Short Communication

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2021.39.006325

The Spread Rate of Covid-19 in North America

Jonathan E Leightner*

Hull College of Business, AllGood Hall, Summerville Campus, Augusta University, USA

***Corresponding author:** Jonathan E Leightner, Hull College of Business, AllGood Hall, Summerville Campus, Augusta University, 1120 15th Street, Augusta, Georgia 30912, USA

ARTICLE INFO

Received: October 16, 2021

Published: October 26, 2021

Citation: Jonathan E Leightner. The Spread Rate of Covid-19 in North America. Biomed J Sci & Tech Res 39(4)-2021. BJSTR. MS.ID.006325.

Keywords: Covid-19; Spread Rates; Omitted Variables; Reiterative Truncated Projected Least Squares; North America

Abbreviations: RTPLS: Reiterative Truncated Projected Least Squats; VSOLS: Variable Slope Ordinary Least Squares; BLUE: Best Linear Unbiased Estimate

ABSTRACT

Aims: This paper presents estimates of the spread rate of Covid-19 in Canada, Mexico, and the USA from the early days of 2020 to October 9, 2021.

Methods: Because it is impossible to measure and model all of the forces that can affect this spread rate, a statistical technique is used that produces a separate spread rate for each observation where differences in these estimates are due to omitted variables. Some of the most important omitted variables whose influence on the spread rate is captured in this paper's estimates include the imposition of social distancing laws, the degree that social distancing laws are observed, what percent of the population has been vaccinated and who was vaccinated, mutations of the virus, the density of the populations, and weather conditions. This paper's estimates are of the change in Covid-19 cases in time period t+1 due to an additional case in time period t [d(cases t+1)/d(cases t)] where t and t + 1 are one week apart.

Results: I found that if the number of Covid-19 case can be reduced by one in time t then the number of cases in time t+1 fall by less than one; in contrast if the number of cases in time t rise by one, then the number of cases in time t+1 increases by more than one.

Conclusion: it is harder to kill Covid-19 than it is for Covid-19 to spread. Thus governments and people should do all that they can to fight this disease.

Introduction

Leightner, Inoue, and Lafaye de Micheaux [1] are the first researchers to apply a variable slope estimation procedure to the spread of an infectious disease – Covid-19 [2]. They applied this technique to data from Brazil, Europe, South Africa, the United Kingdom, and the USA for early 2020 to the end of March 2021. They used weekly data on the number of "new" Covid-19 cases to estimate the change in "new" Covid-19 cases next week due to one more "new" Covid-19 case this week. I follow what they did in some ways and deviate in others. Specifically, I continue to use a one week lag because the Center for Disease Control [3] says that the medium incubation period for Covid-19 is four to five days and the data available for North America is weekly. However, I deviate from what Leightner, et al. [1] did by using the number of cases of Covid-19 in time periods t and t + 1 instead of the number of "new" Covid-19 cases. I made this change because all current cases of Covid-19 can spread the disease, not just "new" cases. Leightner, et al. [1] data ended in March of 2021, but the data for this paper extends through October 9, 2021.This extension of the data is important because the Delta variant of Covid-19 hit North America after March of 2021, and the Delta variant is much more infectious. Finally, I find estimates for the spread rate of Covid-19 in Mexico and Canada – two countries not examined by Leightner, et al. [1]. I use the same variable slope estimation technique employed by Leightner, et al. [1] which is Reiterative Truncated Projected Least Squares (RTPLS).

Materials and Methods

The data was downloaded from the webpage of the European Centre for Disease Prevention and Control (2021) [4]. I began

DOI: 10.26717/BJSTR.2021.39.006325

the data series for each country at the point when that country's number of Covid-19 cases remained above one for the rest of the data set. This resulted in Canada's and the USA's data starting in the fourth week of 2020 and Mexico's data starting in the seventh week of 2020. The data is presented on the left side of Table 1 and depicted in Figure 1. Leightner, et al. [1] use simulation tests to compare and contrast three different variable slope estimation methods – variable slope ordinary least squares (VSOLS), variable slope generalized least squares (VSGLS), and reiterative truncated projected least squats (RTPLS). Although VSGLS is theoretically the best linear unbiased estimate (BLUE), Leightner, et al. [1] used RTPLS because simulations show that RTPLS produces noticeably less error than VSGLS when all the variation in the dependent variable is due to omitted variables and RTPLS captures non-linear relationships better than VSGLS and the spread of a disease is non-linear [5]. Simulations show that VSOLS was always far inferior to both VSGLS and RTPLS.

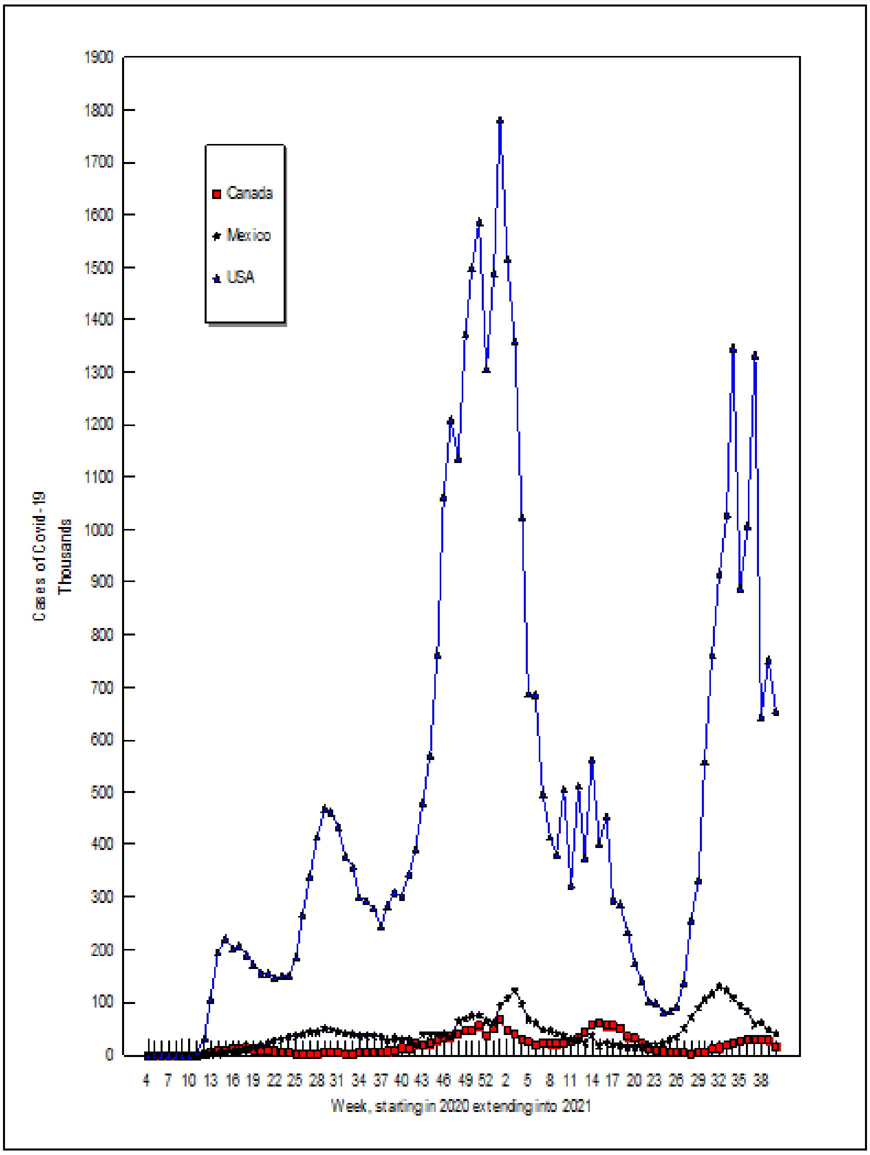

Figure 1: Number of Cases of Covid-19.

All three variable slope estimation methods are built upon the following ideas:

(1) Omitted variables destroy the reliability of estimated coefficients and statistics when they affect the estimated slope (if an omitted variable does not affect the slope in the sample or population, then it merely adds more random noise to the estimation, and does not bias the estimates),

(2) If omitted variables affect the estimated slope and they are ignored, then the estimation procedure produces a constant slope, when in truth the slope varies due to the omitted variables (thus the resulting estimates are hopelessly biased), and

(3) Omitted variables will affect the relative vertical position of observations [6].

All three variable slope estimation procedures use the relative vertical position of observations to capture the influence of omitted variables; all three produce a separate slope estimate for every observation where differences in these slope estimates are due to omitted variables. Variable slope estimation produces estimates that show all the ways that the dependent and independent variables are related (i.e. total derivatives); in contrast to more traditional estimation techniques which produce estimates holding all other included variables constant (thus, partial derivatives). Leightner, et al. [1] explain all three variable slope estimation procedures, test all three using simulations, and then uses RTPLS to estimate the spread rate of Covid-19 as described above. Leightner, et al. [7] and Leightner [8] explain RTPLS and present the mathematical equations used in it. Both Leightner, et al. [1] and Leightner, et al. [7] are open access articles. Published applications of RTPLS include estimates of the inflation/unemployment tradeoff, pollution abatement, effectiveness of monetary, fiscal, exchange rate, and trade policies, and the effects of China accumulating US dollars on the value of the US dollar and on the US trade deficit.

Results

Figure 1 plots the data over time. The two upward spikes in the number of Covid-19 cases in the USA correspond to new variants of the virus. Variant B.1.1.7 hit the world in September 2020 (≈week 38) and the Delta variant hit North America in June of 2021 (≈week 25) (Center of Disease Control and Prevention, 2021) [9]. Figure 1 shows that Mexico and Canada also experienced these new variant spikes (although Canada's Delta spike occurred with a 6 week lag). The noticeable declines in Covid-19 cases in early 2021 in all three countries corresponds to when vaccines were first available. The estimates for d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) are given in the right half of Table 1 and depicted over time in Figure 2. The d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) estimates are highest and most unstable when Covid-19 first emerged in each country. The d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) value for Canada in the fourth week of 2020 means that an additional case in that week would be correlated with 8.466 additional cases the next week. A close examination of Figure 2 reveals some common trends for all of North America: (1) from 2020 week 13 through the end of 2020 d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) estimates were on an upward trend, (2) d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) fell in early 2021 as vaccinations become available, (3) d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) again rose between weeks 4 and 13 of 2021, then fell between weeks 14 and 22, rose again between weeks 21 and 30, and then fell after week 30 of 2021.

Table 1: The Data and Empirical Estimates.

		cases			d(cases t+1)/d(cases t)		
year	**week**	**Canada**	**Mexico**	**USA**	**Canada**	**Mexico**	**USA**
2020	4	1		5	8.466		2.293
2020	5	3		6	2.822		1.078
2020	6	3		1	2.155		8.466
2020	7	1	1	3	6.466	6.466	8.489
2020	8	1	1	20	20.466	16.466	2.973
2020	9	15	11	54	2.898	1.77	8.712
2020	10	38	14	465	6.512	15.819	6.936
2020	11	242	216	3220	4.675	3.053	9.763
2020	12	1126	654	31432	4.29	1.875	3.43
2020	13	4825	1221	107819	1.916	1.71	1.805
2020	14	9241	2083	194610	0.96	1.628	1.13
2020	15	8869	3386	219936	1.175	1.815	0.919
2020	16	10412	6141	202116	1.163	1.488	1.02

2020	17	12107	9135	206223	1.04	1.215	0.932
2020	18	12590	11094	192131	0.745	1.311	0.894
2020	19	9374	14536	171758	0.869	1.322	0.914
2020	20	8143	19213	156958	0.946	1.223	0.997
2020	21	7697	23497	156481	0.812	1.136	0.939
2020	22	6248	26685	146953	0.761	1.127	1.036
2020	23	4752	30070	152172	0.651	1.135	0.997
2020	24	3088	34118	151706	0.828	1.086	1.232
2020	25	2550	37054	186843	0.752	1.05	1.435
2020	26	1913	38916	268084	1.197	1.098	1.267
2020	27	2285	42740	339639	0.902	1.036	1.226
2020	28	2055	44253	416307	1.345	1.124	1.125
2020	29	2759	49745	468318	1.292	0.984	0.984
2020	30	3560	48945	460760	0.836	0.91	0.942
2020	31	2972	44519	433935	0.87	0.92	0.869
2020	32	2581	40936	376909	1.023	0.925	0.951
2020	33	2636	37880	358405	1.068	0.968	0.835
2020	34	2809	36673	299342	1.086	1.028	0.984
2020	35	3044	37703	294552	1.301	0.987	0.948
2020	36	3955	37193	279258	1.206	0.907	0.872
2020	37	4764	33735	243558	1.468	0.832	1.169
2020	38	6990	28075	284835	1.356	1.138	1.089
2020	39	9476	31936	310232	1.376	0.952	0.976
2020	40	13031	30405	302799	0.918	0.985	1.138
2020	41	11961	29957	344699	1.675	0.617	1.137
2020	42	20031	18484	392051	0.897	2.161	1.228
2020	43	17956	39933	481570	1.155	0.958	1.186
2020	44	20737	38232	571197	1.315	1.005	1.338
2020	45	27272	38433	764289	1.172	1.007	1.394
2020	46	31964	38697	1065410	1.077	0.914	1.136
2020	47	34426	35353	1209848	1.156	1.844	0.939
2020	48	39775	65196	1136412	1.129	1.055	1.209
2020	49	44904	68779	1373677	1.015	1.079	1.092
2020	50	45561	74194	1499756	1.198	1.023	1.059
2020	51	54571	75871	1588085	0.673	0.837	0.823
2020	52	36706	63515	1306812	1.353	0.934	1.139
2020	53	49643	59325	1488563	1.34	1.566	1.198
2021	1	66518	92878	1782792	0.705	1.161	0.85
2021	2	46891	107869	1515282	0.809	1.133	0.897
2021	3	37939	122238	1358783	0.806	0.801	0.754
2021	4	30578	97968	1024054	0.802	0.677	0.671
2021	5	24531	66305	687440	0.767	0.903	0.997
2021	6	18804	59879	685603	1.202	0.797	0.723
2021	7	22593	47740	495991	0.908	0.956	0.838
2021	8	20516	45649	415502	1.008	0.903	0.922
2021	9	20665	41196	383101	1.082	0.904	1.323

 DOI: 10.26717/BJSTR.2021.39.006325

2021	10	22349	37252	506660	1.149	0.79	0.639
2021	11	25672	29431	323686	1.286	1.043	1.584
2021	12	32996	30682	512686	1.293	0.778	0.73
2021	13	42658	23863	374335	1.328	1.576	1.501
2021	14	56643	37599	562003	1.073	0.468	0.717
2021	15	60757	17606	402714	0.924	1.285	1.128
2021	16	56145	22624	454253	0.985	0.9	0.653
2021	17	55324	20366	296606	0.921	0.815	0.965
2021	18	50944	16596	286092	0.675	0.93	0.825
2021	19	34396	15427	236081	0.959	0.998	0.737
2021	20	32982	15384	173887	0.607	1.069	0.816
2021	21	20018	16435	141806	0.628	1.267	0.727
2021	22	12563	20820	103062	0.728	0.999	0.964
2021	23	9140	20789	99397	0.692	1.116	0.808
2021	24	6322	23200	80348	0.717	1.246	1.033
2021	25	4527	28902	83014	0.775	1.191	1.111
2021	26	3505	34420	92182	0.991	1.502	1.501
2021	27	3469	51701	138400	0.708	1.371	1.852
2021	28	2451	70870	256273	1.546	1.27	1.298
2021	29	3783	89994	332523	0.832	1.19	1.684
2021	30	3141	107060	559822	3.696	1.091	1.358
2021	31	11604	116832	760508	1.197	1.114	1.205
2021	32	13886	130108	916459	1.272	0.947	1.123
2021	33	17651	123178	1029600	1.283	0.89	1.308
2021	34	22632	109648	1346506	1.152	0.841	0.66
2021	35	26071	92247	888479	1.103	0.895	1.136
2021	36	28745	82532	1009116	1.073	0.691	1.32
2021	37	30838	57001	1332502	0.988	1.101	0.483
2021	38	30458	62763	643648	0.927	0.772	1.168
2021	39	28238	48435	751638	0.523	0.847	0.874
2021	40	14771	41000	656782			

Discussion

It should be noted that the estimates of d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) given in Table 1 and depicted in Figure 2 are for both increases and decreases in the number of cases in time t. However, every time the estimate of d(cases of Covid-19 in t+1)/d(cases of Covid-19 in t) was less than one, Covid-19 cases declined the next time period. This means that if Canada, Mexico, and/or the USA could reduce the number of cases in time t by one [perhaps by stricter social distancing laws, mandating vaccines, or rapid testing and quarantining [10], then the number of cases in time t+1 would decline by less than one. However, if something (like a new Covid-19 mutation or more humid, cooler weather) would increase the number of Covid-19 cases in time t, then the number of cases in time t+1 would increase by more than one. Thus it is harder to kill this virus than it is for it to spread. Governments and people need to do all that they can to beat this virus, because it is easier to spread than it is to defeat.

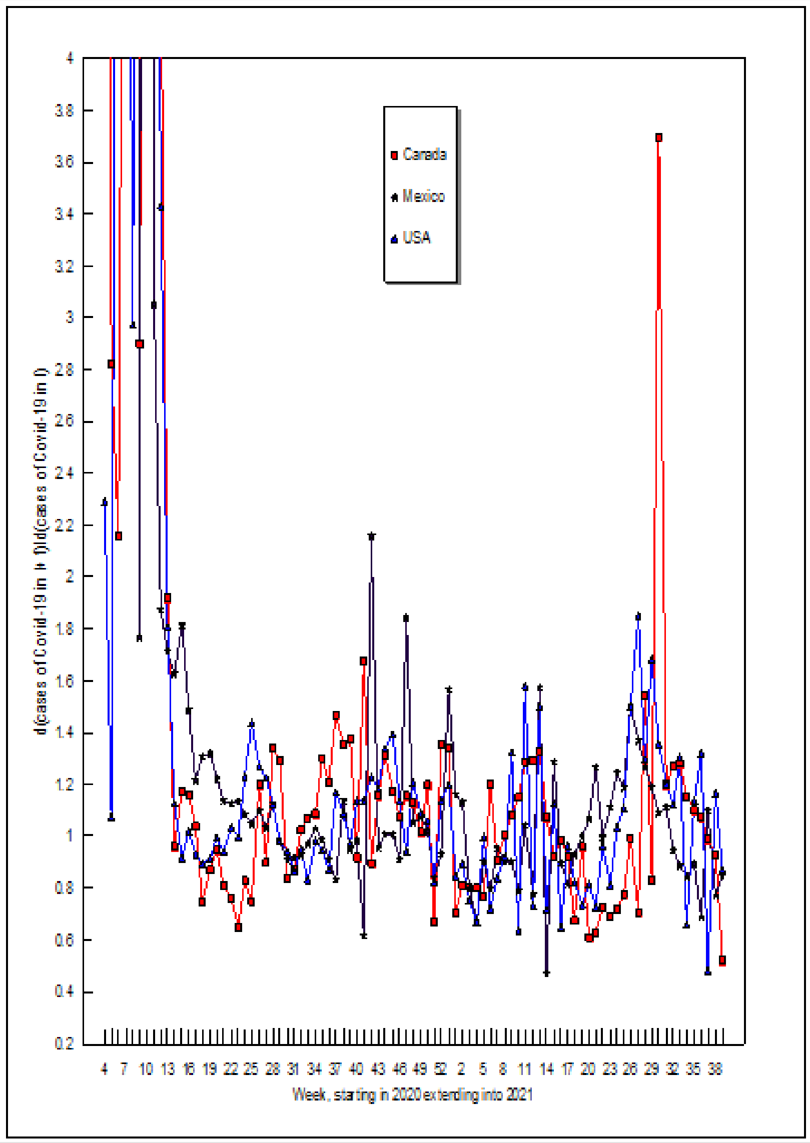

Figure 1: *d*(Cases of Covid-19 in t+1)/d(Cases of Covid-19 in t).

Declarations of Interests

None.

- This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Leightner, Jonathan E, Tomoo Inoue, Pierre Lafaye de Micheaux (2021) Variable Slope Forecasting Methods and COVID-19 Risk. Risk and Financial Management 14: 467.
2. Choi, Youngah (2021) COVID-19 Disease and Treatment of COVID-19. Biomed J Sci & Tech Res 39(2): 2021.
3. Nishiura Hiroshi, Natalie Linton, Andrei Akhmetzhanov (2020) Serial interval of novel coronavirus (COVID-19) infections. International Journal of Infectious Diseases 93: 284-86.
4. European Centre for Disease Prevention and Control. 2021. COVID-19 Update Situation,Worldwide.
5. Sharma, Sunil Kumar, Aashima Bangia, Mohammed Alshehri, Rashmi Bhardwaj (2021) Nonlinear Dynamics for the spread of Pathogenesis of COVID-19 Pandemic. Journal of Infection and Public Health 14: 817-831.
6. Branson, Johannah, Charles Albert (Knox) Lovell 2000. Taxation and Economic Growth in New Zealand. In Taxation and the Limits of Government. In: Gerald W. Scully and Patrick James Caragata (Eds.), Boston: Kluwer Academic, p. 37-88.
7. Leightner Jonathan E, Tomoo Inoue (2012) Solving the Omitted Variables Problem of Regression Analysis using the Relative Vertical Position of Observations. Advances in Decision Sciences.
8. Leightner, Jonathan E (2015) The Limits of Fiscal, Monetary, and Trade Policies: International Comparisons and Solutions. Singapore: World Scientific.
9. Center for Disease Control and Prevention. 2021. Science Brief: Emerging SARS-CoV2 Variants.
10. Halvatsiotis, Panagiotis, Eleni Routsi, Michail Papapanou, Argyris Siate¬lis, et al. (2021) High Resolution Melting Curve for the Rapid and Efficient Detection of SARS-Cov-2 Gene Variation in the Greek Population. Biomed J Sci & Tech Res 39(3): 2021.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2021.39.006325

Jonathan E Leightner. Biomed J Sci & Tech Res