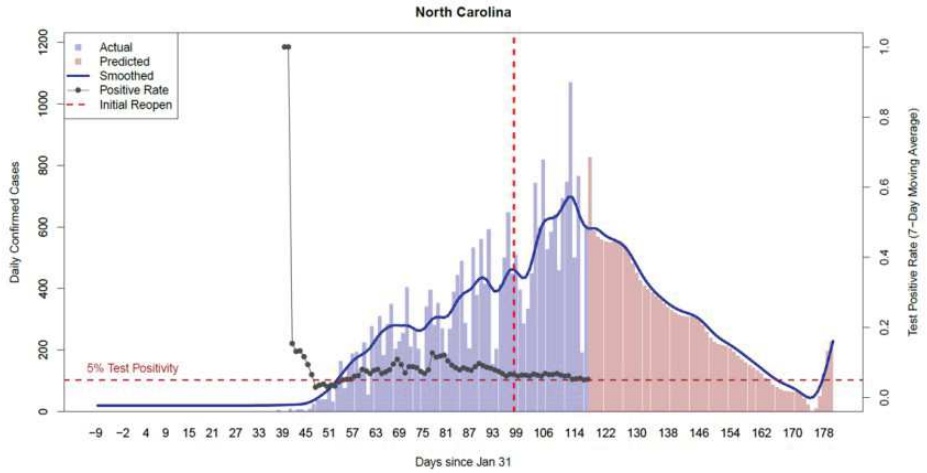
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 73:



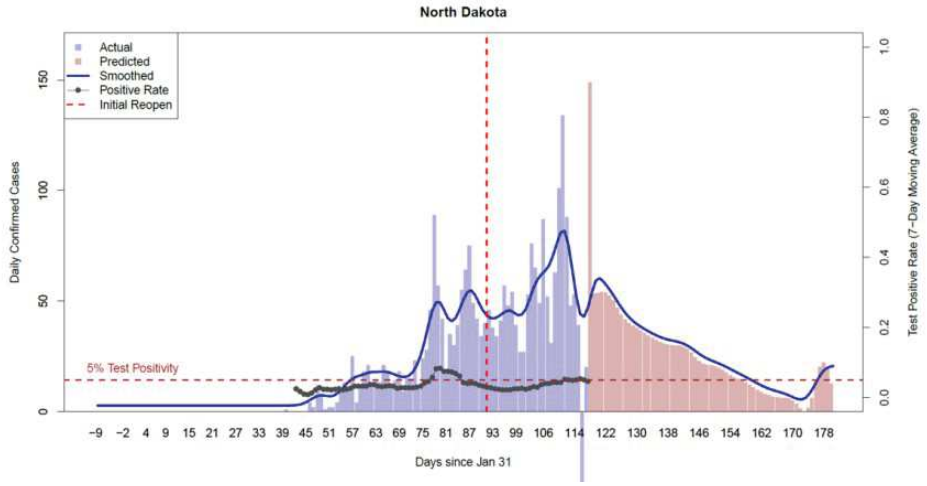
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 74:



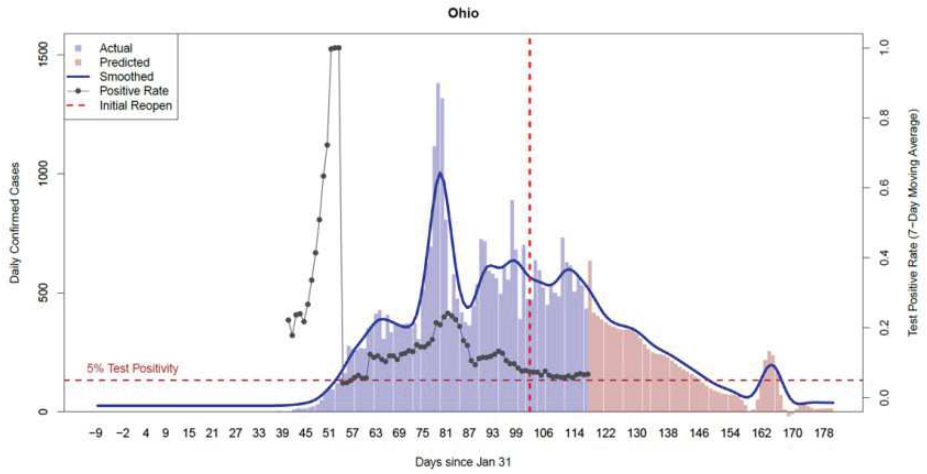
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 75:



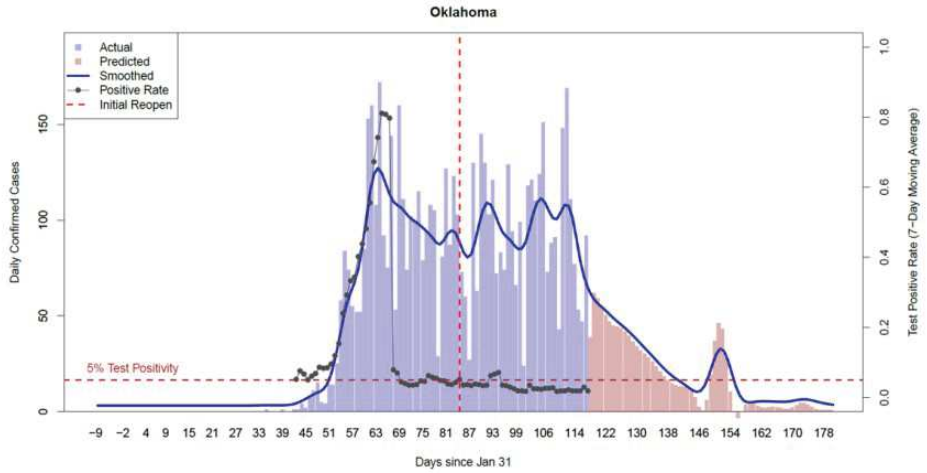
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 76:



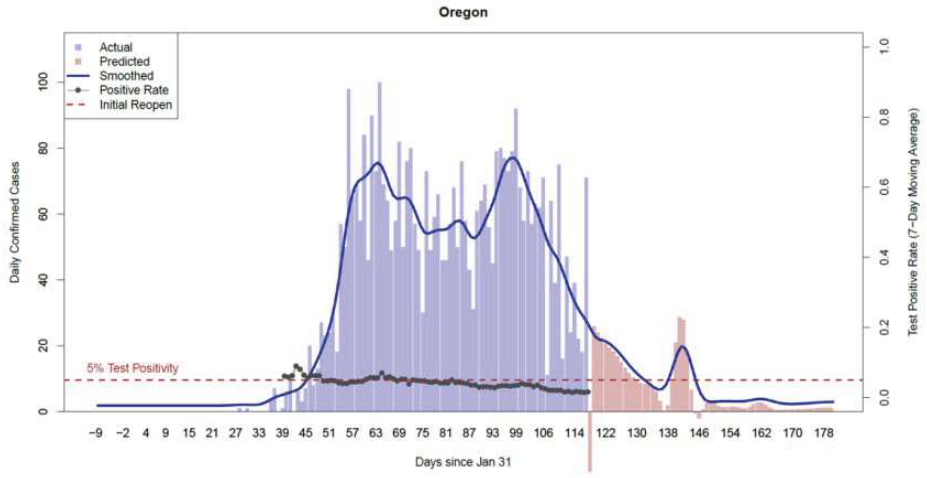
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 77:



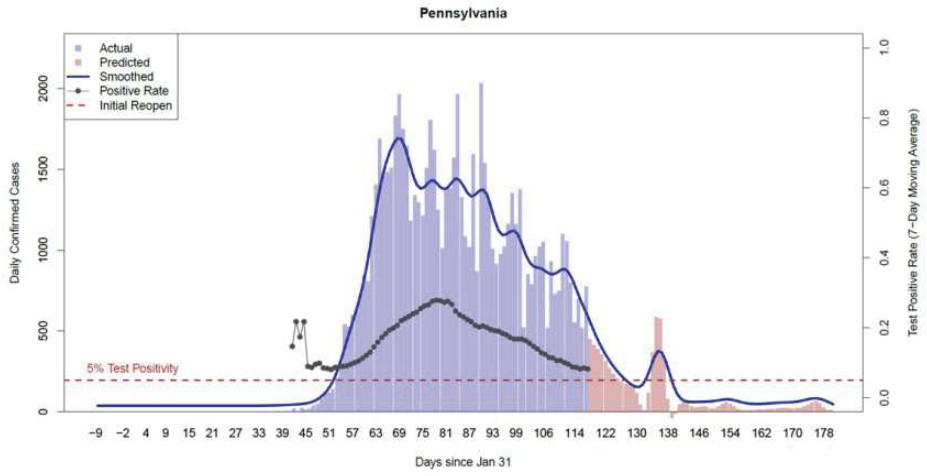
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 78:



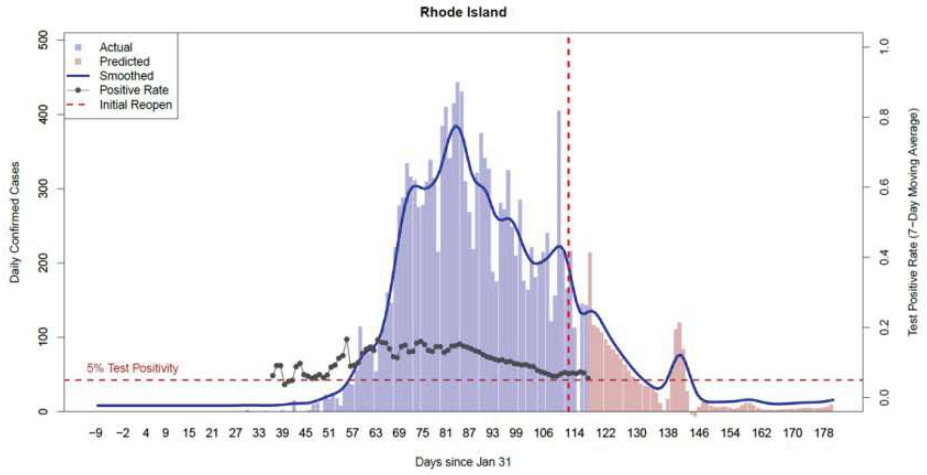
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 79:



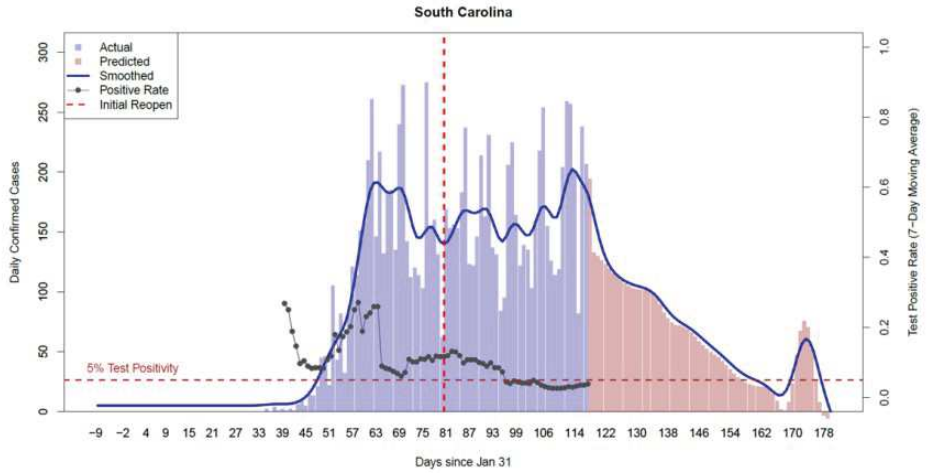
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 80:



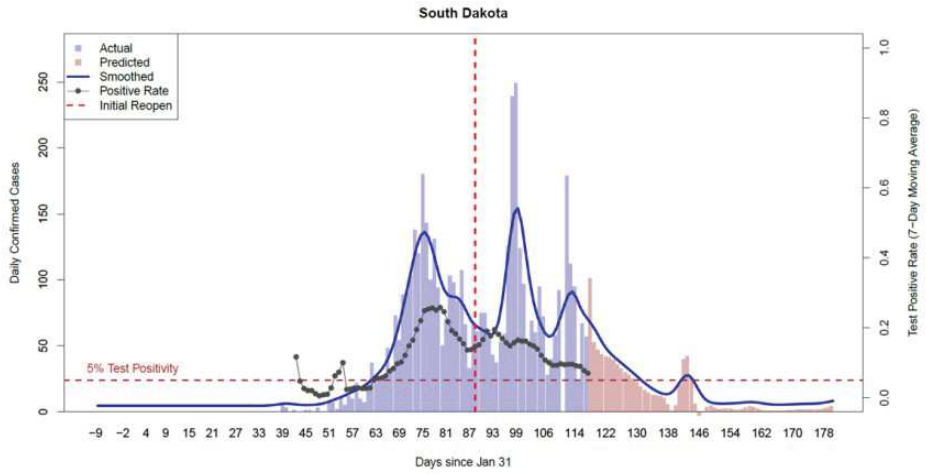
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 81:



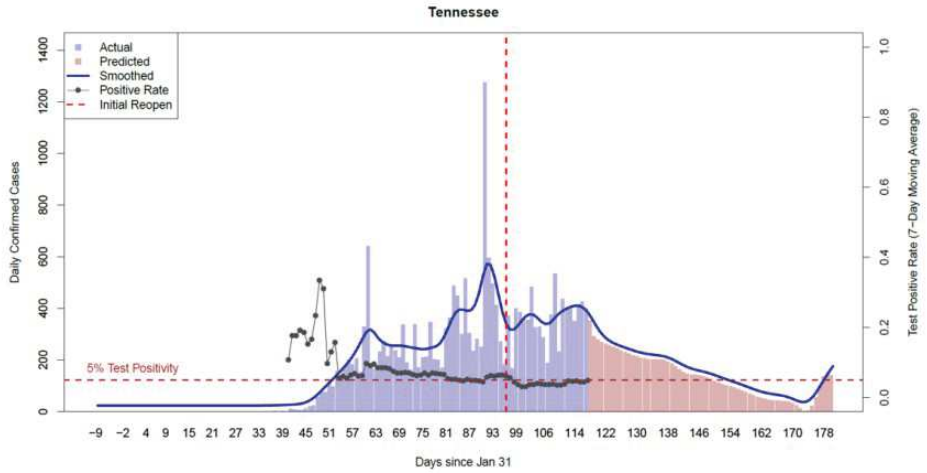
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 82:



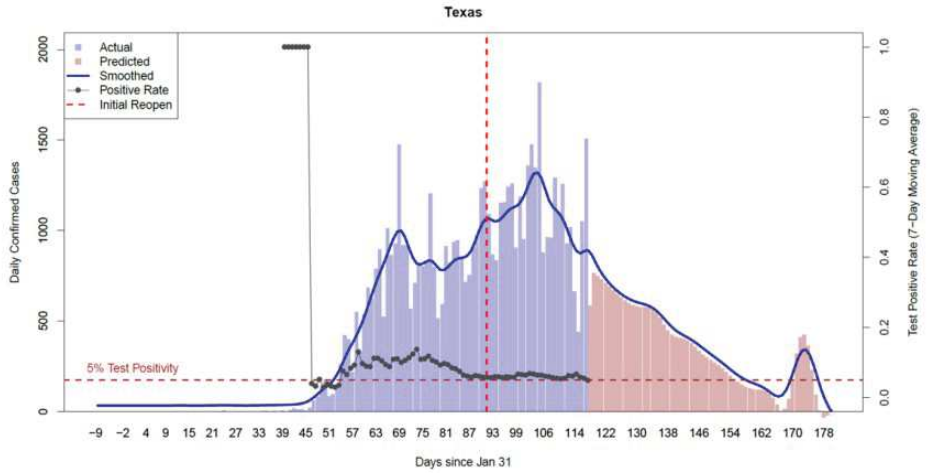
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 83:



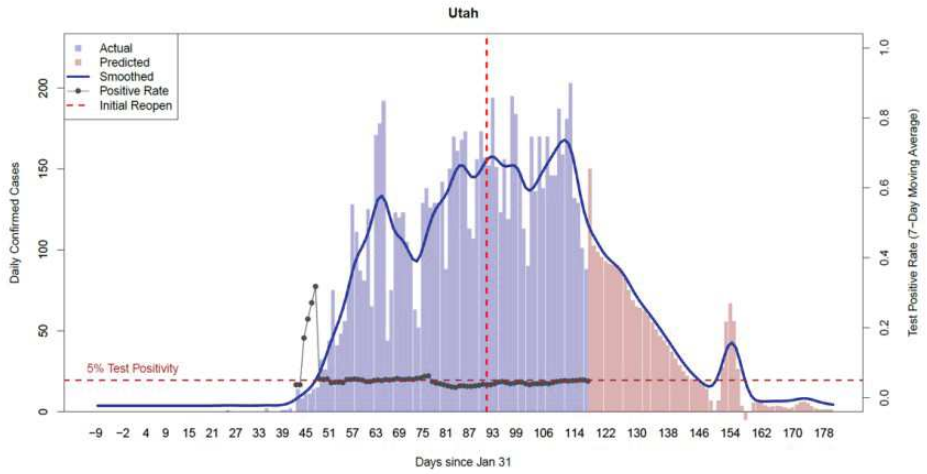
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 84:



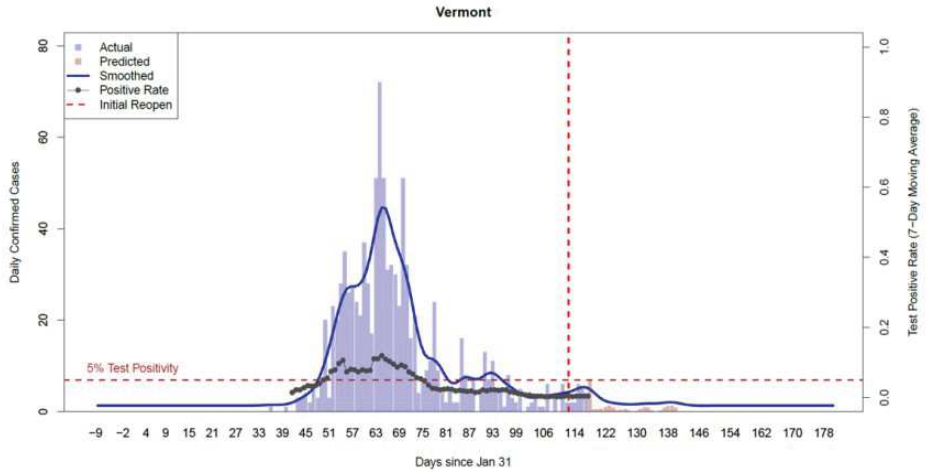
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 85:



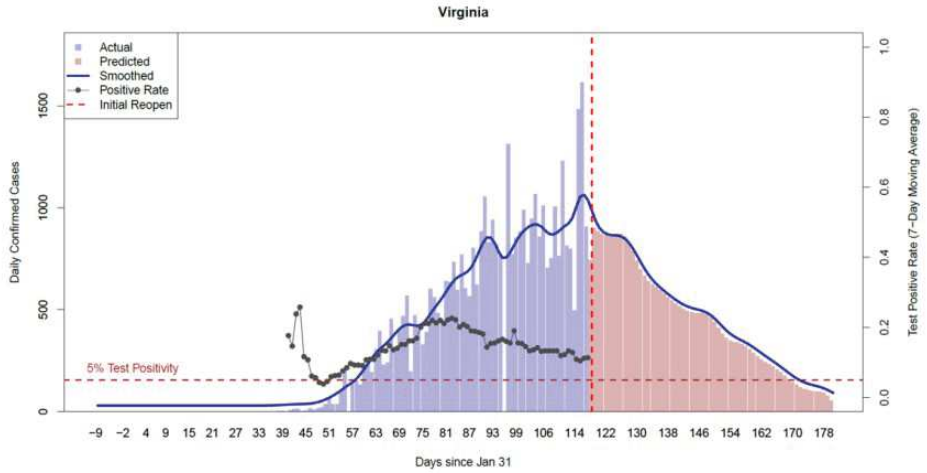
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 86:



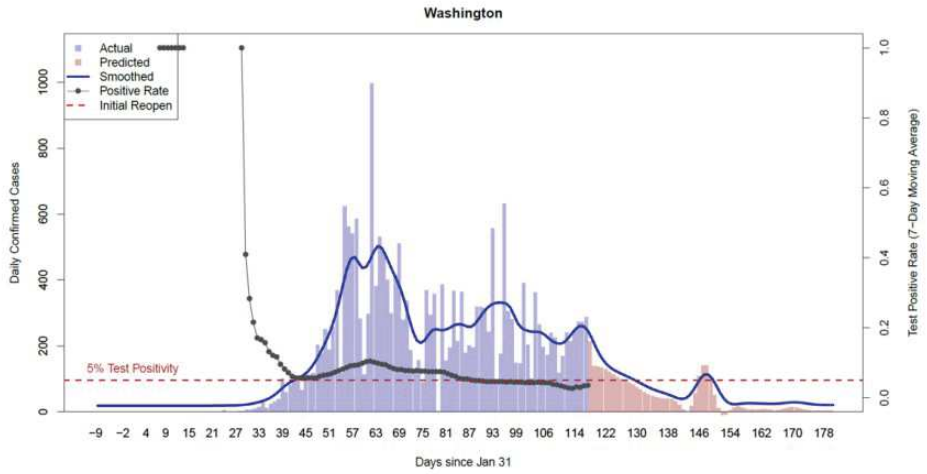
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 87:



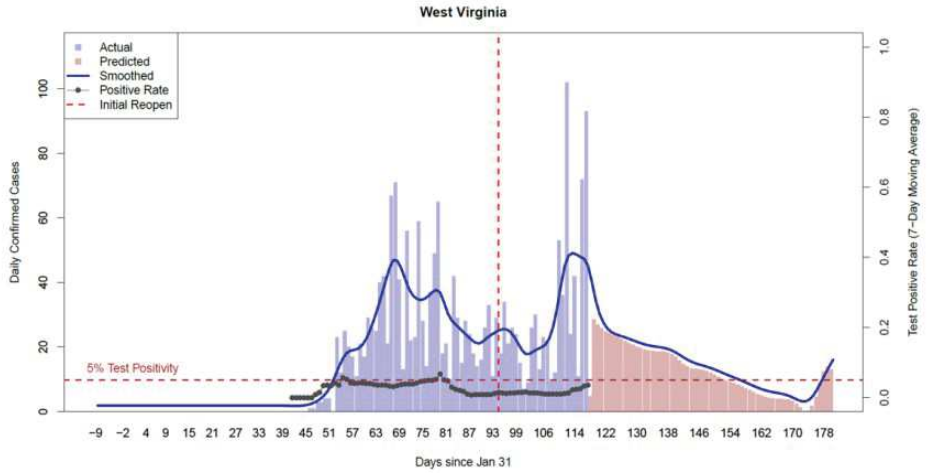
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 88:



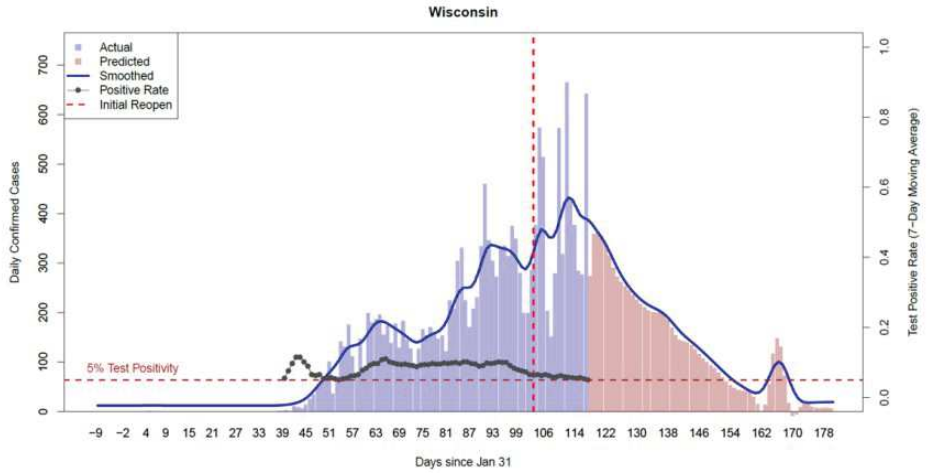
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 89:



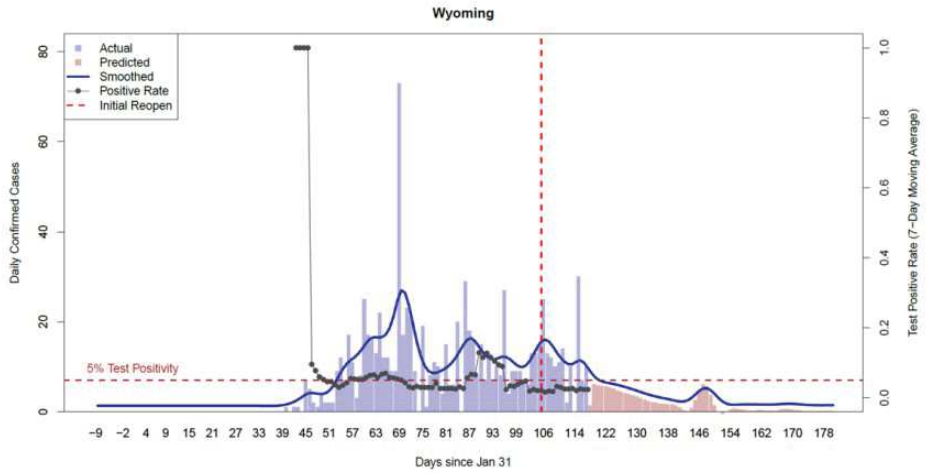
Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 90:



Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Exhibit 91:



Source: Morgan Stanley, NY Times, The COVID Tracking Project, Johns Hopkins CSSE.

Disclosure Section

The information and opinions in Morgan Stanley Research were prepared by Morgan Stanley & Co. LLC, and/or Morgan Stanley C.T.V.M. S.A., and/or Morgan Stanley Mexico, Casa de Bolsa, S.A. de C.V., and/or Morgan Stanley Canada Limited. As used in this disclosure section, "Morgan Stanley" includes Morgan Stanley & Co. LLC, Morgan Stanley C.T.V.M. S.A., Morgan Stanley Mexico, Casa de Bolsa, S.A. de C.V., Morgan Stanley Canada Limited and their affiliates as necessary.

For important disclosures, stock price charts and equity rating histories regarding companies that are the subject of this report, please see the Morgan Stanley Research Disclosure Website at www.morganstanley.com/researchdisclosures, or contact your investment representative or Morgan Stanley Research at 1585 Broadway, (Attention: Research Management), New York, NY, 10036 USA.

For valuation methodology and risks associated with any recommendation, rating or price target referenced in this research report, please contact the Client Support Team as follows: US/Canada +1 800 303-2495; Hong Kong +852 2848-5999; Latin America +1 718 754-5444 (U.S.); London +44 (0)20-7425-8169; Singapore +65 6834-6860; Sydney +61 (0)2-9770-1505; Tokyo +81 (0)3-6836-9000. Alternatively you may contact your investment representative or Morgan Stanley Research at 1585 Broadway, (Attention: Research Management), New York, NY 10036 USA.

Analyst Certification

The following analysts hereby certify that their views about the companies and their securities discussed in this report are accurately expressed and that they have not received and will not receive direct or indirect compensation in exchange for expressing specific recommendations or views in this report: Matthew Harrison.

Unless otherwise stated, the individuals listed on the cover page of this report are research analysts.

Global Research Conflict Management Policy

Morgan Stanley Research has been published in accordance with our conflict management policy, which is available at www.morganstanley.com/institutional/research/conflictpolicies. A Portuguese version of the policy can be found at www.morganstanley.com.br

Important Regulatory Disclosures on Subject Companies

As of April 30, 2020, Morgan Stanley beneficially owned 1% or more of a class of common equity securities of the following companies covered in Morgan Stanley Research: Alnylam Pharmaceuticals Inc, Amgen Inc., Cytokinetics Inc, DBV Technologies SA, Editas Medicine, Moderna Inc, Portola Pharmaceuticals Inc, Schrodinger Inc., Zealand Pharma A/S.

Within the last 12 months, Morgan Stanley managed or co-managed a public offering (or 144A offering) of securities of Alector Inc, Amgen Inc., Aprea Therapeutics Inc, argenx SE, AVROBIO Inc, Biogen Inc, Biomarin Pharmaceutical Inc, Cabaletta Bio Inc, Cytokinetics Inc, Fulcrum Therapeutics Inc, Genmab A/S, Imara Inc, Moderna Inc, NextCure Inc., Prevail Therapeutics Inc, Rhythm Pharmaceuticals Inc, Schrodinger Inc., Viela Bio, Y-mABs Therapeutics Inc., Zealand Pharma A/S, Zentalis Pharmaceuticals Inc.

Within the last 12 months, Morgan Stanley has received compensation for investment banking services from Alector Inc, Alexion Pharmaceuticals, Amgen Inc., Aprea Therapeutics Inc, argenx SE, AVROBIO Inc, Biogen Inc, Biomarin Pharmaceutical Inc, Cabaletta Bio Inc, Cytokinetics Inc, Fulcrum Therapeutics Inc, Galapagos NV, Genmab A/S, Imara Inc, Insmed Inc, Moderna Inc, NextCure Inc., Prevail Therapeutics Inc, Rhythm Pharmaceuticals Inc, Schrodinger Inc., Viela Bio, Y-mABs Therapeutics Inc., Zealand Pharma A/S, Zentalis Pharmaceuticals Inc.

In the next 3 months, Morgan Stanley expects to receive or intends to seek compensation for investment banking services from Acceleron Pharma Inc, Akebia Therapeutics Inc, Alector Inc, Alexion Pharmaceuticals, Alnylam Pharmaceuticals Inc, Amgen Inc., Aprea Therapeutics Inc, argenx SE, Ascendis Pharma A/S, AVROBIO Inc, BeiGene Ltd, Biogen Inc, Biohaven Pharmaceutical Holding Company, Biomarin Pharmaceutical Inc, Bluebird Bio Inc, Blueprint Medicines Corporation, Cabaletta Bio Inc, Cytokinetics Inc, DBV Technologies SA, Denali Therapeutics Inc, Editas Medicine, Epizyme Inc, Evelo Biosciences Inc, Exelixis Inc., Fulcrum Therapeutics Inc, Galapagos NV, Genmab A/S, Gilead Sciences Inc., Global Blood Therapeutics Inc, Imara Inc, Immunomedics Inc, Incyte Corp, Innoviva Inc, Insmed Inc, Ionis Pharmaceuticals Inc, Ironwood Pharmaceuticals, Inc., Kaleido Biosciences Inc., Kodiak Sciences Inc, Moderna Inc, MyoKardia Inc, Nabriva Therapeutics PLC, Neurocrine Biosciences Inc, NextCure Inc., Portola Pharmaceuticals Inc, Prevail Therapeutics Inc, Radius Health Inc, Regeneron Pharmaceuticals Inc., Regenxbio Inc, Rhythm Pharmaceuticals Inc, Rubius Therapeutics Inc., SAGE Therapeutics Inc, Sarepta Therapeutics Inc, Schrodinger Inc., Seattle Genetics Inc., Syndax Pharmaceuticals Inc, Ultragenyx Pharmaceutical Inc, Unity Biotechnology Inc., Vertex Pharmaceuticals, Viela Bio, Voyager Therapeutics Inc, Y-mABs Therapeutics Inc., Zealand Pharma A/S, Zentalis Pharmaceuticals Inc.

Within the last 12 months, Morgan Stanley has received compensation for products and services other than investment banking services from Amgen Inc., Biogen Inc, Galapagos NV, Gilead Sciences Inc., Vertex Pharmaceuticals.

Within the last 12 months, Morgan Stanley has provided or is providing investment banking services to, or has an investment banking client relationship with, the following company: Acceleron Pharma Inc, Akebia Therapeutics Inc, Alector Inc, Alexion Pharmaceuticals, Alnylam Pharmaceuticals Inc, Amgen Inc., Aprea Therapeutics Inc, argenx SE, Ascendis Pharma A/S, AVROBIO Inc, BeiGene Ltd, Biogen Inc, Biohaven Pharmaceutical Holding Company, Biomarin Pharmaceutical Inc, Bluebird Bio Inc, Blueprint Medicines Corporation, Cabaletta Bio Inc, Cytokinetics Inc, DBV Technologies SA, Denali Therapeutics Inc, Editas Medicine, Epizyme Inc, Evelo Biosciences Inc, Exelixis Inc., Fulcrum Therapeutics Inc, Galapagos NV, Genmab A/S, Gilead Sciences Inc., Global Blood Therapeutics Inc, Imara Inc, Immunomedics Inc, Incyte Corp, Innoviva Inc, Insmed Inc, Ionis Pharmaceuticals Inc, Ironwood Pharmaceuticals, Inc., Kaleido Biosciences Inc., Kodiak Sciences Inc, Moderna Inc, MyoKardia Inc, Nabriva Therapeutics PLC, Neurocrine Biosciences Inc, NextCure Inc., Portola Pharmaceuticals Inc, Prevail Therapeutics Inc, Radius Health Inc, Regeneron Pharmaceuticals Inc., Regenxbio Inc, Rhythm Pharmaceuticals Inc, Rubius Therapeutics Inc., SAGE Therapeutics Inc, Sarepta Therapeutics Inc, Schrodinger Inc., Seattle Genetics Inc., Syndax Pharmaceuticals Inc, Ultragenyx Pharmaceutical Inc, Unity Biotechnology Inc., Vertex Pharmaceuticals, Viela Bio, Voyager Therapeutics Inc, Y-mABs Therapeutics Inc., Zealand Pharma A/S, Zentalis Pharmaceuticals Inc.

Within the last 12 months, Morgan Stanley has either provided or is providing non-investment banking, securities-related services to and/or in the past has entered into an agreement to provide services or has a client relationship with the following company: Amgen Inc., BeiGene Ltd, Biogen Inc, Biomarin Pharmaceutical Inc, Cytokinetics Inc, DBV Technologies SA, Galapagos NV, Genmab A/S, Gilead Sciences Inc., Regeneron Pharmaceuticals Inc., Vertex Pharmaceuticals.

Morgan Stanley & Co. LLC makes a market in the securities of Acceleron Pharma Inc, Akebia Therapeutics Inc, Alector Inc, Alexion Pharmaceuticals, Alnylam Pharmaceuticals Inc, Amgen Inc., AVROBIO Inc, Biogen Inc, Biomarin Pharmaceutical Inc, Bluebird Bio Inc, Blueprint Medicines Corporation, Cabaletta Bio Inc, Cytokinetics Inc, Epizyme Inc, Evelo Biosciences Inc, Exelixis Inc., Fulcrum Therapeutics Inc, Gilead Sciences Inc., Global Blood Therapeutics Inc, Imara Inc, Immunomedics Inc, Incyte Corp, Innoviva Inc, Insmed Inc, Ionis Pharmaceuticals Inc, Ironwood Pharmaceuticals, Inc., Kodiak Sciences Inc, MacroGenics Inc, Moderna Inc, Neurocrine Biosciences Inc, NextCure Inc., Portola Pharmaceuticals Inc, Prevail Therapeutics Inc, Radius Health Inc, Regeneron Pharmaceuticals Inc., Rhythm Pharmaceuticals Inc, Schrodinger Inc., Seattle Genetics Inc., Ultragenyx Pharmaceutical Inc, Vertex Pharmaceuticals, Zealand Pharma A/S, Zentalis Pharmaceuticals Inc.

The equity research analysts or strategists principally responsible for the preparation of Morgan Stanley Research have received compensation based upon various factors, including quality of research, investor client feedback, stock picking, competitive factors, firm revenues and overall investment banking revenues. Equity Research analysts' or strategists' compensation is not linked to investment banking or capital markets transactions performed by Morgan Stanley or the profitability or revenues of particular trading desks.

Morgan Stanley and its affiliates do business that relates to companies/instruments covered in Morgan Stanley Research, including market making, providing

liquidity, fund management, commercial banking, extension of credit, investment services and investment banking. Morgan Stanley sells to and buys from customers the securities/instruments of companies covered in Morgan Stanley Research on a principal basis. Morgan Stanley may have a position in the debt of the Company or instruments discussed in this report. Morgan Stanley trades or may trade as principal in the debt securities (or in related derivatives) that are the subject of the debt research report.
Certain disclosures listed above are also for compliance with applicable regulations in non-US jurisdictions.

STOCK RATINGS

Morgan Stanley uses a relative rating system using terms such as Overweight, Equal-weight, Not-Rated or Underweight (see definitions below). Morgan Stanley does not assign ratings of Buy, Hold or Sell to the stocks we cover. Overweight, Equal-weight, Not-Rated and Underweight are not the equivalent of buy, hold and sell. Investors should carefully read the definitions of all ratings used in Morgan Stanley Research. In addition, since Morgan Stanley Research contains more complete information concerning the analyst's views, investors should carefully read Morgan Stanley Research, in its entirety, and not infer the contents from the rating alone. In any case, ratings (or research) should not be used or relied upon as investment advice. An investor's decision to buy or sell a stock should depend on individual circumstances (such as the investor's existing holdings) and other considerations.

Global Stock Ratings Distribution

(as of April 30, 2020)
The Stock Ratings described below apply to Morgan Stanley's Fundamental Equity Research and do not apply to Debt Research produced by the Firm.
For disclosure purposes only (in accordance with FINRA requirements), we include the category headings of Buy, Hold, and Sell alongside our ratings of Overweight, Equal-weight, Not-Rated and Underweight. Morgan Stanley does not assign ratings of Buy, Hold or Sell to the stocks we cover. Overweight, Equal-weight, Not-Rated and Underweight are not the equivalent of buy, hold, and sell but represent recommended relative weightings (see definitions below).
To satisfy regulatory requirements, we correspond Overweight, our most positive stock rating, with a buy recommendation; we correspond Equal-weight and Not-Rated to hold and Underweight to sell recommendations, respectively.

	COVERAGE UNIVERSE		INVESTMENT BANKING CLIENTS (IBC)			OTHER MATERIAL INVESTMENT SERVICES CLIENTS (MISC)	
STOCK RATING CATEGORY	COUNT	% OF TOTAL	COUNT	% OF TOTAL IBC	% OF RATING CATEGORY	COUNT	% OF TOTAL OTHER MISC
Overweight/Buy	**1216**	**38%**	**300**	**42%**	**25%**	**533**	**37%**
Equal-weight/Hold	**1432**	**45%**	**325**	**46%**	**23%**	**698**	**48%**
Not-Rated/Hold	**3**	**0%**	**1**	**0%**	**33%**	**3**	**0%**
Underweight/Sell	**553**	**17%**	**81**	**11%**	**15%**	**220**	**15%**
TOTAL	**3,204**		**707**			**1454**	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the "% of total" column may not add up to exactly 100 percent.

Analyst Stock Ratings

Overweight (O). The stock's total return is expected to exceed the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Equal-weight (E). The stock's total return is expected to be in line with the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Not-Rated (NR). Currently the analyst does not have adequate conviction about the stock's total return relative to the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Underweight (U). The stock's total return is expected to be below the average total return of the analyst's industry (or industry team's) coverage universe, on a risk-adjusted basis, over the next 12-18 months.
Unless otherwise specified, the time frame for price targets included in Morgan Stanley Research is 12 to 18 months.

Analyst Industry Views

Attractive (A): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be attractive vs. the relevant broad market benchmark, as indicated below.
In-Line (I): The analyst expects the performance of his or her industry coverage universe over the next 12-18 months to be in line with the relevant broad market benchmark, as indicated below.
Cautious (C): The analyst views the performance of his or her industry coverage universe over the next 12-18 months with caution vs. the relevant broad market benchmark, as indicated below.
Benchmarks for each region are as follows: North America - S&P 500; Latin America - relevant MSCI country index or MSCI Latin America Index; Europe - MSCI Europe; Japan - TOPIX; Asia - relevant MSCI country index or MSCI sub-regional index or MSCI AC Asia Pacific ex Japan Index.

Important Disclosures for Morgan Stanley Smith Barney LLC Customers

Important disclosures regarding the relationship between the companies that are the subject of Morgan Stanley Research and Morgan Stanley Smith Barney LLC or Morgan Stanley or any of their affiliates, are available on the Morgan Stanley Wealth Management disclosure website at www.morganstanley.com/online/researchdisclosures. For Morgan Stanley specific disclosures, you may refer to www.morganstanley.com/researchdisclosures.
Each Morgan Stanley Equity Research report is reviewed and approved on behalf of Morgan Stanley Smith Barney LLC. This review and approval is conducted by the same person who reviews the Equity Research report on behalf of Morgan Stanley. This could create a conflict of interest.

Other Important Disclosures

Morgan Stanley & Co. International PLC and its affiliates have a significant financial interest in the debt securities of Amgen Inc., Biogen Inc, Biomarin Pharmaceutical Inc, Cytokinetics Inc, Gilead Sciences Inc., Insmed Inc, Ionis Pharmaceuticals Inc, Neurocrine Biosciences Inc, Radius Health Inc, Sarepta

Therapeutics Inc.
Morgan Stanley Research policy is to update research reports as and when the Research Analyst and Research Management deem appropriate, based on developments with the issuer, the sector, or the market that may have a material impact on the research views or opinions stated therein. In addition, certain Research publications are intended to be updated on a regular periodic basis (weekly/monthly/quarterly/annual) and will ordinarily be updated with that frequency, unless the Research Analyst and Research Management determine that a different publication schedule is appropriate based on current conditions.
Morgan Stanley is not acting as a municipal advisor and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of Section 975 of the Dodd-Frank Wall Street Reform and Consumer Protection Act.
Morgan Stanley produces an equity research product called a "Tactical Idea." Views contained in a "Tactical Idea" on a particular stock may be contrary to the recommendations or views expressed in research on the same stock. This may be the result of differing time horizons, methodologies, market events, or other factors. For all research available on a particular stock, please contact your sales representative or go to Matrix at http://www.morganstanley.com/matrix.
Morgan Stanley Research is provided to our clients through our proprietary research portal on Matrix and also distributed electronically by Morgan Stanley to clients. Certain, but not all, Morgan Stanley Research products are also made available to clients through third-party vendors or redistributed to clients through alternate electronic means as a convenience. For access to all available Morgan Stanley Research, please contact your sales representative or go to Matrix at http://www.morganstanley.com/matrix.
Any access and/or use of Morgan Stanley Research is subject to Morgan Stanley's Terms of Use (http://www.morganstanley.com/terms.html). By accessing and/or using Morgan Stanley Research, you are indicating that you have read and agree to be bound by our Terms of Use (http://www.morganstanley.com/terms.html). In addition you consent to Morgan Stanley processing your personal data and using cookies in accordance with our Privacy Policy and our Global Cookies Policy (http://www.morganstanley.com/privacy_pledge.html), including for the purposes of setting your preferences and to collect readership data so that we can deliver better and more personalized service and products to you. To find out more information about how Morgan Stanley processes personal data, how we use cookies and how to reject cookies see our Privacy Policy and our Global Cookies Policy (http://www.morganstanley.com/privacy_pledge.html).
If you do not agree to our Terms of Use and/or if you do not wish to provide your consent to Morgan Stanley processing your personal data or using cookies please do not access our research.
Morgan Stanley Research does not provide individually tailored investment advice. Morgan Stanley Research has been prepared without regard to the circumstances and objectives of those who receive it. Morgan Stanley recommends that investors independently evaluate particular investments and strategies, and encourages investors to seek the advice of a financial adviser. The appropriateness of an investment or strategy will depend on an investor's circumstances and objectives. The securities, instruments, or strategies discussed in Morgan Stanley Research may not be suitable for all investors, and certain investors may not be eligible to purchase or participate in some or all of them. Morgan Stanley Research is not an offer to buy or sell or the solicitation of an offer to buy or sell any security/instrument or to participate in any particular trading strategy. The value of and income from your investments may vary because of changes in interest rates, foreign exchange rates, default rates, prepayment rates, securities/instruments prices, market indexes, operational or financial conditions of companies or other factors. There may be time limitations on the exercise of options or other rights in securities/instruments transactions. Past performance is not necessarily a guide to future performance. Estimates of future performance are based on assumptions that may not be realized. If provided, and unless otherwise stated, the closing price on the cover page is that of the primary exchange for the subject company's securities/instruments.
The fixed income research analysts, strategists or economists principally responsible for the preparation of Morgan Stanley Research have received compensation based upon various factors, including quality, accuracy and value of research, firm profitability or revenues (which include fixed income trading and capital markets profitability or revenues), client feedback and competitive factors. Fixed Income Research analysts', strategists' or economists' compensation is not linked to investment banking or capital markets transactions performed by Morgan Stanley or the profitability or revenues of particular trading desks.
The "Important Regulatory Disclosures on Subject Companies" section in Morgan Stanley Research lists all companies mentioned where Morgan Stanley owns 1% or more of a class of common equity securities of the companies. For all other companies mentioned in Morgan Stanley Research, Morgan Stanley may have an investment of less than 1% in securities/instruments or derivatives of securities/instruments of companies and may trade them in ways different from those discussed in Morgan Stanley Research. Employees of Morgan Stanley not involved in the preparation of Morgan Stanley Research may have investments in securities/instruments or derivatives of securities/instruments of companies mentioned and may trade them in ways different from those discussed in Morgan Stanley Research. Derivatives may be issued by Morgan Stanley or associated persons.
With the exception of information regarding Morgan Stanley, Morgan Stanley Research is based on public information. Morgan Stanley makes every effort to use reliable, comprehensive information, but we make no representation that it is accurate or complete. We have no obligation to tell you when opinions or information in Morgan Stanley Research change apart from when we intend to discontinue equity research coverage of a subject company. Facts and views presented in Morgan Stanley Research have not been reviewed by, and may not reflect information known to, professionals in other Morgan Stanley business areas, including investment banking personnel.
Morgan Stanley Research personnel may participate in company events such as site visits and are generally prohibited from accepting payment by the company of associated expenses unless pre-approved by authorized members of Research management.
Morgan Stanley may make investment decisions that are inconsistent with the recommendations or views in this report.
To our readers based in Taiwan or trading in Taiwan securities/instruments: Information on securities/instruments that trade in Taiwan is distributed by Morgan Stanley Taiwan Limited ("MSTL"). Such information is for your reference only. The reader should independently evaluate the investment risks and is solely responsible for their investment decisions. Morgan Stanley Research may not be distributed to the public media or quoted or used by the public media without the express written consent of Morgan Stanley. Any non-customer reader within the scope of Article 7-1 of the Taiwan Stock Exchange Recommendation Regulations accessing and/or receiving Morgan Stanley Research is not permitted to provide Morgan Stanley Research to any third party (including but not limited to related parties, affiliated companies and any other third parties) or engage in any activities regarding Morgan Stanley Research which may create or give the appearance of creating a conflict of interest. Information on securities/instruments that do not trade in Taiwan is for informational purposes only and is not to be construed as a recommendation or a solicitation to trade in such securities/instruments. MSTL may not execute transactions for clients in these securities/instruments.
Morgan Stanley is not incorporated under PRC law and the research in relation to this report is conducted outside the PRC. Morgan Stanley Research does not constitute an offer to sell or the solicitation of an offer to buy any securities in the PRC. PRC investors shall have the relevant qualifications to invest in such securities and shall be responsible for obtaining all relevant approvals, licenses, verifications and/or registrations from the relevant governmental authorities themselves. Neither this report nor any part of it is intended as, or shall constitute, provision of any consultancy or advisory service of securities investment as defined under PRC law. Such information is provided for your reference only.
Morgan Stanley Research is disseminated in Brazil by Morgan Stanley C.T.V.M. S.A. located at Av. Brigadeiro Faria Lima, 3600, 6th floor, São Paulo - SP, Brazil; and is regulated by the Comissão de Valores Mobiliários; in Mexico by Morgan Stanley México, Casa de Bolsa, S.A. de C.V which is regulated by Comision Nacional Bancaria y de Valores. Paseo de los Tamarindos 90, Torre 1, Col. Bosques de las Lomas Floor 29, 05120 Mexico City; in Japan by Morgan Stanley MUFG Securities Co., Ltd. and, for Commodities related research reports only, Morgan Stanley Capital Group Japan Co., Ltd; in Hong Kong by Morgan Stanley Asia Limited (which accepts responsibility for its contents) and by Morgan Stanley Asia International Limited, Hong Kong Branch; in Singapore by Morgan Stanley Asia (Singapore) Pte. (Registration number 199206298Z) and/or Morgan Stanley Asia (Singapore) Securities Pte Ltd (Registration number 200008434H), regulated by the Monetary Authority of Singapore (which accepts legal responsibility for its contents and should be contacted with respect to any matters arising from, or in connection with, Morgan Stanley Research) and by Morgan Stanley Asia International Limited,

INDUSTRY COVERAGE: Biotechnology

COMPANY (TICKER)	RATING (AS OF)	PRICE* (05/28/2020)
David N Lebowitz, CFA, MPH		
Akebia Therapeutics Inc (AKBA.O)	E (09/07/2018)	$11.51
Alnylam Pharmaceuticals Inc (ALNY.O)	O (03/05/2019)	$133.10
Ascendis Pharma A/S (ASND.O)	O (10/11/2019)	$146.79
AVROBIO Inc (AVRO.O)	O (07/16/2018)	$19.18
Blueprint Medicines Corporation (BPMC.O)	O (04/03/2019)	$66.99
Epizyme Inc (EPZM.O)	O (12/05/2019)	$18.41
Ionis Pharmaceuticals Inc (IONS.O)	U (11/07/2019)	$56.44
Ironwood Pharmaceuticals, Inc. (IRWD.O)	E (03/27/2019)	$9.76
MacroGenics Inc (MGNX.O)	U (11/21/2019)	$23.00
Nabriva Therapeutics PLC (NBRV.O)	E (03/17/2020)	$0.85
Rhythm Pharmaceuticals Inc (RYTM.O)	O (09/07/2018)	$19.84
Schrodinger Inc. (SDGR.O)	E (03/02/2020)	$62.24
Syndax Pharmaceuticals Inc (SNDX.O)	E (10/29/2018)	$16.05
Y-mABs Therapeutics Inc. (YMAB.O)	E (04/29/2020)	$37.66
Zealand Pharma A/S (ZEAL.O)	O (09/12/2018)	$37.00
Jeffrey Hung		
Acceleron Pharma Inc (XLRN.O)	O (02/03/2020)	$99.02
Aprea Therapeutics Inc (APRE.O)	E (10/28/2019)	$26.38
Cytokinetics Inc (CYTK.O)	O (04/09/2020)	$20.72
Exelixis Inc. (EXEL.O)	E (03/18/2019)	$24.33
MyoKardia Inc (MYOK.O)	O (09/10/2018)	$100.15
Neurocrine Biosciences Inc (NBIX.O)	O (09/10/2018)	$120.22
NextCure Inc. (NXTC.O)	O (06/03/2019)	$33.20
Prevail Therapeutics Inc (PRVL.O)	O (07/15/2019)	$16.89
Ultragenyx Pharmaceutical Inc (RARE.O)	O (03/27/2019)	$68.59
Viela Bio (VIE.O)	O (10/28/2019)	$45.62
Voyager Therapeutics Inc (VYGR.O)	E (09/10/2018)	$12.07
Matthew Harrison		

Alector Inc (ALEC.O)	O (03/04/2019)	$31.47
Alexion Pharmaceuticals (ALXN.O)	E (12/17/2019)	$114.42
Amgen Inc. (AMGN.O)	O (12/17/2019)	$224.13
argenx SE (ARGX.O)	O (01/04/2019)	$211.68
BeiGene Ltd (6160.HK)	O (01/17/2020)	HK$97.00
BeiGene Ltd (BGNE.O)	O (01/17/2020)	$162.36
Biogen Inc (BIIB.O)	U (03/22/2019)	$300.50
Biohaven Pharmaceutical Holding Company (BHVN.N)	E (04/09/2019)	$57.80
Biomarin Pharmaceutical Inc (BMRN.O)	O (02/07/2017)	$105.60
Bluebird Bio Inc (BLUE.O)	E (11/03/2017)	$60.81
Cabaletta Bio Inc (CABA.O)	O (11/19/2019)	$8.32
Denali Therapeutics Inc (DNLI.O)	O (01/02/2018)	$27.42
Editas Medicine (EDIT.O)	E (02/29/2016)	$27.29
Evelo Biosciences Inc (EVLO.O)	E (05/21/2020)	$4.47
Fulcrum Therapeutics Inc (FULC.O)	O (08/12/2019)	$19.17
Galapagos NV (GLPG.O)	E (12/17/2019)	$201.47
Genmab A/S (GMAB.CO)	O (08/12/2019)	DKr 2,073.00
Genmab A/S (GMAB.O)	O (08/12/2019)	$30.97
Gilead Sciences Inc. (GILD.O)	E (10/01/2015)	$75.32
Global Blood Therapeutics Inc (GBT.O)	E (03/21/2018)	$68.75
Imara Inc (IMRA.O)	O (04/06/2020)	$32.96
Immunomedics Inc (IMMU.O)	E (01/22/2019)	$33.30
Innoviva Inc (INVA.O)	U (08/14/2014)	$14.36
Insmed Inc (INSM.O)	O (03/21/2018)	$24.95
Kaleido Biosciences Inc. (KLDO.O)	E (05/21/2020)	$7.71
Kodiak Sciences Inc (KOD.O)	O (10/29/2018)	$62.71
Moderna Inc (MRNA.O)	O (01/02/2019)	$55.54
Regeneron Pharmaceuticals Inc. (REGN.O)	E (10/01/2015)	$578.21
Regenxbio Inc (RGNX.O)	O (11/09/2017)	$39.84
Rubius Therapeutics Inc. (RUBY.O)	E (03/13/2020)	$6.29
SAGE Therapeutics Inc (SAGE.O)	O (02/26/2018)	$37.38
Sarepta Therapeutics Inc (SRPT.O)	O (08/01/2018)	$153.00
Seattle Genetics Inc. (SGEN.O)	E (12/10/2019)	$151.55
Unity Biotechnology Inc. (UBX.O)	O (05/29/2018)	$7.85
Vertex Pharmaceuticals (VRTX.O)	O (10/01/2015)	$277.38
Zentalis Pharmaceuticals Inc (ZNTL.O)	O (04/28/2020)	$41.30

Vikram Purohit

DBV Technologies SA (DBVT.O)	E (10/23/2017)	$4.87
Incyte Corp (INCY.O)	E (04/29/2020)	$100.55
Portola Pharmaceuticals Inc (PTLA.O)	E (09/05/2019)	$17.85
Radius Health Inc (RDUS.O)	E (05/13/2020)	$13.33

Stock Ratings are subject to change. Please see latest research for each company.
* Historical prices are not split adjusted.