Online Supplement for: Interrupted time series analysis of Canadian legal cannabis sales during the COVID-19 pandemic

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Purpose

This online supplement provides additional details related to each section of the main paper.

Introduction Notes

In another survey comparing pandemic-period cannabis consumption to beforehand (Canadian Red Cross, 2020), 27% of respondents reported more frequent usage whereas only 12% reported less.

Most jurisdictions allowed licensed cannabis stores to continue operating during the pandemic. The one jurisdiction (Prince Edward Island) that closed all its stores and allowed only online ordering for two months saw legal sales drop 65% (Kingdon, 2020).

Although illicit consumption is very difficult to measure, government estimates indicate it decreased during the 2019-2021 study period (Statistics Canada, 2021a). Estimated first quarter illicit purchases totaled $1.15 billion in 2019, but fell to $0.86 billion in 2020, and to $0.75 billion in 2021's 1st quarter. First quarter purchases in the smaller legal medical cannabis market also declined, from $154 million in 2019 to $142 million in 2020 and to $118 million in 2021. This implies the pandemic did not divert users from the legal to the illicit market.

Prices of legal dry cannabis products had been substantially higher than illicit prices in most jurisdictions when the market was first legalized in 2018 (Mahamad et al, 2020). They began declining when "value-priced" products became available in late 2019 (in Quebec) and early 2020 (in Ontario and elsewhere).

Two of the processed product formats that became legally available in early 2020 were vapes and edibles. Cannabis vape oils were already popular in the illicit market, and quickly became the second most popular legal product format (after dry cannabis). E.g., they represented 16% of sales in Ontario from April 2020 to March 2021 (Ontario Cannabis Store, 2021). Edibles, including cannabis-infused foods and drinks, represented a much smaller share of sales but received much media attention; many producers hoped they would prompt more non-users to try cannabis.

Methods Notes

The national analysis covered $N = 24$ monthly observations. The provincial-territorial analysis covered $N = 12 \times 24 = 288$ province-month observations.

For the two retail closures, we reduced the store count assigned for each respective province and month in proportion to the number of stores closed and length of their closure. E.g., for Newfoundland in August 2020, 10 out of 25 stores were closed during the last 9 days of the 31-day month. So, we set that province's August 2020 store count at (25x22 + 15x9)/31 = 22.097 stores instead of 25.

When preparing the data for regression, the slope variable and the slope change variable in each model were "centered" by subtracting the respective mean from each value. This reduced the collinearity between them.

We did not include a store variable in the national analysis because stores and months were highly correlated at that level. Consequently, including stores alongside months would have added little statistical information and might have caused collinearity problems. By comparison, the correlation was much lower at the provincial/territorial level. Table S1 shows the correlations for both data sets.

Table S1. Correlation coefficients (top number) and their significance (bottom number) for national data (left) and provincial/territorial data (right), including time in months, stores per 100,000 residents, and monthly sales per capita.

	Month	Stores	Month	Stores
Stores	0.995		0.228	
p	*0.001*		*0.001*	
Sales	0.990	0.984	0.519	0.675
p	*0.001*	*0.001*	*0.001*	*0.001*

Results Notes

National Analysis

Results tables are shown below for each linear regression model.

Table S2. March model regression results for national cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standardized coefficients β, standard errors *SE*, and significance *p* for each variable. Model fit R^2 = 98.4%.

March model	*B*	95% *CI*	β	*SE*	*p*
Constant	$5.207	4.976, 5.439	-	0.111	0.000
Slope	$0.268	0.234, 0.302	0.854	0.016	0.000
Slope change	$0.077	-0.002, 0.157	0.138	0.038	0.055
Level change	$0.063	-0.454, 0.581	0.014	0.248	0.801

Table S3. January model regression results for national cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standardized coefficients β, standard errors *SE*, and significance *p* for each variable. Model fit R^2 = 98.5%.

January model	*B*	95% *CI*	β	*SE*	*p*
Constant	$4.824	4.609, 5.040	-	0.103	0.000
Slope	$0.292	0.260, 0.324	0.931	0.015	0.000
Slope change	$0.061	-0.000, 0.122	0.130	0.029	0.050
Level change	-$0.319	-0.697, 0.059	-0.072	0.181	0.094

Provincial/Territorial Analysis

Results tables are show below for each fixed effect panel data linear regression.

Table S4. Base model regression results for provincial/territorial cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standard errors *SE*, and significance *p* for each variable. Within-jurisdiction R^2 = 67.0%.

Base model	*B*	95% *CI*	*SE*	*p*
Constant	$5.643	4.791, 6.494	0.412	0.000
Stores	$0.505	0.379, 0.632	0.061	0.000
Slope	$0.242	0.189, 0.295	0.026	0.000

Table S5. March model regression results for provincial/territorial cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standard errors *SE*, and significance *p* for each variable. Within-jurisdiction R^2 = 68.7%.

March model	*B*	95% *CI*	*SE*	*p*
Constant	$5.040	4.202, 5.879	0.405	0.000
Stores	$0.515	0.386, 0.644	0.062	0.000
Slope	$0.144	0.065, 0.224	0.038	0.001
Slope change	$0.217	0.076, 0.359	0.068	0.004
Level change	-$0.194	-1.097, 0.709	0.437	0.661

Table S6. January model regression results for provincial/territorial cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standard errors *SE*, and significance *p* for each variable. Within-jurisdiction R^2 = 69.6%.

January model	*B*	95% *CI*	*SE*	*p*
Constant	$5.150	4.446, 5.854	0.340	0.000
Stores	$0.513	0.383, 0.643	0.063	0.000
Slope	$0.206	0.149, 0.262	0.027	0.000
Slope change	$0.156	0.062, 0.250	0.045	0.002
Level change	-$1.017	-1.668, -0.367	0.315	0.004

Provincial/Territorial Analysis: Individual Slopes

For robustness checking purposes, we also tried an expanded version of the provincial/territorial analysis in which each jurisdiction had its own slope variable, rather than sharing a common one. This improved the models' fits, and many coefficients changed slightly, but the overall implications remained similar.

Table S7. Expanded March model regression results for provincial/territorial cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standard errors *SE*, and significance *p* for each variable. Within-jurisdiction R^2 = 76.4%.

March model	*B*	95% *CI*	*SE*	*p*
Constant	$4.916	3.294, 6.539	0.784	0.000
Stores	$0.538	0.246, 0.830	0.141	0.001
Slope change	$0.218	0.070, 0.367	0.072	0.006
Level change	-$0.187	-1.072, 0.698	0.428	0.666
Slope PE	-$0.001	-0.127, 0.125	0.061	0.988
Slope NS	$0.013	-0.089, 0.115	0.049	0.794
Slope MB	$0.086	-0.004, 0.176	0.044	0.061
Slope YT	$0.095	-0.106, 0.295	0.097	0.338
Slope NL	$0.101	0.008, 0.195	0.045	0.035
Slope QC	$0.103	-0.006, 0.213	0.053	0.064
Slope ON	$0.114	0.016, 0.213	0.048	0.025
Slope BC	$0.149	0.000, 0.298	0.072	0.049
Slope AB	$0.154	-0.042, 0.349	0.094	0.117
Slope NB	$0.172	0.073, 0.270	0.047	0.001
Slope SK	$0.226	0.097, 0.354	0.062	0.001
Slope NT	$0.463	0.132, 0.794	0.160	0.008

Table S8. Expanded January model regression results for provincial/territorial cannabis sales in Canadian dollars per capita per month, showing raw regression coefficients *B*, 95% confidence intervals *CI*, standard errors *SE*, and significance *p* for each variable. Within-jurisdiction R^2 = 76.8%.

January model	*B*	95% *CI*	*SE*	*p*
Constant	$5.074	3.523, 6.626	0.750	0.000
Stores	$0.529	0.218, 0.839	0.150	0.002
Slope change	$0.157	0.056, 0.258	0.049	0.004
Level change	-$1.015	-1.657, -0.373	0.310	0.003
Slope PE	$0.060	-0.051, 0.172	0.054	0.272
Slope NS	$0.075	-0.007, 0.157	0.040	0.071
Slope MB	$0.149	-0.084, 0.213	0.031	0.000
Slope YT	$0.161	-0.037, 0.360	0.096	0.108
Slope NL	$0.163	0.086, 0.240	0.037	0.000
Slope QC	$0.165	0.070, 0.260	0.046	0.001
Slope ON	$0.177	0.096, 0.257	0.039	0.000
Slope BC	$0.213	0.072, 0.356	0.069	0.005
Slope AB	$0.221	0.023, 0.420	0.096	0.030
Slope NB	$0.233	0.162, 0.304	0.034	0.000
Slope SK	$0.289	0.170, 0.407	0.057	0.000
Slope NT	$0.525	0.196, 0.854	0.159	0.003

Discussion Notes

One reason we analyzed sales in dollar terms, rather than product volumes, was that Canada's national and provincial governments unfortunately disclose very little cannabis data (Armstrong, 2021).

Additional References

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