International Analysis On The Traffic Impact Of The Covid-19 Pandemic

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ABSTRACT

The purpose of this research was to assess, compare, and contrast the impact of COVID-19 activity restrictions on road-based transportation activity in regions of the US, Sweden, and China from January 1st to December 31st, 2020. Roadway traffic volumes were used to relate the progression of reported COVID-19 cases and government directives for social separation in three countries with diverse government responses.

Among the contributions of this paper was the illustration of the timeline and level of public responses to closures, lockdowns, and reopening as represented through rapid traffic decreases and increases. Traffic was greatly impacted, showing that the pandemic influenced activity and travel. A Monday-Monday traffic trend show that more normal traffic levels occurred on weekdays and largest decreases on weekends. Urban roads showed a more rapid response to directives than rural roads. At the study period end, only China and Florida returned to pre-pandemic traffic levels, only China reported zero COVID-19 cases. Sweden experienced a similar COVID-19 curve as the US and had fewer cases-per-million than most states. The findings indicate that rapid traffic decrease was associated with delaying initial COVID-19 peak and a longer time to return to normal traffic, likely delayed the second peak.

This research provides insights for practitioners, researchers, and government entities developing and accessing plans for future pandemics. It is also expected that the findings of this study can be built upon by future researchers who continue to study various aspects of the COVID-19 pandemic and assess the public response to governmental actions.

INTRODUCTION

COVID-19 is a disease caused by the SARS-CoV-2 virus and was first identified in Wuhan, Hubei Provence in China, in late 2019. COVID-19 spread throughout the world and has caused enormous global economic and social disruptions. In response to the virus, public officials issued directives to limit person to person contact to constrain the rapid spread of the virus. The government restrictions and actions varied from country to country in terms of type, timing, and nature of the limitations for citizens. The United States (US), Sweden and China, represent the most diverse virus responses taken. China provided an example of an authoritative, centrally planned response, while Sweden represented a classical liberal approach by limiting large public gatherings, but keeping public schools, restaurants, and other business open. The federalist system of the US allowed state governors to choose response measures that were regarded to be most appropriate by local authorities. This resulted in a mixed approach, with most states falling somewhere in between the measures taken by China and Sweden.

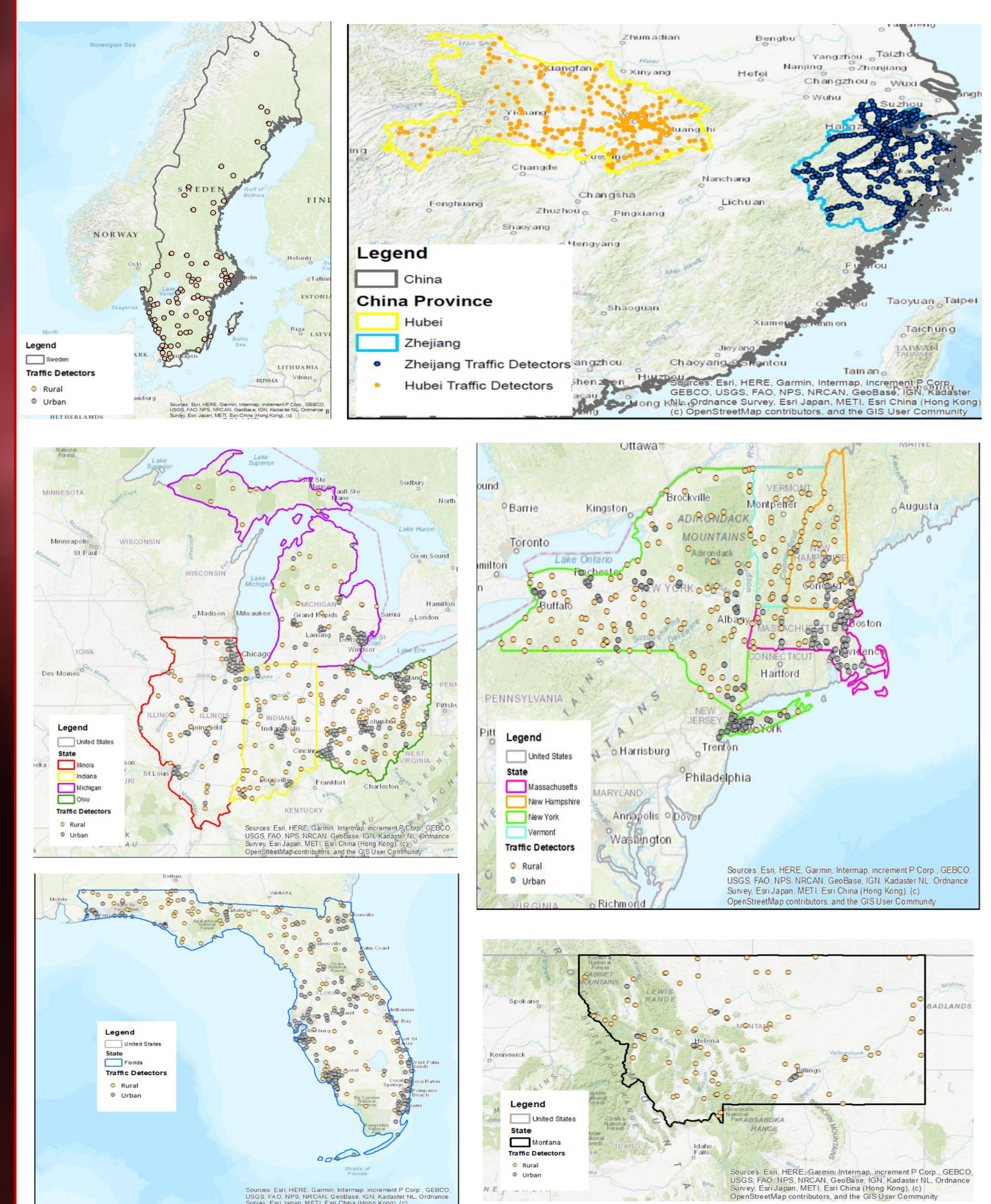
By January 2021, the COVID-19 pandemic was not over, and the assessment of significant and complex impacts will go on for years. There is a need for immediate and prompt assessment of outcomes and efforts as they continue to happen. Public acknowledgment and compliance with government recommendations for social distancing and separation is one of the most critical to assess. This can bring valuable insights for dealing with future pandemics. It is complicated to understand the impact of government mandated limitations on temporal and spatial responses of the public, given the near-infinite possibility for person-to-person interaction and the difficulty to systematically monitor the movement of individuals This research assesses the COVID-19 infections and behavioral reactions using the same consistent measure of roadway traffic across three counties that represent the extreme range of pandemic response of any countries in the world. The impact of travel on decreases and increases of COVID-19 cases, as government mandated restrictions were executed and then reduced across the US, China and Sweden is demonstrated by this paper.

The research includes four main sections. The first section is a brief review of similar efforts and reports to analyze the travel and health outcomes of governmental-mandated restrictions during the beginning of COVID-19. This is followed by description of the data and methods that were used in this study, and the COVID-19 databases and traffic count data systems, and how they were used. The section that follows is a demonstration and discussion of the analytical testing that was performed on the data, together with the findings. Finally, the last section of the paper is a conclusion with a discussion of what the data and findings may be implying.

METHODOLOGY

This study compared 2020 daily traffic volumes to corresponding days in 2019 using a paired t-test in the US, China and Sweden, with a significance level of 0.05. There was no distinction between vehicle types, and the traffic counts were aggregated over 24-hour periods. The comparison period for US and Sweden was one year. This to include the time of initial onset when government restrictions were first being implemented, reopening phases, and the action taken at the end of the year. These dates were January 1 to December 31 2020, and January 2 to December 31 2019. China experienced the COVID-19 pandemic much earlier than Sweden and the US. The comparison period for China was January 2 to April 30, 2019, and January 1 to April 28, 2020. The traffic data for the rest of the year was not available.

Country	State/Providence	Population	Population Density (people/mi2)
USA	Florida	21,477,737	401
	Illinois	12,671,821	228
	Indiana	6,732,219	188
	Massachusetts	6,892,503	884
	Michigan	9,986,857	177
	Montana	1,068,778	7
	New Hampshire	1,359,711	152
	New York	19,453,561	413
	Ohio	11,689,100	286
	Vermont	623,989	68
China	Hubei	59,270,000	825
	Zhejiang	58,500,000	1436
Sweden		10,327,589	9.8



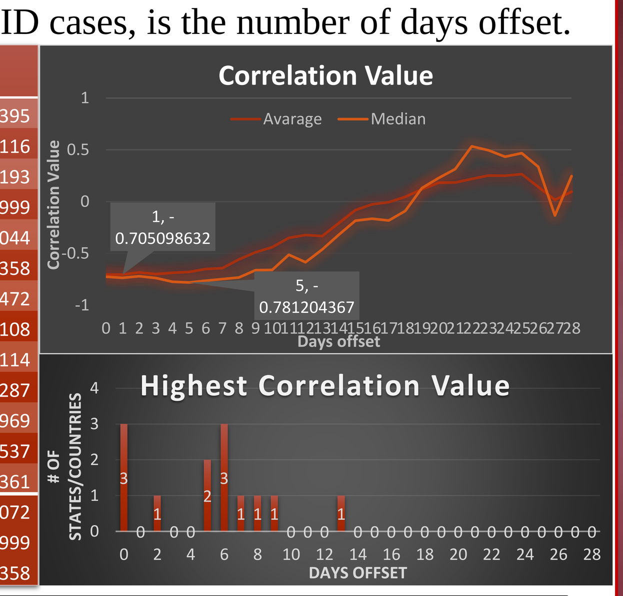
Country	State/Providence	First COVID-19 Case Date	Second COVID-19 Case Date	Third COVID-19 Case Date
USA	Florida	2-Mar	3-Mar	5-Mar
	Illinois	24-Jan	30-Jan	1-Mar
	Indiana	6-Mar	8-Mar	9-Mar
	Massachusetts	1-Feb	3-Mar	6-Mar
	Michigan	10-Mar	10-Mar	12-Mar
	Montana	11-Mar	15-Mar	15-Mar
	New Hampshire	2-Mar	3-Mar	8-Mar
	New York	2-Mar	3-Mar	4-Mar
	Ohio	10-Mar	10-Mar	10-Mar
	Vermont	8-Mar	12-Mar	14-Mar
China	Hubei	17-Jan	17-Jan	17-Jan
	Zhejiang	21-Jan	21-Jan	21-Jan
Sweden		4-Feb	26-Feb	27-Feb

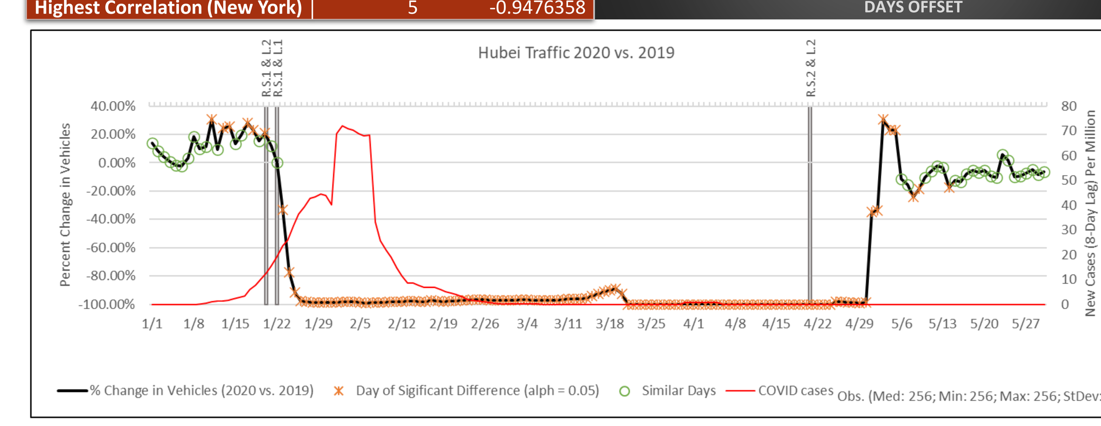
FINDINGS

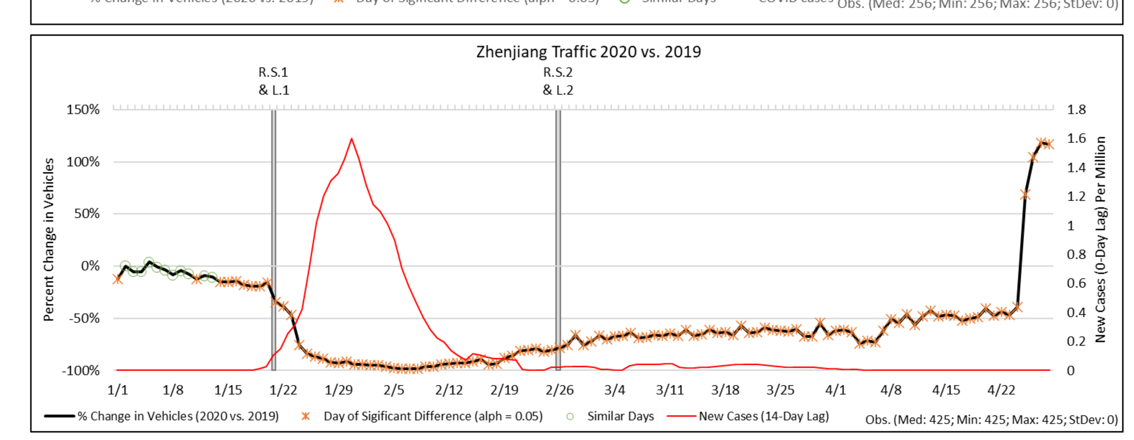
The health data has also been temporally offset from the traffic data. The reason for this was to associate the extent of cases to traffic conditions during the approximate time when the infection occurred. There are many other exposure possibilities that are not connected to vehicular travel and have been recognized by the authors.

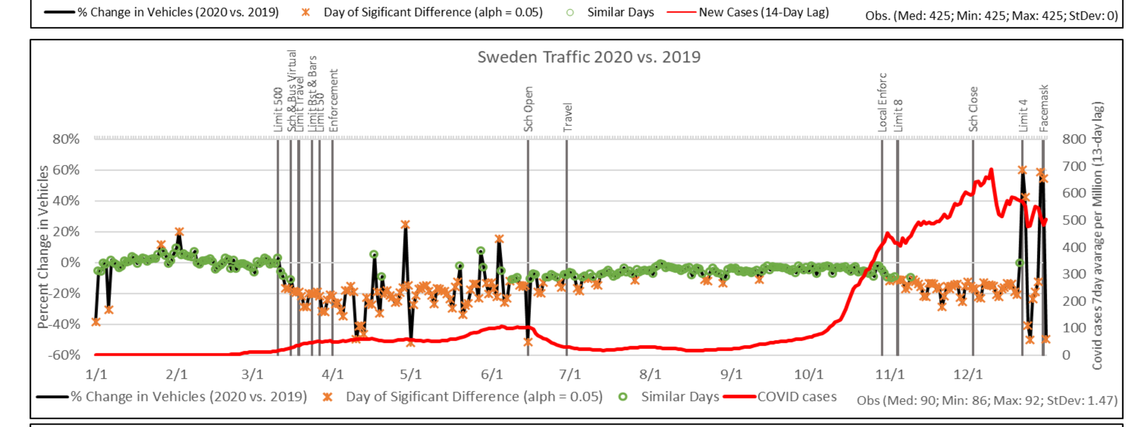
To determine the number of days to offset reported new COVID cases for each individual state and country, a correlation analysis between number of daily cases and decrease in traffic from 2019 to 2020 was conducted. Correlation is the linear relationship between two sets of data. Correlation is measured by a value between +1 to -1, with ±1 being the highest value of correlation. When the correlation is +1, it means the two sets of data have a positive correlation and both of the data sets increase at the same rate. Whereas, when the correlation is -1, it means the two sets of data have negative correlation and one variable decrease while the other increases. Traffic decreases preceded a drop in COVID-19 cases. This traffic/COVID-19 relation is offset in time. By moving the COVID case curve, a date can be found where it correlates more to the traffic decrease, and this relation can be shown more clearly. The difference between that date and the reported date of COVID cases, is the number of days offset.

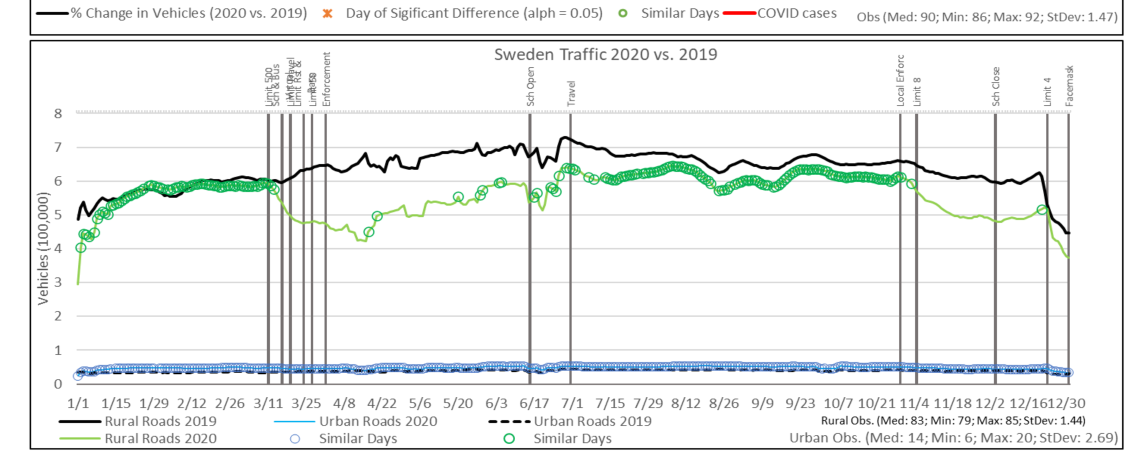
State/Country	Days Offset	Highest C
Montana	0	-0.5528395
Illinois	0	-0.9459116
Zhejiang	0	-0.8042193
Vermont	2	-0.8381999
Florida	5	-0.7812044
New York	5	-0.9476358
Ohio	6	-0.9453472
Indiana	6	-0.8742108
Massachusetts	6	-0.8835114
Michigan	7	-0.9159287
Hubei	8	-0.8323969
New Hampshire	9	-0.8355537
Sweden	13	-0.336361
Average Days Offset	5	-0.8072
Median Days Offset	6	-0.8381999
Highest Correlation (New York)	5	-0.9476358



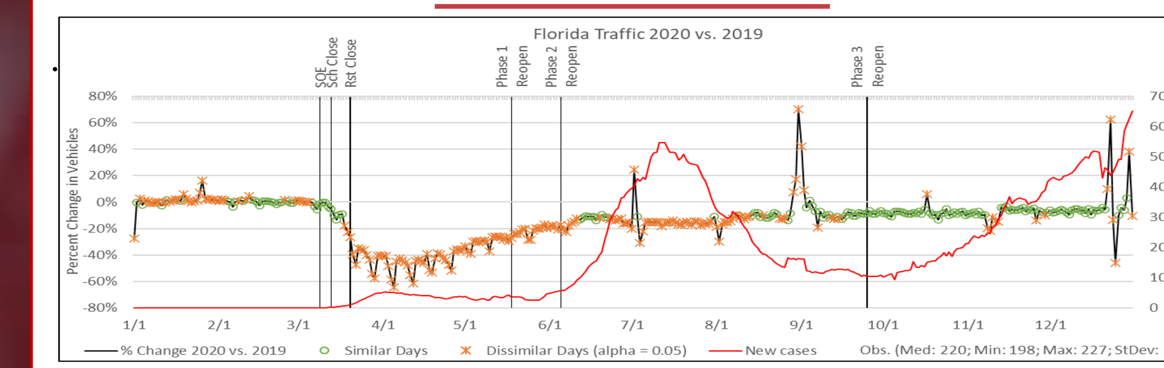


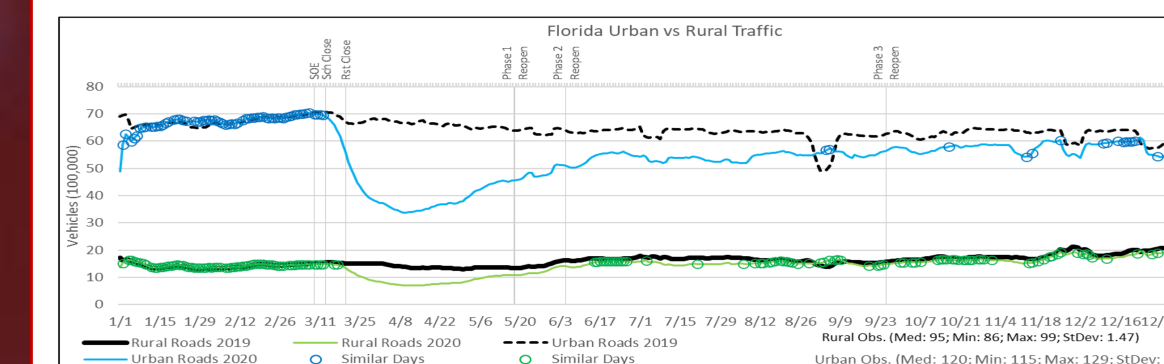


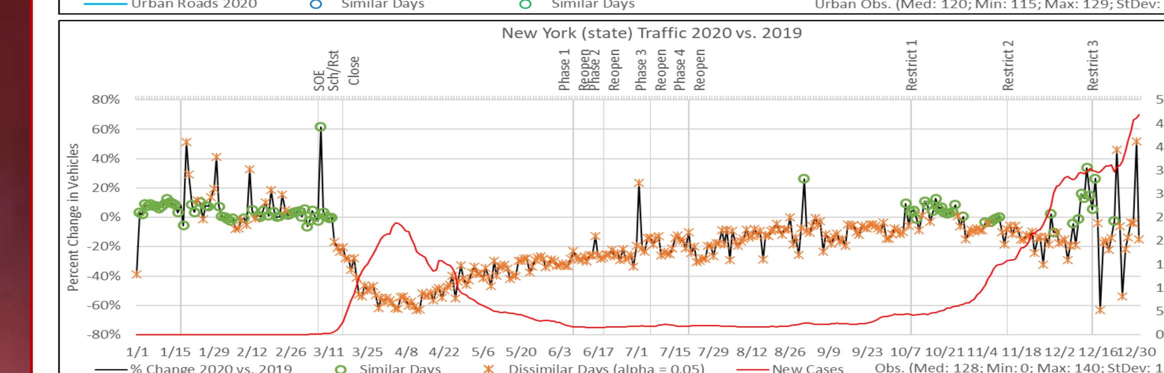


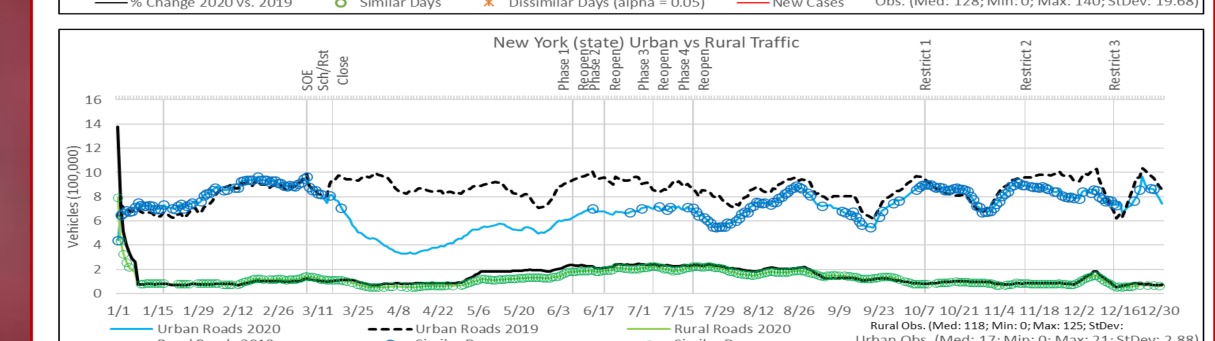


CONCLUSION

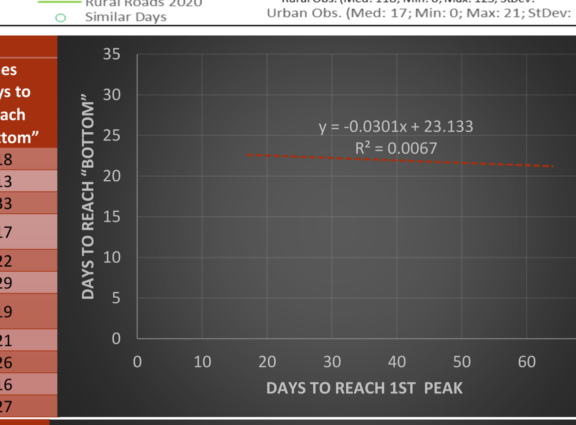




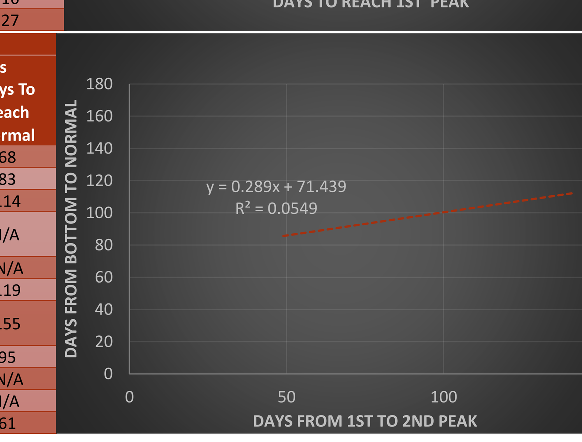




Country	State	Initial Peak: COVID-19 1st Peak Date	Initial Peak: COVID-19 Days to Reach 1st Peak	Initial Peak: Traffic Volumes Traffic "Bottom" Date	Initial Peak: Traffic Volumes Days to Reach "Bottom"
USA	Florida	2-Apr	33	5-Apr	18
	Illinois	4-May	64	22-Mar	13
	Indiana	27-Apr	55	12-Apr	33
	Massachusetts	7-Apr	38	29-Mar	17
	Michigan	1-Apr	27	4-Apr	22
	Montana	1-Apr	17	11-Apr	29
	New Hampshire	28-Apr	60	29-Mar	19
	New York	5-Apr	36	4-Apr	21
	Ohio	1-Apr	28	5-Apr	26
	Vermont	8-Apr	27	29-Mar	16
Sweden		17-Apr	63	10-Apr	27



Country	State/ Providence	Second Peak: COVID 19 2nd peak date	Second Peak: COVID 19 Days To Reach Peak	Second Peak: Traffic Volumes Trend of Similar Days of Traffic	Second Peak: Traffic Volumes Days To Reach Normal
USA	Florida	11-Jul	100	12-Jun	68
	Illinois	5-Sep	124	13-Jun	83
	Indiana	24-Aug	119	4-Aug	114
	Massachusetts	8-Aug	123	N/A	N/A
	Michigan	21-Aug	142	N/A	N/A
	Montana	29-Jul	119	8-Aug	119
	New Hampshire	19-Jul	82	31-Aug	155
	New York	N/A	N/A	2-Jul	95
	Ohio	28-Jun	88	N/A	N/A
	Vermont	8-Jun	61	N/A	N/A
Sweden		5-Jun	49	10-Apr	61



Among the contributions of this paper was the illustration of the timeline and level of public responses to closures, lockdowns, and reopening as represented through rapid traffic decreases and increases.

By the end of the study period only China and Florida had returned to pre-pandemic traffic levels and only China reported zero COVID-19 cases. Florida, New York and Massachusetts shows new record highs, and only Montana, Illinois and Ohio are showing a steady decrease. Sweden experienced a similar COVID-19 curve as the US, and even had fewer cases than most states and lower COVID-19 peaks. Traffic was greatly impacted by lockdowns and reopenings, showing that government directives had an impact on activity and travel. Urban roads show a more rapid response to directive than rural roads. Rural roads return to normal levels much earlier than urban areas. A Monday-Monday traffic trend during the study period show that more normal traffic levels were shown on weekdays, while the weekend had the largest decreases.

An indication that rapid traffic decrease delayed the initial COVID-19 peak and that a longer time for traffic to return to normal delayed the second COVID-19 peak.

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