Face Masks, Public Policies and Slowing the Spread of COVID-19: Evidence from Canada

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ABSTRACT

We estimate the impact of indoor face mask mandates and other non-pharmaceutical interventions (NPI) on COVID-19 case growth in Canada. Mask mandate introduction was staggered over two months in the 34 public health regions in Ontario, Canada. Using this variation, we find that mask mandates are associated with a 25 percent or larger weekly reduction in new COVID-19 cases in July and August, relative to the trend in absence of mandate. Province-level data provide corroborating evidence. We control for factors such as mobility (using Google geo-location data) and past cases. Our analysis of additional survey data shows that mask mandates led to an increase of about 30 percentage points in self-reported mask wearing in public. Counterfactual policy simulations suggest that mandating indoor masks nationwide in early July could have reduced new COVID-19 cases in Canada by 25 to 40 percent in mid-August (700 to 1,100 fewer cases per week).

Introduction

When government policies to stem the spread of COVID-19 were introduced in early 2020, the best available supporting evidence came from research on previous epidemics, epidemiological modeling and case studies [1]. Even when the efficacy of a given intervention for reducing COVID-19 transmission has been established, doubts regarding its usefulness may persist because of uncertainty regarding adherence to the rules and other behavioural responses. For example, even though there is significant agreement in the medical literature that respiratory transmission of COVID-19 is the dominant vector [2], and many clinical studies show that face masks reduce the spread of COVID-19 and similar diseases [3–6], a mask mandate may not be effective in practice if it fails to increase the prevalence of mask wearing (compliance) or leads to increased contacts because of a false sense of security.

The relatively low economic cost of mask mandates relative to other COVID-19 containment measures and substantial variation in official advice regarding mask use across jurisdictions and over time has generated keen interest in studying their effectiveness. One challenge is to disentangle the impact of mask mandates from that of other policies, behavioural responses, or third factors [8,9]. Given the absence of large-scale randomised controlled trials on mask mandates [10], observational studies are essential for informing health policy and public opinion, by formally analyzing the relationship between policy measures and the rate of propagation of COVID-19.

We quantify the impact of mask mandates and other non-pharmaceutical interventions (NPI) on the growth of COVID-19 cases in Canada, including regulations on businesses and gatherings, school closures, travel and self-isolation, and long-term care. Our data allow two complementary approaches. First, we estimate the effect of mask mandates by using within-province variation in the timing of indoor face mask mandates in the 34 Public Health Units (PHU), sub-regions of Ontario, Canada’s most populous province with roughly 40% (15 mln) of the country’s population [11]. The advantage of this approach is that it studies relatively small geographic units, holding all province-level policies and factors constant. The adoption of indoor face mask mandates in the 34 PHUs was staggered over approximately two months, creating sufficient intertemporal variation.

Second, we evaluate the impact of NPIs in Canada as a whole, using the variation in policy timing across the country’s ten provinces. We construct time series for COVID-relevant policy indicators from official public health
orders and announcements. By studying inter-provincial variation in these policy measures, we analyze not only mask mandates, but also other NPIs, for which there is little or no variation across Ontario’s PHUs, including regulations on businesses and gatherings, schooling, travel and long-term care. In addition, the province-level data include both the ‘closing’ period (March-April) and the gradual ‘re-opening’ period (May-August), providing variation from both the imposition and the relaxation of policies.

Our panel-data estimation strategy broadly follows the approach of [8], adapted to the Canadian context. We allow for behavioural responses (using Google Mobility Reports geo-location data as proxy for behaviour changes and trends), as well as lagged epidemiological outcome responses to policy and behavioural changes. Our statistical approach also allows past outcomes (cases or case growth) to impact current outcomes as information variables reflecting unmeasured behaviour and policy, or directly, as in the epidemiological SIR model.

We find that, two weeks after implementation, mask mandates are associated, on average, with a reduction of 29 to 37 log points in the weekly case growth rate, which can be interpreted as a 25 to 31% weekly reduction in new COVID-19 cases in Ontario, relative to the trend in absence of mandate. We find corroborating evidence in the province-level analysis, a 36 to 46% weekly reduction in cases relative to the no-mandate trend, depending on the empirical specification. Furthermore, using additional survey data, [12], we show that mask mandates increased self-reported mask usage in Canada by about 30 percentage points shortly after implementation, suggesting that mandates had a significant impact on behaviour.

We also find that, controlling for public policies, a 1% increase in the number of new cases is associated with a subsequent decrease of approximately 0.2 percentage points in the weekly growth of new cases. This implies that the effect of a given NPI on the growth rate of new cases is likely to diminish as the level of new cases drops relative to the no-policy scenario, possibly due to unmeasured behavioural changes.

Counterfactual policy simulations using our empirical estimates suggest that mandating indoor masks Canada-wide in early July could have reduced weekly new cases by 25 to 40% on average by mid-August relative to the realized counts, which corresponds to 700 to 1,100 fewer new cases per week.

In addition, we find that the most stringent policy restrictions on businesses (e.g., retail, restaurants and bars) and gatherings observed in the data are associated with a weekly decrease of 48 to 57% in new cases (65 to 85 log point reduction in case growth) relative to absence of restrictions. The business/gathering estimates are, however, noisier than our estimates for mask mandates and do not retain statistical significance in all specifications; they appear driven by the smaller provinces and the re-opening period (May to August). School closures and travel restrictions are associated with a large decrease in weekly case growth in the closing period (March-April).

Our paper relates most closely to [8], [13] and [9], which are recent studies on mask mandates using observational data, but adds to them in several ways. First, we use regional variation within the same province (like [9], but with a larger sample of treated regions that obviates the need for synthetic controls). This mitigates concerns about omitted variables, e.g., the provincial media environment or other policies. Second, we additionally use variation at a different level, namely across provinces (similar to [8] and [13] for the USA), and obtain similar results as in our main analysis. Third, we estimate the increase in self-reported mask usage following mask mandates, which can help understand and predict how the effect of mask mandates on COVID-19 spread might differ in other contexts. Moreover, our finding that mask mandates significantly increased mask use corroborates the large estimated mask mandate effect on COVID-19 case growth that we find. Fourth, an important difference between our paper and [8] is that we evaluate the effect of universal mandatory indoor mask wearing for the public rather than mandatory mask

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wearing for employees only. While other factors such as differences in mask-wear compliance between Canada and the U.S. may also contribute to the different estimated magnitude of the policy impact, our results suggest that more comprehensive mask policies can be more effective in reducing the spread of COVID-19.

In the medical literature, [2], a comprehensive review on COVID-19 transmission, presents strong evidence from case and cluster reports that respiratory transmission is dominant, with proximity and ventilation being key determinants, as opposed to direct contact or fomite transmission. Numerous other studies, e.g. [4–6, 10], argue that face masks can reduce the spread of COVID-19. Our paper also complements recent work on COVID-19 non-pharmaceutical interventions in various countries [14–17] and in Canada [18–21].

Results

Definitions and descriptive analysis

Outcome. Our main outcome variable is the weekly growth rate of new positive COVID-19 cases, $\Delta \log(\Delta C_t)$, formally defined in Methods. We use weekly data to remove fluctuations from day-of-the-week effects. Weekly case growth is a metric that can be helpful in assessing trends in the spread of COVID-19; it is highlighted in the WHO’s weekly epidemiological updates [22].

Policy. In the Ontario analysis, we use regional variation in the timing of indoor mask mandates staggered over two months in the province’s 34 PHUs. Fig. 1 displays the gradual introduction of mask mandates in the 34 PHUs. The exact implementation dates of the mask mandates are reported in the SI Appendix. Mandatory masks were introduced first in Wellington-Dufferin-Guelph on June 12 and last in the Northwestern PHU on August 17.

Figure 1. Ontario - mask mandates over time

Notes: There are a total of 34 public health units (PHU) in Ontario. See SI Appendix Table C2 for the exact date of mask mandate implementation in each PHU.

We construct five policy aggregates at the daily level, as described in Methods: (i) travel, which includes international and domestic travel restrictions and self-isolation rules; (ii) school, an indicator of provincial school closure including Spring and Summer breaks; (iii) business/gathering, which comprises regulations and restrictions on non-essential businesses and retail, personal businesses, restaurants, bars and nightclubs, places of worship, events, gyms and recreation, and limits on gathering; (iv) long-term care (LTC), which includes NPIs governing
long-term care homes (visitor rules and whether staff are required to work on a single site) and (v) mask. All values are on the interval [0,1], with 0 denoting absence or lowest level of restrictions and 1 denoting maximal restrictions. A value between 0 and 1 indicates partial restrictions, either in intensity or geographical coverage in large provinces (see the SI Appendix for details and definitions). For example, the mask aggregate takes value 1 if an indoor mask mandate has been introduced, 0 if not, or value between 0 and 1 if only part of a province has enacted the policy.

**Figure 2.** Policy aggregates - Canada

Notes: The figure plots the numerical values of the 5 policy aggregates (Mask, Business/gathering, School, Travel and Long-term care, LTC) over time, for each of the 10 provinces. The mask policy values for ON reflect the gradual adoption of mandates (see Fig. 1) and the respective PHU population sizes.

Fig. 2 plots the values of the five policy aggregates over time for each of the 10 provinces. Travel restrictions, school closures and business closures were implemented in a relatively short period in the middle of March. There is some variation in the travel policy aggregate since some Canadian provinces (the Atlantic provinces and Manitoba) implemented inter-provincial travel restrictions or self-isolation rules in addition to the federal restrictions on international travel. Regulations in the LTC facilities were introduced more gradually. In the re-opening period (May-August), there is more policy intensity variation, especially for business and gatherings, as each province implemented its own re-opening plan. Mask mandates were introduced in Ontario starting from June in a few smaller PHUs and in early July in the most populous PHUs, Toronto, Peel and Ottawa (see SI Appendix Table C2). In Quebec, indoor masks were mandated province-wide on July 18. Nova Scotia (province-wide) and Alberta’s major
cities, Calgary and Edmonton, implemented mask mandates on July 31 and August 1, respectively.

There are two empirical challenges specific to the Canadian context and data. First is the presence of small provinces or sub-regions with very few COVID-19 cases or deaths. We report results with different ways of handling the observations with zero cases. Second, there are only 10 provinces in Canada and 34 public health units in Ontario, unlike the 51 U.S. jurisdictions in e.g., [8]. To account for the resulting small number of clusters in the estimation, we calculate and report “wild bootstrap” standard errors and p-values, as in [23]. On the flip side, our data has the advantage of a longer time horizon and non-binary, more detailed policy variables compared to [8, 24].

**Behaviour proxy.** We follow [8] and others in interpreting the Google Community Mobility Reports location trend indices as measures of changes in people’s behaviour during the pandemic, keeping in mind that location is only one aspect of behaviour relevant to COVID-19. See SI Appendix Fig. B3 for the general trends. We construct a behaviour proxy by aggregating these indices (see Methods). SI Appendix Tables A3 and A4 show the correlation between the behaviour proxy $B_{it}$ and the policy aggregates $P_{it}$. The behaviour proxy and mask mandate variable are not highly correlated, suggesting that the effect of mask mandates on COVID-19 outcomes is likely not dependent on location behaviour changes.

**Information.** We use the lagged value of the weekly case growth rate, $\Delta \log(\Delta C_{it-l})$ and the log of past weekly cases, $\log(\Delta C_{it-l})$ as the information variables $I_{it-l}$ in our baseline estimation equation (1) (see Methods). We also use the lagged provincial (in the Ontario analysis) or national (in the Canada analysis) case growth rate and log of weekly cases as additional information variables in some specifications. A two-week information lag, $l = 14$, is used in the baseline analysis.

**Control variables.** In all regressions, we control for region fixed effects (PHU or province) and the weekly COVID-19 testing growth rate $\Delta \log(\Delta T_{it})$, defined analogously to the weekly case growth rate. We also include a time trend: our baseline results use a cubic polynomial in days, and we also report results without time trend or using week fixed effects. In robustness checks, we also include news and weather variables.

**Time period.** We use the period May 15 to August 13 in the Ontario PHU data analysis and March 11 to August 13 in the provincial-level analysis. The start date for the Ontario sample (May 15) is approximately two weeks after the last first-wave restrictive measures were implemented and four weeks before the first PHU mask mandate was introduced. The initial date for the province-level sample (March 11) was chosen as the first date on which each province reported at least one COVID-19 test. The end date reflects data availability at the time of the statistical analysis and the fact that mask mandate adoption in Ontario’s PHUs was essentially complete by late July. We perform sensitivity checks with alternative dates.

**Mask mandates in Ontario’s public health regions**

We start with a simple graphical illustration of the effect of mask mandates on COVID-19 cases growth. Fig. 3 displays the average log case growth, $Y_{it} = \Delta \log(\Delta C_{it})$ in Ontario PHUs with and without mask mandates. On average, the PHUs with a mask mandate two weeks prior have lower case growth than the PHUs without a mask mandate two weeks prior.

Table 1 shows the estimates of equation (1), in which we control for other policies, behaviour, and information (lagged cases and lagged case growth at the PHU or province level), as explained in Methods. To account for the small number of clusters, we compute and report wild bootstrap p-values, ( [23]), clustered at the PHU level (see SI Appendix Table A6 for alternative specifications). In all tables, Variable\_14 denotes the 14-day lag of Variable.

The estimates in Table 1 imply that, controlling for other policies, information, testing, and geo-location mobility
behaviour, mandatory indoor face masks are associated with a decrease of 29.1 to 37.6 log points ($p < 0.05$) in the weekly growth rate of new cases, two weeks after their implementation. This can be interpreted as a 25–31% weekly reduction in new cases, relative to the trend without mask mandate (see Methods).

Columns (3)–(6) of Table 1 show that our estimates of the mask mandate policy remain robust to including a cubic time trend or week fixed effects. We include these to control for additional province-wide factors possibly affecting the spread of COVID-19, e.g., adaptation over time, income support policies or “COVID fatigue”. Since the cubic time trend specification allows for non-monotonic aggregate time trend in case growth in a parsimonious way, we choose it as our baseline specification in the “Robustness” and “Counterfactuals” sections. The magnitude of our mask policy estimates is also not very sensitive to whether lagged province-level data are included as additional information.

The results in Table 1 indicate that indoor mask mandates can be a powerful preventive measure in the COVID-19 context. Our estimates of the mask mandate impact in Ontario’s PHUs are larger than the 9–10 percentage point reduction in case growth estimated by [8] for the U.S. A possible explanation is that Ontario’s mask mandates are more comprehensive: we evaluate universal indoor mask-wearing for the public rather than mask-wearing for employees only in [8]. Differences in compliance may also be a factor (see the “Mask usage” section).

Table 1 also shows a statistically significant negative association between information (past cases, log($\Delta C$)$_{14}$) and current weekly case growth ($p < 0.01$ in all specifications), indicating that a higher level of cases two weeks prior is correlated with lower current case growth. While the location-based proxy allows for certain behavioural responses to information, its coefficient estimate in Table 1 is close to zero, which suggests that it may not capture other important behavioural aspects, e.g., hand-washing or physical distancing. In SI Appendix Table A18, we find strong contemporaneous correlations between policy, log cases, and the Google mobility behavioural proxy. This suggests that the information in lagged cases and the lagged policy variables may absorb lagged behavioural responses or other latent behavioural changes.
Table 1. Main results - Ontario public health regions

|                          | Outcome: weekly case growth $Y_t = \Delta \log(\Delta C_t)$ | (1) no time trend | (2) cubic time trend | (3) weekly fixed effects | (4) cubic time trend | (5) weekly fixed effects | (6) cubic time trend | (7) weekly fixed effects |
|--------------------------|-------------------------------------------------------------|-------------------|---------------------|--------------------------|---------------------|--------------------------|---------------------|--------------------------|
| Mask_14                  | -0.291 **                                                   | [-0.017]          | -0.323 **           | [-0.016]                 | -0.366 **           | [-0.010]                 | -0.376 ***          | [-0.008]                 |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| Business/gathering_14    | -0.625                                                      | [0.209]           | -0.457              | [0.473]                  | -0.137              | [0.877]                  | 0.279               | [0.687]                  |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| Long-term care_14        | 0.643                                                       | [0.463]           | 0.544               | [0.549]                  | 0.747               | [0.677]                  | -0.097              | [0.930]                  |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| Behaviour proxy_14       | -0.020                                                      | [0.160]           | -0.016              | [0.215]                  | -0.018              | [0.266]                  | -0.018              | [0.272]                  |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| $\Delta \log(\Delta C)_14$ | 0.030                                                        | [0.614]           | 0.029               | [0.649]                  | 0.024               | [0.692]                  | 0.028               | [0.665]                  |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| $\log(\Delta C)_14$      | -0.214 ***                                                   | [0.000]           | -0.214 ***          | [0.000]                  | -0.203 ***          | [0.000]                  | -0.209 ***          | [0.001]                  |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| $\Delta \log(\Delta PC)_14$ | 0.287                                                       | [0.307]           | 0.184               | [0.566]                  | 0.543 **            | [0.046]                  |                   |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| $\log(\Delta PC)_14$     | -0.028                                                      | [0.907]           | 0.528               | [0.124]                  |                   | 0.112                    |                   |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| $\Delta \log(\Delta T)$  | -0.313 *                                                    | [0.087]           | -0.409 *            | [0.058]                  | -0.260              | [0.287]                  | -0.382              | [0.125]                  |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
|                          |                                                             |                   |                     |                          |                     |                          |                     |                          |
| R-squared                | 0.046                                                       | 0.050             | 0.051               | 0.058                    | 0.091               | 0.094                    |                   |                          |
| N                        | 3,094                                                       | 3,094             | 3,094               | 3,094                    | 3,094               | 3,094                    |                   |                          |
| PHU fixed effects        | X                                                           | X                 | X                   | X                        | X                   | X                        |                   |                          |
| cubic time trend (days)   |                                                             |                   |                     |                          |                     |                          |                     |                          |
| week fixed effects       | X                                                           | X                 | X                   | X                        | X                   | X                        |                   |                          |

Notes: The time period is May 15 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors with 5000 repetitions clustered by PHU are reported in the square brackets. Mask_14, Business/gathering_14, Behaviour_14, $\Delta \log(\Delta C)_14$ and $\log(\Delta C)_14$ are measured at the PHU level, while Long-term care_14, $\Delta \log(\Delta PC)_14$, $\log(\Delta PC)_14$, and $\Delta \log(\Delta T)$ are at the province level. PC denotes provincial total cases. Mask mandates and regulations on businesses and gatherings vary at the PHU level. Long-term care policy changed only province-wide. The Ontario school and travel policies do not vary in the sample period and hence are omitted from the analysis. ***, ** and * denote 1%, 5% and 10% significance respectively. Missing values (1.4% of all observations) for Behaviour proxy_14 are imputed via linear interpolation.

Province-level results

We next evaluate the impact of mask mandates and other NPIs on COVID-19 case growth in Canada as a whole by using variation in the timing of policy interventions across the 10 provinces.

Fig. 4 plots the average log weekly case growth in the provinces with and without mask mandates two weeks prior. While mask mandates are implemented relatively late in our sample period, average case growth in the provinces with a mask mandate (Ontario and Quebec) begins to diverge from the average case growth in the provinces without a mandate roughly two to four weeks after the mandates are imposed.

Table 2 displays the estimates of equation (1) in Methods for weekly case growth, along with wild bootstrap p-values clustered at the province level. The most robust result is the estimated effect of mask mandates, which are associated with a large reduction in weekly case growth of 45 to 62 log points, corresponding to a 36 to 46% weekly reduction in new cases across the different specifications, relative to the trend in absence of mandate. The estimates are statistically significantly different from zero in all cases, with p-values less than 0.001 in columns (1)-(4); they
are consistent with our Ontario PHU results given the uncertainty involved.

Table 2 further shows that restrictions on businesses and gatherings are associated with a reduction in the weekly case growth of 65 to 85 log points or, vice versa, relaxing business/gathering restrictions is associated with higher case growth. The estimate corresponds to a 48 to 57% weekly decrease in new cases in our sample period, relative to the trend in absence of mandate. The business/gathering estimates are, however, noisier than our estimates for mask mandates and do not retain statistical significance in the specification with week fixed effects. Tables A8 and A15 in the SI Appendix further suggest that the results on business and gathering NPIs are driven by the smaller provinces and the re-opening period (May to August). Still, these findings suggest that relaxed restrictions and the associated increase in business and workplace activity or gatherings (including restaurants, bars and retail) can be an important offsetting factor for the estimated impact of mask mandates on COVID-19 case growth, both in our sample and at later dates.

We also find that school closures (the variable School_14) are negatively associated with case growth. However, the estimates are statistically significant from zero only in the specifications with cubic time trend. As seen in Fig. 2, provincial school closures occurred in a very short time interval in March, so we lack statistical power to separately identify their effect from that of other NPIs (especially travel-related restrictions). Hence, we interpret this result with caution. Finally, as in Table 1, past cases, \( \Delta \log(\Delta C)_{14} \), are negatively and statistically significantly associated with current weekly case growth in columns (1)-(4).

**Robustness**

We perform robustness and sensitivity analysis on our main results and report details in the SI Appendix. We check robustness with respect to potential collinearity in the policy variables by omitting one policy at a time in Tables A7 and A10. We check robustness to alternative treatments of zero weekly cases in Tables A5 and A8, including weighted OLS and restricting the sample to the four largest provinces. We check sensitivity to alternative initial sample dates (Fig. B4 and B5) or alternative lags (Fig. B6 and B7). We also consider adding weather and news variables to the baseline regression to account for possible omitted variables (Table A11). The results from these
Table 2. Main results – Canadian provinces

| Outcome: weekly case growth \( Y_t = \Delta \log(\Delta C_t) \) | (1) no time trend | (2) cubic time trend | (3) week fixed effects | (4) cubic time trend | (5) week fixed effects | (6) cubic time trend |
|-------------------------------------------------------------|----------------|-----------------|-----------------|----------------|-----------------|----------------|
| Mask_14                                                      | -0.446 ***  | -0.484 ***  | -0.618 ***  | -0.613 ***  | -0.581 **  | -0.567 **  |
|                                                           | [0.000]    | [0.000]    | [0.000]    | [0.000]    | [0.030]    | [0.026]    |
| Business/gathering_14                                       | -0.654 **  | -0.827 **  | -0.835 **  | -0.846 **  | -0.648    | -0.694    |
|                                                           | [0.018]    | [0.019]    | [0.031]    | [0.033]    | [0.146]    | [0.137]    |
| School_14                                                   | -0.336    | -0.480    | -0.425 **  | -0.433 **  | -0.261    | -0.347    |
|                                                           | [0.352]    | [0.196]    | [0.015]    | [0.019]    | [0.235]    | [0.130]    |
| Travel_14                                                   | -0.585    | -0.772    | -0.375    | -0.412    | -0.396    | -0.553    |
|                                                           | [0.146]    | [0.118]    | [0.613]    | [0.636]    | [0.695]    | [0.559]    |
| Long-term care_14                                           | -0.052    | -0.119    | 0.023    | 0.032    | 0.063    | 0.056    |
|                                                           | [0.824]    | [0.715]    | [0.958]    | [0.920]    | [0.889]    | [0.898]    |
| Behaviour proxy_14                                          | -0.009    | -0.008    | -0.001    | 0.000    | -0.003    | 0.001    |
|                                                           | [0.257]    | [0.350]    | [0.880]    | [0.972]    | [0.858]    | [0.935]    |
| \( \Delta \log(\Delta C) \) _14                           | -0.061    | -0.062    | -0.078 *  | -0.072    | -0.055    | -0.054    |
|                                                           | [0.177]    | [0.262]    | [0.090]    | [0.198]    | [0.449]    | [0.459]    |
| \( \log(\Delta C) \) _14                                   | -0.223 ***  | -0.244 ***  | -0.227 **  | -0.227 *  | -0.224    | -0.232    |
|                                                           | [0.000]    | [0.003]    | [0.019]    | [0.090]    | [0.102]    | [0.113]    |
| \( \Delta \log(\Delta NC) \) _14                          | 0.015    | -0.107    | -0.050    | -0.050    | -0.050    | -0.050    |
|                                                           | [0.895]    | [0.631]    | [0.807]    | [0.807]    | [0.807]    | [0.807]    |
| \( \log(\Delta NC) \) _14                                  | 0.141    | 0.055      | 0.302 **  | 0.302 **  | 0.302 **  | 0.302 **  |
|                                                           | [0.326]    | [0.825]    | [0.048]    | [0.048]    | [0.048]    | [0.048]    |
| \( \Delta \log(\Delta T) \)                                | 0.112    | 0.166 *  | 0.172 **  | 0.169 *  | 0.158    | 0.166 *  |
|                                                           | [0.170]    | [0.074]    | [0.043]    | [0.056]    | [0.110]    | [0.073]    |
| R-squared                                                   | 0.406    | 0.410    | 0.414    | 0.414    | 0.430    | 0.433    |
| N                                                           | 1,560    | 1,560    | 1,560    | 1,560    | 1,560    | 1,560    |
| province fixed effects                                       | X        | X        | X        | X        | X        | X        |
| cubic time trend (days)                                      | X        | X        | X        | X        | X        | X        |
| week fixed effects                                           | X        | X        | X        | X        | X        | X        |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5,000 repetitions are reported in the square brackets. ***, ** and * denote 10%, 5% and 1% significance level respectively. NC denotes national total cases.

Checks confirm that our main results on mask mandates remain stable and robust to these specification changes.

Mask usage

The effectiveness of any NPI crucially depends on how it affects behaviour. We use self-reported survey data on mask usage to examine whether mask mandates increased mask use in Canada. We use data from the YouGov COVID-19 Public Monitor [12], which includes multiple waves of public opinion surveys fielded since early April 2020 in many countries. We focus on inter-provincial comparison within Canada. Our variable of interest is based on the responses to the question “Thinking about the last 7 days, how often have you worn a face mask outside your home (e.g. when on public transport, going to a supermarket, going to a main road)?” The answer choices are “Always”, “Frequently”, “Sometimes”, “Rarely”, and “Not at all”. We create a binary variable taking value 1 if the response is “Always” and 0 otherwise, and another variable taking value 1 if the respondent answered either

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“Always” or “Frequently” and 0 otherwise.

SI Appendix Fig. B2 plots average self-reported mask usage (the response “Always”) in the provinces with and without mask mandates from April to August 2020, clearly showing that mask usage is higher, by up to 50 percentage points, in the provinces with a mask mandate.

**Figure 5.** Event study of self-reported mask usage – Canada

![Graph of self-reported mask usage](image)

Notes: The outcome is a binary variable taking value 1 if the respondent respectively answered “Always” (in the left panel) or “Always” or “Frequently” (in the right panel) to “Thinking about the last 7 days, how often have you worn a face mask outside your home?” The figure plots the estimates from a version of equation (2) where the mask policy variable is replaced by the interaction of a variable denoting being in the treatment group (imposed mask mandate) with a series of dummies for each week, ranging from 6 weeks before the mask mandate to 6 weeks after (T=–6 to +5, where T=0 is the mandate implementation date). The reference point is 1 week before the implementation (T=–1). Wild bootstrap (cgmwildboot) standard errors with 5,000 repetitions clustered by province are used to construct the confidence intervals. Sample weights are used.

Since Fig. B2 does not account for compositional changes, we also perform formal event-study analysis using self-reported mask usage as the behavioural outcome in Fig. 5. The figure presents results for the “Always” (left panel) and “Always” or “Frequently” (right panel) mask usage answers. Neither panel shows a pre-trend – the estimates are close to zero before mask mandates are implemented. This addresses the potential concern that provinces which implemented mask mandates may have had a different trend in mask usage than provinces which did not. Second, the effect of mask mandates on mask usage is immediate: an increase of roughly 20 percentage points as soon as the policy is implemented at T = 0. Third, the effect appears persistent rather than transitory, since mask usage after T = 0 does not revert to its previous level.

Table 3 displays the estimates on self-reported mask usage (answer “Always”) in equation (2) in Methods along with wild bootstrap p-values clustered at the province level. Our preferred specification with cubic time trend, column (4), shows that mask mandates are associated with 31.5 percentage point increase in self-reported mask usage (p < 0.001), from a base of self-reported mask usage without mask mandate of 29.8% (see also SI Appendix Table A12, which shows that “Always” or “Frequent” mask usage increases by 21.5 percentage points).

These “first-stage” results show that mask mandates exhibit broad compliance in Canada and establish a basis for the significant impact of the mandates on the spread of COVID-19 that we find. That said, given that mask mandates do not change everyone’s behaviour, our estimates in Tables 1 and 2 represent intent-to-treat effects. The effect of the entire population switching to wearing masks is likely larger – if we take at face value the increase of about 30 percentage points in reported mask usage induced by the mandates, the full effect of mask wearing
Table 3. Self-reported mask usage – Canada

|                        | (1) no time trend | (2) cubic time trend | (3) week fixed effects |
|------------------------|-------------------|----------------------|------------------------|
| Mask                   | 0.404 ***         | 0.396 ***            | 0.304 ***              |
|                        | [0.000]           | [0.000]              | [0.000]                |
| ∆log(∆C)               | -0.017            | -0.006               | -0.006                 |
|                        | [0.663]           | [0.611]              | [0.524]                |
| log(∆C)                | -0.025            | 0.015 **             | 0.004                  |
|                        | [0.127]           | [0.025]              | [0.662]                |
| ∆log(∆NC)              | -0.106 *          | -0.023               | 0.191                  |
|                        | [0.054]           | [0.324]              | [0.108]                |
| log(∆NC)               | -0.089 ***        | -0.028               | -0.068                 |
|                        | [0.000]           | [0.669]              | [0.582]                |
| R-squared              | 0.157             | 0.169                | 0.172                  |
| N                      | 8,859             | 8,859                | 8,859                  |
| individual characteristics | X    | X                    | X                      |
| province fixed effects | X                | X                    | X                      |
| cubic time trend (days) | X              | X                    | X                      |
| week fixed effects     | X                | X                    |                        |
| average mask usage rate without mask mandate = 0.298 |

Notes: The time period is April 2 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors with 5000 repetitions clustered by province are reported in the square brackets. NC denotes national total cases. The outcome is a dummy that takes value 1 if the respondent answered “Always” to the survey question “Thinking about the last 7 days, how often have you worn a face mask outside your home?” Sample weights are used. Individual characteristics include a gender dummy, age dummy (in years), dummies for each household size, dummies for each number of children, and dummies for each employment status. ***, ** and * denote 10%, 5% and 1% significance level respectively.

There is a heated debate on whether community use of masks may create a false sense of security that reduces adherence to other preventive measures. We investigate this question using the YouGov survey data. SI Appendix Tables A13 and A14 indicate no evidence that mask mandates in Canada have had an offsetting effect on other preventive measures such as hand washing, using sanitizer, avoiding gatherings, or avoiding touching objects in public during the period we study. On the contrary, mask mandates may slightly increase social distancing in one out of the precaution categories (avoiding crowded areas) ($p < 0.10$). Consistent with this, [25] report that mask wear increased physical distancing in a randomized controlled trial in waiting lines outside German stores.

**Counterfactuals**

We use our estimates to evaluate counterfactuals in which the actual mask policy in Ontario or Canada-wide is replaced by an alternative policy. Our procedure is explained in Methods.

Fig. 6 shows results from two counterfactual policy evaluations. The first counterfactual (left panels) assumes that masks are adopted everywhere at the earliest date observed in the data (June 12 for the Ontario PHUs and July 7 for all Canadian provinces). The ‘counterfactual’ line is initially set equal to the observed weekly case value and diverges from it after the assumed 14-day lag from mask mandate implementation. Using our mask policy estimate (treatment-on-the-treated) would be roughly triple our estimate, or even larger if there is desirability bias in answering the mask usage survey question once a mandate is imposed.
from Table 1, Fig. 6 shows that an early face mask mandate implemented in all Ontario PHUs could have led to an average reduction of about 300 cases per week as of August 13, all else equal. For Canada as a whole, a nationwide adoption of mask mandates in early July is predicted to reduce total cases per week by 700 to 1,100 cases on average as of August 13, depending on whether we use the more conservative mask estimate (-0.376) from column (4) of Table 1 (see Fig. 6) or the larger estimate (-0.613) from Table 2 (see SI Appendix Fig. B11).

In the right-side panels of Fig. 6, we perform the opposite simulation, assuming instead that mask mandates were not adopted in any Ontario PHU or any Canadian province by mid-August. Our estimates imply that this would have led to a large increase in new cases, both in Ontario and Canada-wide (see also SI Appendix Fig. B12 for counterfactuals with British Columbia and Alberta).

The counterfactual simulations assume that all other variables, behaviour and policies (except the mask policy and \( t - 14 \) case counts) remain fixed at their values observed in the data. This is a strong assumption, but it may be plausible over the relatively short period that we analyze. In addition, the counterfactuals assume that people in the regions without a mask mandate would react in the same way, on average, as in the regions that have imposed a mandate. Therefore, these results should be interpreted with caution and only as rough projections of the estimated impact of mask mandates on COVID-19 cases.
Additional analysis

Closing and re-opening periods. We investigate whether the NPI impact varied in different phases of the pandemic by splitting the data into two sub-periods: “closing” (March 11 to May 14) and “re-opening” (May 15 to August 13). The dividing date of May 15 (referring to the NPIs in place on May 1) was chosen because very few policies were relaxed before May 1 and very few non-mask policies were tightened after May 1 in our study period (see Fig. 2). In SI Appendix Table A15, we report estimates separately for the closing and re-opening periods. We find that the school closures and travel restrictions imposed early in the closing period are associated with a large subsequent reduction in weekly case growth (see also SI Appendix Fig. B8). Long-term care restrictions are also associated with reduced case growth two weeks later during the closing period. We interpret these results with caution, since many NPIs and restrictions were enacted in a brief time interval in March and there is not much inter-provincial variation (see Fig. 2). No mask mandates exist in the closing period.

Our results for the May–August re-opening period are in line with the full-sample results for mask mandates and business/gathering regulations (Table 2). Travel restrictions and school closures are not statistically significant since the relaxation of travel policies was minor (only re-opening to safe areas within Canada), and schools only re-opened in parts of Quebec and BC, with voluntary attendance and reduced classes.

Deaths. We also analyze the growth rate of COVID-19 deaths as an outcome variable in the same way as we do for cases. We only have deaths data at the province level. Table 4 reports results from estimating analogous specifications to those in Table 2 (see also SI Appendix Fig. B13). We use a 28-day lag for the policy, behaviour proxy, and information variables to reflect that deaths occur on average about two weeks after case detection; see SI Appendix for details and references.

Because there are only 10 days with observations at least 28 days after the first significant adoption of mask mandates in Ontario on July 7, we interpret the large estimated reduction in the observed weekly deaths growth rate four weeks later in Table 4 (more than 90 log points reduction in growth, or equivalently 60% weekly reduction in deaths relative to the no-mandate trend) as only suggestive. These estimates are also less robust than those for case growth (see SI Appendix Table A16).

Discussion

We use both within-province and cross-province variation in the timing of face mask mandates in Canada and find a robust significantly negative association between the mandates and subsequent COVID-19 case growth: a 25 to 46% average weekly reduction in new cases in the first few weeks after adoption. These results are supported by our analysis of survey data on compliance with the mask mandates, which shows that the mandates significantly increased the proportion of people reporting always wearing mask in public by around 30 percentage points. We conclude that mandating mask wearing in indoor public spaces can be a powerful policy tool to keep COVID-19 transmission at a manageable level, especially given its relatively low cost to the economy.

Mask mandates were introduced in Canada at a time when other policy measures were relaxed, as part of the economy’s re-opening. We find that reduced restrictions on businesses or gatherings are positively associated with subsequent COVID-19 case growth – a factor that can easily offset and obscure the public health benefits of mask mandates. Past case totals were also found to matter for subsequent COVID-19 outcomes, suggesting that riskier behaviour may follow information perceived as favourable. These effects may limit how low the number of new cases can be pushed by mask mandates or other restrictions. Importantly, the effect of mask mandates that we
### Table 4. Canada – deaths growth rate and policies

| (1) | (2) | (3) | (4) | (5) | (6) |
|-----|-----|-----|-----|-----|-----|
| no time trend | cubic time trend | week fixed effects | no time trend | cubic time trend | week fixed effects |
| Mask | -1.391*** | -1.453*** | -0.922** | -0.983** | -0.904** | -0.915** |
| [0.000] | [0.000] | [0.022] | [0.032] | [0.036] | [0.045] |
| Business/gathering | 0.241 | 0.271 | -0.134 | -0.224 | -0.279 | -0.268 |
| [0.529] | [0.521] | [0.762] | [0.748] | [0.712] | [0.732] |
| School | 0.002 | 0.018 | 0.441 | 0.440 | 0.624 | 0.630 |
| [0.974] | [0.924] | [0.317] | [0.341] | [0.114] | [0.113] |
| Travel | -0.176 | -0.287 | -0.005 | -0.027 | -0.191 | -0.161 |
| [0.553] | [0.432] | [0.972] | [0.935] | [0.638] | [0.718] |
| Long-term care | -0.091 | -0.140 | -0.035 | -0.036 | -0.024 | -0.017 |
| [0.592] | [0.600] | [0.900] | [0.900] | [0.936] | [0.948] |
| Behaviour proxy | 0.003 | 0.000 | 0.002 | 0.003 | 0.005 | 0.005 |
| [0.718] | [1.000] | [0.815] | [0.737] | [0.675] | [0.695] |
| Δlog(ΔD) | 0.151 | 0.175 | 0.141 | 0.152 | 0.154 | 0.153 |
| [0.194] | [0.245] | [0.361] | [0.345] | [0.266] | [0.266] |
| log(ΔD) | -0.238*** | -0.248*** | -0.216*** | -0.220*** | -0.229*** | -0.227*** |
| [0.000] | [0.000] | [0.000] | [0.000] | [0.000] | [0.000] |
| Δlog(ΔND) | -0.110 | -0.121 | -0.121 | -0.019 | -0.019 | -0.019 |
| [0.471] | [0.476] | [0.476] | [0.806] | [0.806] | [0.806] |
| log(ΔND) | -0.015 | 0.018 | 0.018 | -0.053 | -0.053 | -0.053 |
| [0.743] | [0.858] | [0.858] | [0.557] | [0.557] | [0.557] |
| Δlog(ΔT) | 0.081 | 0.018 | -0.038 | -0.051 | -0.037 | -0.037 |
| [0.409] | [0.922] | [0.758] | [0.735] | [0.752] | [0.748] |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. 205 out of the 1,470 observations (14%) had log(0) replaced by -1. *** , ** and * denote 10%, 5% and 1% significance level respectively. ND denotes national total deaths. 28-day lag of a variable is denoted by _28.

The estimate is relative to their absence and not absolute; thus, depending on the context, a mandate may not be sufficient on its own to prevent an increase in new infections and should be considered in conjunction with other measures.

### Methods

**Data.** We use provincial official sources to collect a complete data set of COVID-19 cases, deaths, tests and policy measures in all ten Canadian provinces, including all revisions as of mid-August 2020 (see SI Appendix Table C3 and the project’s Github repository.) In addition, our data include cases and policy indicators for each of the 34 PHUs in Ontario.

Implementation dates of NPIs and other public policies were collected from government websites, announcements, public health orders and staged re-opening plans, collected from the respective official sources. In the national data, the raw policy measures data contain the dates or enactment and relaxation (if applicable) of 17 policy indicators, each taking values between 0 and 1, reflecting: mandatory mask wear; closure and re-opening of retail and non-essential businesses, restaurants, recreation facilities, and places of worship; school closures; limits on events and gatherings; international and domestic travel restrictions and self-isolation requirements; restrictions on visits and staff movement in long-term care homes. All policy indicator variables are defined in SI Appendix Table C1. In the Ontario PHU data, the implementation dates of mask mandates and the relaxation
dates of policies for businesses and gatherings vary across PHUs. Decisions about the former were made at the PHU level, while decisions about the latter were made by the province.

Many NPIs were implemented around the same time, both relative to each other and/or across the regions, especially during the March closing-down period. This causes many of the policy indicators to be highly correlated with each other (see SI Appendix Table A17). To avoid multi-collinearity issues, we group, via simple averaging, the 17 policy indicators into 5 policy aggregates. The numerical values are assigned at the daily level for each area (PHU in the Ontario analysis, province in the national analysis) while maintaining comparability across areas. For consistency with the weekly outcome and information variables and our empirical model timing, we construct the policy aggregates \( P_{it} \) used in the regressions (where \( j = 1, \ldots, 5 \) denotes policy type) as weekly moving averages, from date \( t - 6 \) to date \( t \).

Regarding behavioural responses, we use the Google COVID-19 Mobility Reports, which summarize daily cellphone geo-location data for each province as indices calculated relative to the median value for the same day of the week in a five-week baseline period, Jan. 3 to Feb. 6, 2020. In Ontario, these location data are available for each of the 51 first-level administrative divisions (counties, regional municipalities, single-tier municipalities and districts). Each of these divisions is either entirely (in most cases) or predominantly located within a single PHU. If a PHU corresponds to multiple divisions, 2016 Census population numbers were used as weights to compute the PHU’s mobility index.

Several of the six location indicators (retail, grocery and pharmacy, workplaces, transit, parks and residential) are highly correlated with each other (see SI Appendix Tables A1 and A2) and/or contain many missing observations for the smaller PHUs and provinces. To address these data limitations and the possible impact of collinearity on the estimation results, we use as proxy for behavioural changes the simple average of three mobility indicators: “retail”, “grocery and pharmacy” and “workplaces”. We do not use the “transit”, “parks”, and “residential” location indicators because, respectively, 10.6%, 13.7% and 2.8% of the observations are missing in the provincial data, and 20.7%, 52.1%, and 11.1% are missing in the Ontario data. The “transit” and “residential” variables are highly correlated with each other (see SI Appendix Tables A1 and A2) and/or contain many missing observations for the smaller numbers were used as weights to compute the PHU’s mobility index.

Estimation strategy. We use a version of the approach in [8], modified and adapted to the Canadian context. Our empirical strategy uses the panel data structure of the outcome, policy and behavioural proxy variables, and includes lags of outcomes as information, following the causal paths suggested by the epidemiological SIR model, [26]. Specifically, we estimate the effect of policy interventions on COVID-19 outcomes while controlling for information and behaviour. In contrast to [8] and [15], who study variation in NPIs across U.S. states or across countries, our identification strategy uses policy variation at the sub-provincial level (Ontario PHUs) in addition to cross-province variation, and our data captures both the closing and gradual re-opening stages of the epidemic.

The main data variables used in our empirical analysis are listed below. Everywhere \( i \) denotes health region (PHU) for the Ontario analysis and province for the national analysis, and \( t \) denotes time measured in days.

1. Outcome, \( Y_{it} \) – the growth rate of weekly cases or deaths.
2. Policy/NPIs, \( P_{it} \) – for the national analysis, five policy aggregates by province and date; for the Ontario analysis, two policy variables (mask mandates and regulations on businesses and gatherings) by PHU and date.
3. Behavioural responses, \( B_{it} \) – proxied by Google mobility data capturing changes in people’s geo-location relative to a baseline period in January-February.
4. Information, \( I_{it} \) – lagged outcomes, i.e., level or growth rate of cases (or deaths). We also consider a specification that includes past cases (deaths) and case (deaths) growth at the national level as additional information variables.
5. Controls, \( W_{it} \) – province or PHU fixed effects, growth rate of weekly new COVID-19 tests, and a time trend.

To assess and disentangle the impact of NPIs and behavioural responses on COVID-19 outcomes, we estimate:

\[ Y_{it} = \pi P_{it-1} + \alpha B_{it-1} + \mu I_{it-1} + \delta W_{it} + \epsilon_{it} \]  

(1)

where \( l \) denotes a time lag measured in days. Equation (1) models the relationship between COVID-19 outcomes, \( Y_{it} \) and lagged policy measures, \( P_{it-1} \), lagged behaviour, \( B_{it-1} \), and information (lagged outcomes), \( I_{it-1} \). For case growth as the outcome, we use a 14-day lag, \( l = 14 \). For deaths growth as the outcome, we use \( l = 28 \). The choice of these lags is discussed in detail in the SI Appendix and alternative lags are explored in robustness checks.

By including lagged outcomes, we allow for possible endogeneity of the policy interventions \( P_{it} \), that is, the introduction or relaxation of NPIs based on information about the level or growth rate of cases or deaths. Also, past cases may be correlated with (lagged) government policies or behaviours that may not be fully captured by the included policy and behaviour variables.

In SI Appendix Table A18, we also report estimates of:

\[ B_{it} = \beta P_{it} + \gamma I_{it} + \delta W_{it} + \epsilon_{it} \]  

(2)
which models the relationship between policies $P_t$, information, $I_t$ (levels or growth of cases) and behaviour, $B_t$ assuming that behaviour reacts to the information without a significant lag. We find strong correlation between the policy measures and the Google mobility behavioural proxy.

Equation (1) captures both the direct effect of policies on outcomes, with the appropriate lag, as well as the potential indirect effect on outcomes from changes in behaviour captured by the geo-location trends proxy, $B_{t-7}$. In the SI Appendix we also estimate equation (1) without including the behavioural proxy, capturing the total effect of policies on outcomes. Since our estimates of $\alpha$ in equation (1) are not significantly different from zero, the results without controlling for $B_{t-7}$ are very similar to those from estimating (1).

Our main outcome of interest is the weekly growth rate of new positive COVID-19 cases. Specifically, let $C_t$ denote the cumulative case count up to day $t$ and define $\Delta C_t = C_t - C_{t-7}$ as the weekly COVID-19 cases reported for the 7-day period ending at day $t$. The (log) weekly case growth rate, $Y_t$ is then defined as:

$$Y_t = \Delta \log(\Delta C_t) = \log(\Delta C_t) - \log(\Delta C_{t-7}),$$

(3)

that is, the week-over-week growth in cases in region $i$ as of day $t$. Using equations (1) and (3), a coefficient estimate $\hat{\beta}$ on Mask$_{14}$, as the latter changes from 0 to 1, corresponds to a exp($\hat{\beta}$) – 1 percent change in the ratio of current-week to past-week cases.

To deal with zero weekly values, which mostly occur in the smaller regions we replace $\log(0)$ with -1 as in [8]. We check the robustness of our results by adding 1 before taking logs, by replacing $\log(0)$ with 0, and by using population weighted least squares, see the SI Appendix. The weekly death growth rate is defined analogously, using cumulative deaths data.

**Counterfactuals.** Letting $t_0$ be the implementation date of a counterfactual policy, we set the counterfactual weekly case count, $\Delta C^c_{it}$, equal to $\Delta C_t$ for all $t < t_0$. For each date $t \geq t_0$, using the definition of $Y_t$ in (3), we compute $\Delta C^c_{it}$ and the counterfactual weekly case growth rate, $Y^c_{it}$ as:

$$\Delta C^c_{it} = \exp(Y^c_{it}) (\Delta C^c_{it-7}) \quad \text{and} \quad Y^c_{it} = Y_{it} + \beta_{Mask_{14}} (\text{Mask}^c_{i14} - \text{Mask}_{i14}) + \beta_{\log(\Delta C)_{14}} \left(\ln(\Delta C^c_{it-14}) - \ln(\Delta C_{it-14})\right),$$

where $\hat{Y}_{it}$ is the regression-fitted value of weekly case growth; $\beta_{Mask_{14}}$ is the coefficient estimate (-0.376 or -0.613) on the mask mandate variable Mask$_{14}$ in baseline specification (column 4) in Table 1 or 2, depending on the counterfactual; Mask$_{i14}$ is the counterfactual mask policy (e.g., different implementation date, wider geographic coverage or absence of mask mandate); and $\beta_{\log(\Delta C)_{14}}$ is the coefficient estimate (-0.209 or -0.227) on lagged cases $\log(\Delta C)_{14}$ in Tables 1 or 2, column (4). The coefficient $\beta_{\log(\Delta C)_{14}}$ adjusts the counterfactual case growth rate for the negative statistically significant association between the weekly case total two weeks prior and time-$t$ case growth. This feedback effect may be due to people being more careful when they perceive the risk of infection to be higher.

**Data availability**

All data sources are documented in the SI Appendix. The data used in the study is available from the project’s Github repository: github.com/C19-SFU-Econ/data.

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Supporting Information Appendix

Face Masks, Public Policies and Slowing the Spread of COVID-19: Evidence from Canada∗

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Robustness

**Policy collinearity**
A possible concern about our data for the national analysis is that some NPIs (e.g., international travel restrictions or closing of schools) were implemented within a very short time interval.\(^1\) Thus, we may lack sufficient regional variation to distinguish and identify the separate effect of each policy.\(^2\) Collinearity could also affect the standard errors and the signs of the estimated coefficients.

To check robustness with respect to potential collinearity in the policy variables, Tables A7 and A10 report estimates from our baseline specifications with cubic time trend, omitting one policy at a time, for Ontario and Canada respectively. First, the mask mandate estimates are hardly affected by omitting any of the other policies. This is expected since mask mandates were imposed during a period where other NPIs changed little (see Figure 2). Similarly, the effects of business/gathering regulations and school closures in Table A10 are not sensitive to omitting other policies one at a time, which suggests that there is sufficient statistical power and variation to identify them in the national analysis.

**Treatment of zero weekly cases**
Another possible concern is that the dependent variable \(Y_{it} = \Delta \log(\Delta C_{it})\) is not well defined when the weekly case totals \(\Delta C_{it}\) or \(\Delta C_{it-7}\) is zero. As in CKS (2020), we replace \(\log(0)\) with \(-1\) in our baseline analysis.\(^3\) We now check the robustness of our estimates to alternative treatments of zero weekly cases.

For easier comparison, the first two columns in Table A5 repeat the baseline results from columns (3) and (4) in Table 1 for Ontario. Our main results on mask mandates in Ontario PHUs are robust to replacing \(\log(0)\) with 0 and to adding 1 to all \(\Delta C_{it}\) observations before taking logs, as shown in columns (3)-(6) of Table A5. Another way to address the issue of PHUs with very few cases is to estimate a weighted least squares regression in which the PHUs are weighted by population. Columns (7) and (8) in Table A5 show that the resulting mask mandate estimate has a slightly smaller magnitude and, due to the reduced effective sample size, weaker statistical significance.

Similarly, Table A8 shows that our province-level estimates, in particular for mask mandates, are also robust to the same alternative specifications as above. In columns (9) and (10)

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\(^1\) Table A4 shows a correlation of 0.61 between the Travel and School policy aggregates.

\(^2\) Aggregating the 17 basic policy indicators into five groups mitigates this issue. Here, we test whether any remaining collinearity poses a problem.

\(^3\) 5% out of 3,094 observations (17%) in Table 1 and 230 out of 1,560 observations (15%) in Table 2 are affected, mostly in the small provinces or PHUs. When both \(\Delta C_{it}\) and \(\Delta C_{it-7}\) equal zero, the weekly case growth rate is \(Y_{it} = 0\).
of Table A8, we also restrict the sample to only the largest 4 provinces (British Columbia, Ontario, Quebec and Alberta), for which only 0.3% of observations (2 out of 624) are zeroes. Again, the estimated mask mandate effect changes very little.

**Alternative dates**
Figure B4 shows that our estimates and confidence intervals for the effect of mask mandates in the Ontario baseline regressions do not vary much with the initial date of the sample. Similarly, Figure B5 shows that, in the national analysis, our results about mask mandates and business/gathering restrictions are also robust to alternative initial dates.

**Alternative lags**
We explore alternative time lags, of either shorter or longer duration, centered around the baseline value of 14 days. Figure B6 (with Ontario data) and Figure B7 (with province-level data) plot the estimates and confidence intervals from the baseline regressions and show that our mask mandate estimates remain fairly consistent for different plausible lag values.

**Omitted variables**
Our behaviour proxy variable (Google geo-location trends) likely misses some aspects of behaviour that could be relevant for COVID-19 transmission. One factor that may impact behaviour is weather. For example, good weather may cause more people to spend time outside, lowering the chance of viral transmission. Columns (3) and (4) in Table A11 report national estimates with lagged weather variables (daily maximum and minimum temperatures and precipitation for the largest city in each province\textsuperscript{4}) as additional regressors. Our NPI estimates, in particular for mask mandates, are little changed from the baseline results in columns (1) and (2).

Another possible concern is that our information variables (lagged cases and lagged case growth) may not fully capture the information based on which people react or adjust their behaviour, possibly affecting the observed weekly case growth. Columns (5) and (6) in Table A11 add a national-level “News” variable to the baseline specification. The variable is defined as the number of daily search results from a news aggregator website (ProQuest Canadian Newsstream) for the terms “coronavirus” or “COVID-19” (see Appendix C for more details). In column (6), the lagged news variable approaches the 10% significance level ($p = 0.103$). Our estimates on masks and business/gathering remain very close to those in the baseline.

\textsuperscript{4}Vancouver, BC; Calgary, AB; Saskatoon, SK; Winnipeg, MB; Toronto, ON; Montreal, QC; Moncton, NB; Halifax, NS; Charlottetown, PE; and St. John’s, NL.
### Additional tables

**Table A1: Ontario – Correlations between the Google mobility indicators**

| category   | retail | grocery | workplaces | transit | residential | parks     | N  |
|------------|--------|---------|------------|---------|-------------|-----------|----|
| retail     | 1      |         |            |         |             |           |    |
| grocery    | 0.82   | 1       |            |         |             |           |    |
| workplaces | 0.39   | 0.26    | 1          |         |             |           |    |
| transit    | 0.57   | 0.47    | 0.65       | 1       |             |           |    |
| residential| -0.54  | -0.38   | -0.92      | -0.69   | 1           | -0.47     |    |
| parks      | 0.50   | 0.31    | 0.40       | 0.40    | -0.47       | 1         |    |

**Notes:** The time period is May 1 to July 30 (two weeks before the May 15 - August 13 sample period). Daily PHU-level data.

**Table A2: Canada – Correlations between the Google mobility indicators**

| category   | retail | grocery | workplaces | transit | residential | parks     | N  |
|------------|--------|---------|------------|---------|-------------|-----------|----|
| retail     | 1      |         |            |         |             |           |    |
| grocery    | 0.84   | 1       |            |         |             |           |    |
| workplaces | 0.69   | 0.53    | 1          |         |             |           |    |
| transit    | 0.82   | 0.60    | 0.86       | 1       |             |           |    |
| residential| -0.80  | -0.58   | -0.91      | -0.85   | 1           |           |    |
| parks      | 0.53   | 0.43    | 0.19       | 0.25    | -0.46       | 1         |    |

**Notes:** The time period is February 26 to July 30 (two weeks before the March 11 - August 13 sample period). Daily province-level data.
### Table A3: Ontario – Correlations between policies and location behaviour

| Behaviour proxy     | Mask | Business/gathering | LTC  |
|---------------------|------|--------------------|------|
| Behaviour proxy     | 1    |                    |      |
| Mask                | 0.17 | 1                  |      |
| Business/gathering  | -0.55| -0.63              | 1    |
| Long-term care (LTC)| -0.27| -0.75              | 0.66 | 1    |

Notes: The time period is May 15 to August 13 (N = 3,094). Each variable is a 7-day moving average. All variables are at the PHU level, except LTC which is measured at the province level.

### Table A4: Canada – Correlations between policies and location behaviour

| Behaviour proxy     | Mask | Business/gathering | School | Travel | LTC  |
|---------------------|------|--------------------|--------|--------|------|
| Behaviour proxy     | 1    |                    |        |        |      |
| Mask                | 0.09 | 1                  |        |        |      |
| Business/gathering  | -0.86| -0.23              | 1      |        |      |
| School              | -0.37| 0.08               | 0.37   | 1      |      |
| Travel              | -0.14| -0.09              | 0.30   | 0.61   | 1    |
| Long-term care (LTC)| -0.14| -0.11              | 0.24   | 0.44   | 0.22 | 1    |

Notes: The time period is March 11 to August 13 (N = 1,560). Province-level, 7-day moving averages.
Table A5: Ontario – Robustness (treatment of zero weekly cases)

|                        | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  | (7)                  | (8)                  |
|------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| **Baseline**           | **Alternative 1**     | **Alternative 2**    | **Alternative 3**    |
| p-values in [ ] brackets | replace log(0) by -1 | replace log(0) by 0  | add 1 before taking log | weighted by population |
| Mask_14                | -0.366 **            | -0.376 ***           | -0.310 **            | -0.315 ***           | -0.272 **            | -0.280 **            | -0.249 *             | -0.259 *             |
|                        | [0.010]              | [0.008]              | [0.010]              | [0.008]              | [0.017]              | [0.013]              | [0.096]              | [0.082]              |
| Business/gathering_14  | -0.137               | 0.279                | 0.021                | 0.290                | -0.006               | 0.270                | 0.350                | 0.529 *              |
|                        | [0.877]              | [0.689]              | [0.945]              | [0.613]              | [1.000]              | [0.616]              | [0.226]              | [0.092]              |
| Long-term care_14      | 0.747                | -0.097               | -0.003               | -0.568               | 0.196                | -0.327               | -1.652               | -1.927 *             |
|                        | [0.677]              | [0.930]              | [0.973]              | [0.667]              | [0.908]              | [0.782]              | [0.137]              | [0.070]              |
| Behaviors_14           | -0.018               | -0.018               | -0.016               | -0.016               | -0.013               | -0.014               | -0.008               | -0.009               |
|                        | [0.266]              | [0.272]              | [0.188]              | [0.194]              | [0.278]              | [0.270]              | [0.416]              | [0.418]              |
| Δlog(ΔC)_14            | 0.024                | 0.028                | 0.043                | 0.045                | 0.028                | 0.030                | 0.038                | 0.038                |
|                        | [0.692]              | [0.665]              | [0.330]              | [0.322]              | [0.520]              | [0.494]              | [0.578]              | [0.562]              |
| log(ΔC)_14             | -0.203 ***           | -0.209 ***           | -0.184 ***           | -0.188 ***           | -0.164 ***           | -0.169 ***           | -0.223 ***           | -0.231 ***           |
|                        | [0.001]              | [0.001]              | [0.001]              | [0.000]              | [0.001]              | [0.001]              | [0.000]              | [0.000]              |
| Δlog(ΔPC)_14           | 0.184                | 0.132                | 0.094                | 0.066                | 0.528                | 0.302                | 0.437                | 0.300                |
|                        | [0.566]              | [0.647]              | [0.722]              | [0.696]              | [0.124]              | [0.302]              | [0.101]              | [0.257]              |
| log(ΔPC)_14            | 0.528                | 0.302                | 0.437                | 0.300                | 0.129                | -0.215               | -0.012               | -0.063               |
|                        | [0.124]              | [0.302]              | [0.101]              | [0.257]              | [0.287]              | [0.361]              | [0.203]              | [0.486]              |
| Δlog(ΔT)               | -0.260               | -0.382               | -0.189               | -0.266               | -0.129               | -0.215               | -0.012               | -0.063               |
|                        | [0.287]              | [0.125]              | [0.361]              | [0.203]              | [0.486]              | [0.242]              | [0.942]              | [0.677]              |
| R-squared              | 0.051                | 0.058                | 0.059                | 0.062                | 0.057                | 0.063                | 0.066                | 0.069                |
| N                      | 3,094                | 3,094                | 3,094                | 3,094                | 3,094                | 3,094                | 3,094                | 3,094                |
| PHU fixed effects      | X                    | X                    | X                    | X                    | X                    | X                    | X                    | X                    |
| cubic time trend (days) | X                    | X                    | X                    | X                    | X                    | X                    | X                    | X                    |
| weighted               | X                    | X                    | X                    | X                    | X                    | X                    | X                    | X                    |

Notes: The time period is May 15 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by public health unit (PHU) with 5000 repetitions are reported in the square brackets. Columns (1) and (2) repeat columns (3) and (4) from Table 1 where we replace log(0) with -1. Columns (3) and (4) replace log(0) with 0, and columns (5) and (6) add 1 to all ΔC_it observations. Columns (7) and (8) report estimates from a weighted least squares regression with weights equal to the PHU population sizes. ***, ** and * denote 10%, 5% and 1% significance level respectively.
Table A6: Ontario – Robustness (standard errors)

|                 | (1)  | (2)  |
|-----------------|------|------|
| **Mask**_14     | -0.366 | -0.376 |
|                 | (0.014) ** | (0.012) ** |
|                 | [0.010] ** | [0.008] *** |
|                 | {0.022} ** | {0.016} ** |
| **Business/gathering**_14 | -0.137 | 0.279 |
|                 | (0.849) | (0.688) |
|                 | [0.877] | [0.689] |
|                 | {0.887} | {0.703} |
| **Long-term care**_14 | 0.747 | -0.097 |
|                 | (0.657) | (0.951) |
|                 | [0.677] | [0.930] |
|                 | {0.702} | {0.935} |
| **Behaviour proxy**_14 | -0.018 | -0.018 |
|                 | (0.183) | (0.197) |
|                 | [0.266] | [0.272] |
|                 | {0.281} | {0.272} |
| **R-squared**   | 0.054 | 0.060 |
| **N**           | 3,094 | 3,094 |
| **Δlog(ΔC)**_14 | X     | X     |
| **log(ΔC)**_14  | X     | X     |
| **Δlog(ΔPC)**_14 | X     |       |
| **log(ΔPC)**_14 |       | X     |
| **Δlog(ΔT)**    | X     | X     |
| **PHU fixed effects** | X | X |
| **cubic time trend (days)** | X | X |

Notes: The time period is May 15 to August 13. P-values from standard clustering by PHU (Stata command cluster) in the ( ) parentheses, wild bootstrap with one-way clustering by PHU and 5000 repetitions in the [ ] square brackets, and wild bootstrap with two-way clustering by PHU and day with 5000 repetitions in the { } curly braces. PC denotes provincial cases.
Table A7: Ontario – Robustness (policy collinearity)

| Outcome: weekly case growth, \( Y_{it} = \Delta \log(\Delta C_{it}) \) | (1) Baseline | (2) Drop Mask_14 | (3) Drop Business/gathering_14 | (4) Drop LTC_14 | (5) Drop Business/gathering_14 | (6) Drop LTC_14 | (7) Drop Business/gathering_14 | (8) Drop LTC_14 |
|---|---|---|---|---|---|---|---|---|
| Mask_14 | -0.366 ** (0.010) | -0.376 ** (0.008) | -0.362 ** (0.012) | -0.382 *** (0.009) | -0.363 ** (0.010) | -0.376 *** (0.008) | -0.363 ** (0.010) | -0.376 *** (0.008) |
| Business/gathering_14 | -0.137 (0.877) | 0.279 (0.689) | -0.041 (0.976) | 0.398 (0.565) | -0.047 (0.947) | 0.260 (0.682) | -0.047 (0.947) | 0.260 (0.682) |
| Long-term care (LTC)_14 | 0.747 (0.677) | -0.097 (0.930) | 0.650 (0.728) | -0.271 (0.836) | 0.653 (0.682) | 0.229 (0.890) | 0.653 (0.682) | 0.229 (0.890) |
| Behaviour proxy_14 | -0.018 (0.266) | -0.018 (0.272) | -0.014 (0.323) | -0.014 (0.336) | -0.017 (0.199) | -0.019 (0.174) | -0.017 (0.199) | -0.019 (0.174) |
| \( \Delta \log(\Delta C) \) | 0.024 (0.692) | 0.028 (0.665) | 0.035 (0.541) | 0.039 (0.512) | 0.025 (0.696) | 0.027 (0.676) | 0.025 (0.696) | 0.027 (0.676) |
| log(\( \Delta C \)) | -0.203 *** (0.001) | -0.209 *** (0.001) | -0.215 *** (0.001) | -0.221 *** (0.001) | -0.202 *** (0.001) | -0.210 *** (0.001) | -0.202 *** (0.001) | -0.210 *** (0.001) |
| \( \Delta \log(\Delta PC) \) | 0.184 (0.566) | 0.217 (0.485) | 0.122 (0.722) | 0.159 (0.611) | 0.174 (0.566) | 0.217 (0.485) | 0.122 (0.722) | 0.159 (0.611) |
| log(\( \Delta PC \)) | 0.528 (0.124) | 0.486 (0.158) | 0.544 (0.115) | 0.532 (0.132) | 0.174 (0.566) | 0.217 (0.485) | 0.122 (0.722) | 0.159 (0.611) |
| \( \Delta \log(\Delta T) \) | -0.260 (0.287) | -0.382 (0.125) | -0.243 (0.322) | -0.367 (0.136) | -0.263 (0.291) | -0.364 (0.162) | -0.263 (0.291) | -0.364 (0.162) |
| R-squared | 0.051 | 0.058 | 0.049 | 0.054 | 0.054 | 0.060 | 0.054 | 0.060 |
| N | 3,094 | 3,094 | 3,094 | 3,094 | 3,094 | 3,094 | 3,094 | 3,094 |
| PHU fixed effects | X | X | X | X | X | X | X | X |
| cubic time trend (days) | X | X | X | X | X | X | X | X |

Notes: The time period is May 15 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by public health unit (PHU) with 5000 repetitions are reported in the square brackets. Columns (1) and (2) repeat columns (3) and (4) from Table 1. We drop each policy at at time in columns (3)-(8). ***, ** and * denote 10%, 5% and 1% significance level respectively.
Table A8: Canada - Robustness (treatment of zero weekly cases)

Outcome: weekly case growth, $Y_{it} = \Delta \log(\Delta C_{it})$

|               | (1) Baseline Replace log(0) by -1 | (2) Alternative 1 Replace log(0) by 0 | (3) Alternative 2 Add 1 before taking log | (4) Weighted by population | (5) 4 largest provinces |
|---------------|-----------------------------------|--------------------------------------|------------------------------------------|----------------------------|------------------------|
| Mask_14       | -0.618 *** -0.613 ***             | -0.599 *** -0.591 ***               | -0.594 *** -0.587 ***                   | -0.618 *** -0.613 ***     | -0.593 *** -0.588 ***  |
| Business / gathering_14 | 0.031 | 0.033 | 0.076 | 0.070 | 0.046 | 0.055 | 0.513 | 0.615 | 0.754 | 0.509 |
| School_14     | -0.425 ** -0.433 **              | -0.393 ** -0.410 **               | -0.366 ** -0.381 **                     | -0.148 | -0.211 ** | -0.029 | -0.060 |
| Travel_14     | -0.375 | -0.412 | -0.499 | -0.565 | -0.283 | -0.338 | -1.513 * -1.811 * | -2.368 | -4.980 *** |
| LTC_14        | 0.023 | 0.032 | 0.093 | 0.108 | 0.051 | 0.063 | 0.097 | 0.119 | -0.054 | -0.076 |
| Behaviour_14  | -0.001 | 0.000 | -0.002 | 0.000 | 0.001 | 0.002 | -0.015 | * -0.013 | -0.025 *** | -0.030 *** |
| log(ΔC)_14    | -0.078 * | -0.072 | -0.034 | -0.025 | -0.042 | -0.035 | 0.002 | 0.005 | 0.036 | 0.023 |
| Δlog(ΔC)_14   | -0.227 ** | -0.227 * | -0.236 *** | -0.236 *** | -0.209 *** | -0.210 ** | -0.265 *** | -0.276 *** | -0.281 | -0.290 *** |
| log(ΔNC)_14   | 0.055 | 0.100 | 0.085 | 0.255 | 0.079 | 0.074 | 0.072 | 0.071 |
| Δlog(ΔT)      | 0.172 ** | 0.169 * | 0.098 * | 0.093 | 0.113 * | 0.109 | 0.079 | 0.074 | 0.072 | 0.071 |
| R-squared     | 0.414 | 0.414 | 0.483 | 0.484 | 0.471 | 0.471 | 0.651 | 0.653 | 0.804 | 0.813 |
| N             | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 624 | 624 |
| province FE   | X | X | X | X | X | X | X | X | X | X |
| cubic time trend | weighted | X | X | X | X | X | X | X | X | X |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions in the square brackets. Columns (1) and (2) repeat columns (3) and (4) from Table 2 where we replace log(0) with -1. Columns (3) and (4) replace log(0) with 0, and columns (5) and (6) add 1 to all $\Delta C_{it}$ observations. Columns (7) and (8) report results from a weighted least squares regression with the province populations as weights. Finally, columns (9) and (10) restrict the sample to only the largest 4 provinces (BC, ON, QC, and AB) which have only 0.3% zero observation cases. ***, ** and * denote 10%, 5% and 1% significance level respectively.
| Outcome: weekly case growth, $Y_{it} = \Delta \log(\Delta C_{it})$ | (1)   | (2)   |
|------------------------------------------------------------|-------|-------|
| Mask$_{14}$                                                | -0.618| -0.613|
|                                                           | (0.014)** | (0.014)** |
|                                                           | [0.000]** | [0.000]** |
|                                                           | \{0.000\}** | \{0.000\}** |
| Business/gathering$_{14}$                                  | -0.835| -0.846|
|                                                           | (0.027)** | (0.023)** |
|                                                           | [0.031]** | [0.033]** |
|                                                           | \{0.035\}** | \{0.039\}** |
| School$_{14}$                                              | -0.425| -0.433|
|                                                           | (0.042)** | (0.025)** |
|                                                           | [0.015]** | [0.019]** |
|                                                           | \{0.015\}** | \{0.014\}** |
| Travel$_{14}$                                              | -0.375| -0.412|
|                                                           | (0.526) | (0.534) |
|                                                           | [0.613] | [0.636] |
|                                                           | \{0.612\} | \{0.637\} |
| Long-term care$_{14}$                                      | 0.023 | 0.032 |
|                                                           | (0.948) | (0.926) |
|                                                           | [0.958] | [0.920] |
|                                                           | \{0.958\} | \{0.920\} |
| Behaviour proxy$_{14}$                                     | -0.001| 0.000 |
|                                                           | (0.857) | (0.962) |
|                                                           | [0.880] | [0.972] |
|                                                           | \{0.878\} | \{0.972\} |
| R-squared                                                  | 0.406 | 0.410 |
| N                                                         | 1,560 | 1,560 |
| $\Delta \log(\Delta C)_{14}$                              | X     | X     |
| $\log(\Delta C)_{14}$                                     | X     | X     |
| $\Delta \log(\Delta NC)_{14}$                             | X     |       |
| $\log(\Delta NC)_{14}$                                    | X     |       |
| $\Delta \log(\Delta T)$                                   | X     | X     |
| province fixed effects                                     | X     | X     |
| cubic time trend (days)                                    | X     | X     |

Notes: The time period is March 11 to August 13. P-values from standard clustering by province in the ( ) parentheses, wild bootstrap with one-way clustering by province and 5000 repetitions in the [ ] square brackets, and wild bootstrap with two-way clustering by province and day with 5000 repetitions in the { } curly braces.
Table A10: Canada - Robustness (policy collinearity)

|     | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     | drop Mask_14 | drop Business/gathering_14 | drop School_14 | drop Travel_14 | drop LTC_14 |
| Mask_14 | -0.621 *** | -0.614 *** | -0.588 *** | -0.592 *** | -0.635 *** | -0.636 *** | -0.618 *** | -0.614 *** |
|        | [0.000] | [0.000] | [0.006] | [0.004] | [0.000] | [0.004] | [0.000] | [0.000] |
| Business/gathering_14 | -0.837 ** | -0.847 ** | -0.827 ** | -0.847 ** | -0.895 ** | -0.909 ** | -0.829 ** | -0.837 ** |
|        | [0.033] | [0.040] | [0.031] | [0.034] | [0.012] | [0.013] | [0.035] | [0.030] |
| School_14 | -0.389 ** | -0.406 ** | -0.413 ** | -0.434 ** | -0.494 *** | -0.476 ** | -0.419 ** | -0.424 ** |
|        | [0.040] | [0.041] | [0.019] | [0.042] | [0.008] | [0.018] | [0.013] | [0.036] |
| Travel_14 | -0.421 | -0.472 | -0.571 | -0.623 | -0.525 | -0.502 | -0.383 | -0.422 |
|        | [0.548] | [0.566] | [0.378] | [0.411] | [0.445] | [0.556] | [0.544] | [0.562] |
| LTC_14 | 0.024 | 0.033 | -0.075 | -0.069 | -0.041 | -0.028 | 0.061 | 0.068 |
|        | [0.961] | [0.908] | [0.842] | [0.848] | [0.918] | [0.926] | [0.850] | [0.821] |
| II Behaviour_14 | -0.001 | 0.000 | 0.007 | 0.008 | 0.003 | 0.003 | 0.001 | 0.001 |
|        | [0.883] | [0.982] | [0.527] | [0.338] | [0.767] | [0.704] | [0.826] | [0.814] |
| Δlog(ΔC)_14 | -0.074 | -0.069 | -0.059 | -0.055 | -0.084 * | -0.077 | -0.089 ** | -0.083 * |
|        | [0.110] | [0.217] | [0.180] | [0.302] | [0.069] | [0.184] | [0.043] | [0.095] |
| log(ΔC)_14 | -0.227 ** | -0.228 * | -0.230 *** | -0.232 * | -0.227 ** | -0.223 | -0.214 *** | -0.211 ** |
|        | [0.019] | [0.090] | [0.007] | [0.068] | [0.107] | [0.002] | [0.040] | [0.000] |
| Δlog(ΔNC)_14 | -0.080 | 0.083 | -0.081 | -0.069 | -0.107 | -0.083 | -0.071 | -0.063 |
|        | [0.743] | [0.742] | [0.659] | [0.765] | [0.755] | [0.680] | [0.775] | [0.642] |
| log(ΔNC)_14 | -0.122 | -0.092 | -0.077 | -0.055 | -0.084 * | -0.077 | -0.098 *** | -0.083 * |
|        | [0.572] | [0.659] | [0.697] | [0.883] | [0.932] | [0.893] | [0.932] | [0.642] |
| Δlog(ΔT) | 0.057 || 0.170 * | 0.167 * | 0.153 * | 0.151 | 0.174 ** | 0.169 * |
|        | [0.055] | [0.072] | [0.080] | [0.102] | [0.048] | [0.060] | [0.060] | [0.070] |
| R-squared | 0.410 | 0.411 | 0.408 | 0.408 | 0.412 | 0.412 | 0.413 | 0.413 |
| N | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 |
| province fixed effects | X | X | X | X | X | X | X | X |
| cubic time trend (days) | X | X | X | X | X | X | X | X |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. We drop each policy one at a time in columns (3)-(12). ***, ** and * denote 10%, 5% and 1% significance level respectively.
Table A11: Canada – Robustness (news and weather)

|                  | (1)        | (2)        | (3)        | (4)        | (5)        | (6)        |
|------------------|------------|------------|------------|------------|------------|------------|
|                  | baseline   | add weather| add weather| add weather| add weather| add weather|
| Mask_14          | -0.618 *** | -0.613 *** | -0.676 **  | -0.666 **  | -0.629 *** | -0.616 *** |
|                  | [0.000]    | [0.000]    | [0.020]    | [0.026]    | [0.000]    | [0.002]    |
| Business/        | -0.835 **  | -0.846 **  | -0.903 *   | -0.912 *   | -0.884 **  | -0.892 **  |
| gathering_14     | [0.031]    | [0.033]    | [0.078]    | [0.070]    | [0.018]    | [0.024]    |
| School_14        | -0.425 **  | -0.433 **  | -0.497 *   | -0.528 *   | -0.297     | -0.292     |
|                  | [0.015]    | [0.019]    | [0.068]    | [0.085]    | [0.205]    | [0.111]    |
| Travel_14        | -0.375     | -0.412     | -0.242     | -0.318     | -0.302     | -0.415     |
|                  | [0.613]    | [0.636]    | [0.777]    | [0.727]    | [0.687]    | [0.627]    |
| Long-term care_14| 0.023      | 0.032      | 0.052      | 0.063      | 0.043      | 0.056      |
|                  | [0.958]    | [0.920]    | [0.908]    | [0.884]    | [0.900]    | [0.881]    |
| Behaviour proxy_14| -0.001     | 0.000      | -0.002     | -0.001     | -0.001     | 0.002      |
|                  | [0.880]    | [0.972]    | [0.868]    | [0.962]    | [0.918]    | [0.814]    |
| Δlog(ΔC)_14      | -0.078 *   | -0.072     | -0.083 *   | -0.078     | -0.071     | -0.072     |
|                  | [0.090]    | [0.198]    | [0.068]    | [0.170]    | [0.118]    | [0.202]    |
| log(ΔC)_14       | -0.227 **  | -0.227 *   | -0.221 *   | -0.224     | -0.216 *   | -0.221     |
|                  | [0.019]    | [0.090]    | [0.054]    | [0.120]    | [0.090]    | [0.110]    |
| Δlog(ΔNC)_14     | -0.107     | -0.136     | -0.136     | -0.066     | -0.066     | -0.066     |
|                  | [0.631]    | [0.470]    | [0.774]    |           |           |           |
| log(ΔNC)_14      | 0.055      | 0.130      | 0.338      |           |           |           |
|                  | [0.825]    | [0.612]    | [0.332]    |           |           |           |
| Δlog(ΔT)         | 0.172 **   | 0.169 *    | 0.189 **   | 0.187 *   | 0.161 *   | 0.158 *   |
|                  | [0.043]    | [0.056]    | [0.033]    | [0.052]    | [0.064]    | [0.078]    |
| Rain_14          |            |            |           |           |           | -0.003    |
|                  |            |            |           |           |           | [0.278]   |
| Max temp_14      | 0.037      | 0.039      |           |           |           |           |
|                  | [0.434]    | [0.389]    |           |           |           |           |
| Min temp_14      | -0.031     | -0.034     |           |           |           |           |
|                  | [0.562]    | [0.519]    |           |           |           |           |
| News_14          |            |            |           |           | -0.007    |           |
|                  |            |            |           |           | [0.103]   |           |
| R-squared        | 0.414      | 0.414      | 0.419      | 0.419      | 0.415      | 0.416      |
| N                | 1,560      | 1,560      | 1,560      | 1,560      | 1,560      | 1,560      |
| province fixed effects | X  | X  | X  | X  | X  | X  |
| cubic time trend (days) | X  | X  | X  | X  | X  | X  |
| weather news     | X  | X  |    |    |    |    |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. Columns (1) and (2) repeat columns (3) and (4) from Table 2. Columns (3) and (4) report estimates with lagged weather variables as additional controls. Columns (5) and (6) add a “news” variable to the baseline specification (see Appendix C for more details). ***, ** and * denote 10%, 5% and 1% significance level respectively.
Table A12: Self-reported mask usage (“Always” or “Frequently”) – Canada

|                  | (1) no time trend | (2) cubic time trend | (3) week fixed effects |
|------------------|-------------------|----------------------|-----------------------|
| Mask             | 0.371 ***         | 0.217 ***            | 0.212 ***             |
|                  | [0.000]           | [0.002]              | [0.000]               |
| Δlog(ΔC)         | -0.029            | -0.017 **            | -0.016 **             |
|                  | [0.503]           | [0.032]              | [0.047]               |
| log(ΔC)          | -0.037 *          | 0.015 ***            | 0.016 ***             |
|                  | [0.079]           | [0.000]              | [0.002]               |
| Δlog(ΔNC)        | -0.158 **         | -0.044               | 0.185                 |
|                  | [0.036]           | [0.236]              | [0.132]               |
| log(ΔNC)         | -0.148 ***        | 0.025                | -0.024                |
|                  | [0.000]           | [0.582]              | [0.907]               |

R-squared 0.132 0.162 0.173 0.173 0.174 0.175
N 8,859 8,859 8,859 8,859 8,859 8,859
mean wo mask mandates 0.464 0.464 0.464 0.464 0.464 0.464
individual characteristics X X X X X X
province fixed effects X X X X X X
cubic time trend (days) X X
week fixed effects X X

Notes: The time period is April 2 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. NC denotes national total cases. The data source is YouGov. The outcome is a dummy that takes value 1 if the respondent answered “Always” or “Frequently” to the survey question “Thinking about the last 7 days, how often have you worn a face mask outside your home?” Sample weights are used. Individual characteristics include a gender dummy, dummies for each age (in years), dummies for each household size, dummies for each number of children, and dummies for each employment status. ***, ** and * denote 10%, 5% and 1% significance level respectively.
Table A13: Self-reported precautions – Canada

| Outcome: “Always” response | (1) wash hands | (2) use sanitizer | (3) avoid going out in general | (4) avoid small gatherings | (5) avoid medium gatherings | (6) avoid large gatherings | (7) avoid crowded areas | (8) avoid touching objects |
|----------------------------|---------------|------------------|-----------------------------|-------------------------|--------------------------|--------------------------|-------------------------|--------------------------|
| **Mask**                   | -0.013        | -0.013           | 0.014                       | 0.047                   | 0.015                    | 0.058                    | 0.083                   | 0.030                    |
|                            | [0.560]       | [0.864]          | [0.452]                     | [0.122]                 | [0.766]                  | [0.386]                  | [0.069]                 | [0.417]                  |
| **Δlog(ΔC)**               | 0.006         | 0.006            | 0.003                       | 0.002                   | 0.011                    | 0.007                    | 0.021                   | -0.003                   |
|                            | [0.348]       | [0.512]          | [0.607]                     | [0.914]                 | [0.385]                  | [0.562]                  | [0.016]                 | [0.748]                  |
| **log(ΔC)**                | -0.011 ⋆      | -0.005           | 0.013 ⋆                    | 0.019 ⋆                | 0.011                   | 0.011                    | 0.011                   | 0.011                    |
|                            | [0.071]       | [0.523]          | [0.021]                     | [0.056]                 | [0.556]                  | [0.348]                  | [0.388]                 | [0.162]                  |
| **Δlog(ΔNC)**              | -0.031        | -0.025           | -0.028                      | 0.069 ⋆                | -0.012                   | 0.008                    | -0.030                   | -0.038                   |
|                            | [0.333]       | [0.518]          | [0.420]                     | [0.000]                 | [0.740]                  | [0.726]                  | [0.296]                 | [0.264]                  |
| **log(ΔNC)**               | 0.063 ***     | 0.066            | -0.014                      | -0.012                  | 0.043                    | 0.004                    | 0.051                   | 0.033                    |
|                            | [0.002]       | [0.256]          | [0.725]                     | [0.806]                 | [0.461]                  | [0.937]                  | [0.424]                 | [0.525]                  |
| R-squared                  | 0.045         | 0.049            | 0.048                       | 0.133                   | 0.146                    | 0.126                    | 0.081                   | 0.042                    |
| N                          | 8,859         | 8,859            | 8,859                       | 8,859                   | 8,859                    | 8,859                    | 8,859                   | 8,859                    |
| individual characteristics | X             | X                | X                           | X                       | X                        | X                        | X                       | X                        |
| province fixed effects     | X             | X                | X                           | X                       | X                        | X                        | X                       | X                        |
| cubic time trend (days)    | X             | X                | X                           | X                       | X                        | X                        | X                       | X                        |
| average w/o mask mandate   | 0.719         | 0.477            | 0.274                       | 0.470                   | 0.601                    | 0.770                    | 0.654                   | 0.491                    |
| survey item # (i12,...)    | health_2      | health_3         | health_6                    | health_12               | health_13                 | health_14                | health_15               | health_20                 |

Notes: The time period is April 2 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. NC denotes national total cases. The data source is YouGov. The outcome is a dummy that takes value 1 if the respondent answered “Always” to each survey question listed in Table C4. Sample weights are used. Individual characteristics include a gender dummy, age dummy (in years), dummies for each household size, dummies for each number of children, and dummies for each employment status. ⋆, ⋆⋆ and ⋆⋆⋆ denote 10%, 5% and 1% significance level respectively.
Table A14: Self-reported precautions – Canada (continued)

|                | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|----------------|-----|-----|-----|-----|-----|-----|-----|-----|
| wash hands     | -0.005 | 0.003 | 0.035 | 0.046 | 0.009 | 0.050 | 0.074 *** | 0.016 |
| uses sanitizer  | 0.858 | 0.899 | 0.272 | 0.192 | 0.869 | 0.140 | [0.009] | [0.717] |
| avoid going out in general | -0.006 | -0.010 | -0.004 | -0.005 | 0.006 | -0.005 | 0.009 | -0.001 |
| avoid small gatherings | 0.916 | 0.757 | 0.568 | 0.167 | 0.688 | 0.614 | [0.291] | [0.666] |
| avoid medium gatherings | 0.000 | -0.004 | 0.018 *** | 0.017 *** | 0.012 | 0.005 | 0.009 | -0.001 |
| avoid large gatherings | [0.938] | [0.596] | [0.000] | [0.000] | [0.168] | [0.536] | [0.288] | [0.760] |
| avoid crowded areas | -0.004 | -0.004 | -0.093 | -0.089 | -0.075 * | 0.038 | 0.001 | -0.047 |
| avoid touching objects | [0.912] | [0.933] | [0.265] | [0.102] | [0.072] | [0.382] | [0.963] | [0.052] |
| log(ΔC)        | 0.011 | 0.074 | 0.029 | 0.073 | 0.100 * | 0.002 | -0.001 | 0.056 |
| log(ΔNC)       | 0.578 | 0.177 | 0.533 | 0.285 | 0.085 | 0.972 | 0.998 | [0.092] |
| R-squared      | 0.076 | 0.050 | 0.074 | 0.109 | 0.101 | 0.089 | 0.079 | 0.046 |
| N              | 8,869 | 8,859 | 8,859 | 8,859 | 8,859 | 8,859 | 8,859 | 8,859 |
| individual characteristics | X | X | X | X | X | X | X | X |
| province fixed effects | X | X | X | X | X | X | X | X |
| cubic time trend (days) | X | X | X | X | X | X | X | X |
| average w/o mask mandate | 0.929 | 0.755 | 0.629 | 0.696 | 0.777 | 0.869 | 0.859 | 0.796 |
| survey item # (i12) | health_2 | health_3 | health_6 | health_12 | health_13 | health_14 | health_15 | health_20 |

Notes: The time period is April 2 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. NC denotes national total cases. The data source is YouGov. The outcome is a dummy that takes value 1 if the respondent answered “Always” or “Frequently” to each survey question in Table C4. Sample weights are used. Individual characteristics include a gender dummy, age dummy (in years), dummies for each household size, dummies for each number of children, and dummies for each employment status. ***, ** and * denote 10%, 5% and 1% significance level respectively.
Table A15: Canada – Closing vs. Re-opening sub-periods

| Outcome: weekly case growth, $Y_{it} = \Delta \log(\Delta C_{it})$ | Closing: March 11 - May 14 | Re-opening: May 15 - August 13 |
|---------------------------------------------------------------|-----------------------------|-------------------------------|
|                                                               | (1)            | (2)            | (3)            | (4)            |
| Mask_{14}                                                     | n.a.           | n.a.           | -0.788 *       | -0.797 *       |
|                                                              | n.a.           | n.a.           | [0.070]         | [0.056]         |
| Business/gathering_{14}                                       | -0.045         | -0.095         | -1.115 **      | -1.148 *       |
|                                                              | [0.914]        | [0.874]        | [0.038]         | [0.056]         |
| School_{14}                                                   | -0.998 ***     | -1.041 ***     | 0.005          | -0.016         |
|                                                              | [0.000]        | [0.000]        | [1.000]         | [0.939]         |
| Travel_{14}                                                   | -2.433 ***     | -2.623 ***     | 0.910          | 0.929          |
|                                                              | [0.000]        | [0.000]        | [0.351]         | [0.376]         |
| Long-term care_{14}                                           | -0.803 ***     | -0.906 **      | -0.260         | -0.264         |
|                                                              | [0.006]        | [0.010]        | [0.578]         | [0.563]         |
| Behaviour proxy_{14}                                          | -0.036 *       | -0.034         | -0.012         | -0.013         |
|                                                              | [0.087]        | [0.139]        | [0.841]         | [0.834]         |
| $\Delta \log(\Delta C)_{14}$                                  | 0.075          | 0.076          | -0.156         | -0.157         |
|                                                              | [0.184]        | [0.250]        | [0.105]         | [0.136]         |
| $\log(\Delta C)_{14}$                                         | -0.399 ***     | -0.413 ***     | -0.221         | -0.221         |
|                                                              | [0.000]        | [0.000]        | [0.148]         | [0.161]         |
| $\Delta \log(\Delta NC)_{14}$                                | -0.120         | -0.346         | -0.346         | -0.346         |
|                                                              | [0.535]        |                | [0.709]         |                |
| $\log(\Delta NC)_{14}$                                        | 0.285          | 0.494          |                |                |
|                                                              | [0.312]        |                | [0.657]         |                |
| $\Delta \log(\Delta T)$                                      | 0.110          | 0.099          | 0.233          | 0.261          |
|                                                              | [0.256]        | [0.299]        | [0.479]         | [0.423]         |
| R-squared                                                     | 0.689          | 0.689          | 0.169          | 0.170          |
| N                                                             | 650            | 650            | 910            | 910            |
| province fixed effects                                        | X              | X              | X              | X              |
| cubic time trend (days)                                       | X              | X              | X              | X              |

Notes: P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. ***, ** and * denote 10%, 5% and 1% significance level respectively. NC denotes national total cases. No mask mandates are present in the closing period.
Table A16: Canada – Deaths growth (treatment of zero weekly deaths)

|                       | Outcome: weekly deaths growth, $Y_{it} = \Delta \log(\Delta D_{it})$ | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          |
|-----------------------|-----------------------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                       | baseline                                                              | 4 largest provinces | population weighted |
| Mask_28               | -0.922 **                                                             | -0.983 **    | 0.139        | 0.009        | -0.260       | -0.480       |
|                       | [0.022]                                                               | [0.032]      | [0.762]      | [0.762]      | [0.592]      | [0.488]      |
| Business/gathering_28 | -0.134                                                                | -0.224       | -2.067 ***   | -2.277 ***   | -1.300       | -1.442       |
|                       | [0.762]                                                               | [0.748]      | [0.000]      | [0.000]      | [0.102]      | [0.106]      |
| School_28             | 0.441                                                                 | 0.440        | 0.599        | 0.601        | 0.355        | 0.371        |
|                       | [0.317]                                                               | [0.341]      | [0.381]      | [0.255]      | [0.500]      | [0.557]      |
| Travel_28             | -0.005                                                                | -0.027       | 1.645        | 2.101        | 0.906        | 0.741        |
|                       | [0.972]                                                               | [0.935]      | [0.259]      | [0.244]      | [0.216]      | [0.405]      |
| Long-term care_28     | -0.035                                                                | -0.036       | -0.024       | -0.088       | -0.053       | -0.056       |
|                       | [0.900]                                                               | [0.900]      | [0.878]      | [0.762]      | [0.896]      | [0.808]      |
| Behaviour proxy_28    | 0.002                                                                 | 0.003        | -0.012       | -0.001       | -0.009       | -0.001       |
|                       | [0.815]                                                               | [0.737]      | [0.244]      | [0.861]      | [0.500]      | [0.958]      |
| $\Delta \log(\Delta D)$,28 | 0.141                                                                | 0.152        | -0.037 ***   | 0.006        | 0.010        | 0.065        |
|                       | [0.361]                                                               | [0.345]      | [0.000]      | [0.599]      | [0.818]      | [0.344]      |
| $\log(\Delta D)$,28  | -0.216 ***                                                            | -0.220 ***   | -0.139       | -0.164       | -0.164 *     | -0.181       |
|                       | [0.000]                                                               | [0.000]      | [0.381]      | [0.253]      | [0.056]      | [0.100]      |
| $\Delta \log(\Delta ND)$,28 | -0.121                                                               | -0.197       | -0.262 *     |              |              |              |
|                       | [0.476]                                                               | [0.244]      | [0.065]      |              |              |              |
| $\log(\Delta ND)$,28 | 0.018                                                                 | 0.203        |              |              |              |              |
|                       | [0.858]                                                               | [0.125]      |              |              |              |              |
| $\Delta \log(\Delta T)$ | -0.038                                                               | -0.051       | 0.194 ***    | 0.125        | 0.176        | 0.130        |
|                       | [0.758]                                                               | [0.735]      | [0.000]      | [0.255]      | [0.050]      | [0.124]      |
| R-squared             | 0.251                                                                 | 0.254        | 0.474        | 0.480        | 0.496        | 0.507        |
| N                     | 1,470                                                                 | 1,470        | 588          | 588          | 1,470        | 1,470        |
| province fixed effects | X                                                                     | X            | X            | X            | X            | X            |
| cubic time trend (days)| X                                                                     | X            | X            | X            | X            | X            |
| population weighted   | X                                                                     | X            |              |              |              | X            |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. Columns (1) and (2) repeat columns (3) and (4) from Table ???. Columns (3) and (4) report results from a weighted least squares regression with the province populations used as weights. Columns (5) and (6) restrict the sample to only the largest 4 provinces (BC, ON, QC, and AB) with only 5% (29 out of 588) observations with zero weekly deaths. ***, ** and * denote 10%, 5% and 1% significance level respectively. ND denotes national total deaths.
Table A17: Canada - Correlations between the policy indicators

| Policy indicator                     | P1   | P2   | P3   | P4   | P5   | P6   | P7   | P8   | P9   | P10  | P11  | P12  | P13  | P14  | P15  | P16  | P17  |
|-------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Mask                                |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P1. mandatory indoor masks          | 1    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P2. non-essential business/retail   | -0.11|      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P3. personal services               | -0.18| 0.67 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P4. restaurants                     | -0.14| 0.64 | 0.83 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Business/gathering                  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P5. bars/nightclubs                 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P6. religious worship               | -0.05| 0.66 | 0.76 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P7. events gathering                |      | -0.07| 0.65 | 0.81 | 0.84 | 0.76 | 0.79 |      |      |      |      |      |      |      |      |      |      |
| P8. recreation/parks/gyms           |      |      | -0.17| 0.74 | 0.78 | 0.73 | 0.75 | 0.81 |      |      |      |      |      |      |      |      |      |
| P9. gathering maximum index         |      |      |      | -0.02| 0.56 | 0.70 | 0.72 | 0.71 | 0.79 | 0.76 | 0.64 |      |      |      |      |      |      |
| School                              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P10. no school                      | 0.05 | 0.18 | 0.27 | 0.26 | 0.41 | 0.27 | 0.42 | 0.20 | 0.51 |      |      |      |      |      |      |      |      |
| P11. travel ban international       | 0.04 | 0.16 | 0.27 | 0.26 | 0.43 | 0.34 | 0.41 | 0.16 | 0.57 | 0.77 |      |      |      |      |      |      |      |
| Travel                              |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P12. travel ban domestic            | -0.09| 0.09 | 0.07 | -0.02| 0.14 | 0.04 | -0.01| 0.06 | 0.15 | 0.15 | 0.14 |      |      |      |      |      |      |
| P13. self-isolation international   | 0.04 | 0.16 | 0.27 | 0.23 | 0.38 | 0.30 | 0.40 | 0.13 | 0.53 | 0.72 | 0.86 | 0.15 |      |      |      |      |      |
| P14. self-isolation domestic        | -0.14| 0.12 | 0.20 | 0.07 | 0.19 | 0.21 | 0.06 | 0.07 | 0.26 | 0.24 | 0.23 | 0.63 | 0.23 |      |      |      |      |
| LTC                                 |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| P15. LTC visits                     | -0.16| 0.40 | 0.56 | 0.58 | 0.59 | 0.54 | 0.57 | 0.48 | 0.54 | 0.35 | 0.35 | 0.13 | 0.32 | 0.33 |      |      |      |
| P16. LTC single site                | 0.05 | -0.23| -0.17| -0.08| -0.13| -0.20| -0.05| -0.20| -0.03| 0.18 | 0.25 | -0.15| 0.26 | -0.23| -0.06|      |      |
| P17. provincial emergency           | -0.07| 0.21 | 0.33 | 0.39 | 0.56 | 0.44 | 0.42 | 0.30 | 0.51 | 0.55 | 0.63 | 0.16 | 0.57 | 0.26 | 0.40 | 0.01 |      |

Notes: The time period is Feb 26 to July 30 (two weeks before the March 11 - August 13 sample period). Daily province-level data.
Table A18: Canada – Location behaviour and policies

| Outcome: location behaviour | (1) Retail | (2) Grocery | (3) Workplaces | (4) Behaviour proxy, $B_t$ |
|----------------------------|-----------|------------|----------------|----------------------------|
| Mask                       | -4.204    | -4.175     | -0.670         | -0.810                     |
|                            | [0.440]   | [0.429]    | [0.814]        | [0.770]                    |
| Business/gathering          | -18.959 * | -14.359 *  | -12.243 **     | -8.640                     |
|                            | [0.055]   | [0.092]    | [0.044]        | [0.153]                    |
| School                     | -16.524 **| -8.927     | -7.111 **      | -24.795 ***                |
|                            | [0.020]   | [0.297]    | [0.013]        | [0.019]                    |
| Travel                     | -15.648   | -10.505    | -18.913 ***    | -13.735 **                 |
|                            | [0.162]   | [0.340]    | [0.000]        | [0.019]                    |
| Long-term care             | 0.131     | -0.717     | -0.237         | -1.088                     |
|                            | [0.980]   | [0.914]    | [0.960]        | [0.768]                    |
| Δlog(ΔC)                   | 1.614 **  | 1.235 *    | 1.905 ***      | 1.397 ***                  |
|                            | [0.023]   | [0.051]    | [0.000]        | [0.004]                    |
| log(ΔC)                    | -2.545 ***| -2.062 *** | -1.935 ***     | -1.537 ***                 |
|                            | [0.005]   | [0.000]    | [0.007]        | [0.006]                    |
| Δlog(ΔNC)                  | 5.462 **  | 8.543 ***  | 6.511 ***      | 6.839 ***                  |
|                            | [0.034]   | [0.000]    | [0.013]        | [0.006]                    |
| log(ΔNC)                   | -9.372 ***| -7.206 **  | -9.076 ***     | -8.551 ***                 |
|                            | [0.004]   | [0.018]    | [0.000]        | [0.000]                    |
| R-squared                  | 0.935     | 0.942      | 0.866          | 0.880                      |
| N                          | 1,560     | 1,560      | 1,560          | 1,560                      |
| province fixed effects     | X         | X          | X              | X                          |
| cubic time trend (days)    | X         | X          | X              | X                          |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. The behaviour proxy $B_t$ in columns (7) and (8) is the unweighted average of the “retail”, “grocery” and “workplaces” Google mobility indices. ***, ** and * denote 10%, 5% and 1% significance level respectively. NC denotes national total cases.
Table A19: Ontario – Policies and information only

|                  | (1)     | (2)     | (3)     | (4)     | (5)     | (6)     |
|------------------|---------|---------|---------|---------|---------|---------|
|                  | no time trend | cubic time trend | week fixed effects |
| **Mask**, 2014   | -0.228 * | -0.286 ** | -0.333 ** | -0.341 ** | -0.286 ** | -0.298 ** |
|                  | [0.050] | [0.036] | [0.025] | [0.025] | [0.036] | [0.028] |
| **Business/gathering**, 2014 | 0.041 | 0.132 | 0.039 | 0.512 | 0.128 | 0.256 |
|                  | [0.816] | [0.710] | [0.937] | [0.437] | [0.824] | [0.670] |
| **Long-term care**, 2014 | 0.467 | 0.366 | 0.799 | -0.240 | -1.022 | -2.033 * |
|                  | [0.570] | [0.670] | [0.653] | [0.856] | [0.393] | [0.099] |
| **Δlog(ΔC)**, 2014 | 0.028 | 0.026 | 0.027 | 0.030 | 0.014 | 0.014 |
|                  | [0.645] | [0.682] | [0.676] | [0.652] | [0.804] | [0.825] |
| **log(ΔC)**, 2014 | -0.198 *** | -0.202 *** | -0.200 *** | -0.207 *** | -0.195 *** | -0.198 *** |
|                  | [0.002] | [0.001] | [0.001] | [0.000] | [0.001] | [0.001] |
| **Δlog(ΔPC)**, 2014 | 0.391 | 0.260 | 0.260 | 0.572 ** |
|                  | [0.170] | [0.401] | [0.038] | [0.038] |
| **log(ΔPC)**, 2014 | -0.045 | 0.462 | 0.462 | 0.128 |
|                  | [0.841] | [0.168] | [0.712] | [0.168] |
| **Δlog(ΔT)**, 2014 | -0.363 ** | -0.481 ** | -0.209 | -0.343 | -0.194 | -0.464 |
|                  | [0.050] | [0.028] | [0.381] | [0.169] | [0.564] | [0.144] |

|                  | R-squared | N  | PHU fixed effects | cubic time trend (days) | week fixed effects |
|------------------|-----------|----|-------------------|-------------------------|-------------------|
|                  | 0.046 | 3,094 | X | X | X |

Notes: The time period is May 15 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by public health unit (PHU) with 5000 repetitions are reported in the square brackets. ***, ** and * denote 10%, 5% and 1% significance level respectively.
### Table A20: Canada – Policy and information only

| Outcome: weekly case growth, $Y_{it} = \Delta \log(\Delta C_{it})$ | (1) no time trend | (2) cubic time trend | (3) week fixed effects |
|---------------------------------------------------------------|-------------------|---------------------|-----------------------|
| Mask$_{14}$                                                  | -0.413 ***        | -0.416 ***          | -0.567 ***            |
|                                                           | [0.000]           | [0.000]             | [0.000]               |
| Business /gathering$_{14}$                                   | -0.288            | -0.425              | -0.500                |
|                                                           | [0.112]           | [0.165]             | [0.138]               |
| School$_{14}$                                                | -0.244            | -0.381              | -0.250                |
|                                                           | [0.461]           | [0.334]             | [0.258]               |
| Travel$_{14}$                                                | -0.509            | -0.794              | -0.430                |
|                                                           | [0.270]           | [0.106]             | [0.612]               |
| Long-term care$_{14}$                                       | -0.100            | -0.193              | 0.081                 |
|                                                           | [0.67]            | [0.494]             | [0.805]               |
| $\Delta \log(\Delta C)$_$_{14}$                             | -0.024            | -0.010              | -0.017                |
|                                                           | [0.56]            | [0.824]             | [0.772]               |
| $\log(\Delta C)$_$_{14}$                                    | -0.182 ***        | -0.208 ***          | -0.201 *              |
|                                                           | [0.000]           | [0.000]             | [0.064]               |
| $\Delta \log(\Delta NC)$_$_{14}$                            | -0.073            | -0.221              | -0.106                |
|                                                           | [0.636]           | [0.291]             | [0.581]               |
| $\log(\Delta NC)$_$_{14}$                                   | 0.121             | 0.012               | 0.281 *               |
|                                                           | [0.359]           | [0.938]             | [0.090]               |
| $\Delta \log(\Delta T)$                                     | 0.139             | 0.187 *             | 0.155                 |
|                                                           | [0.107]           | [0.052]             | [0.131]               |

| R-squared | 0.382 | 0.386 | 0.391 | 0.393 | 0.414 | 0.416 |
| N         | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 | 1,560 |
| province fixed effects | X | X | X | X | X | X |
| cubic time trend (days) | X | X | X | X | X | X |

Notes: The time period is March 11 to August 13, 2020. P-values from wild bootstrap (cgmwildboot) standard errors clustered by province with 5000 repetitions are reported in the square brackets. ***, ** and * denote 10%, 5% and 1% significance level respectively.
Additional Figures

Figure B1: Self-reported mask usage in selected countries and Canadian provinces

Figure B2: Canada - mask mandates and self-reported mask usage

Notes: The data source is YouGov. The figure plots the average self-reported mask usage by week (the fraction of respondents that answered “Always” to the survey question “Thinking about the last 7 days, how often have you worn a face mask outside your home?”) in the provinces with and without mask mandates. Sample weights are used to compute the averages.
Figure B3: Canada - Behaviour proxy, $B_{it}$

Notes: The Behaviour proxy $B_{it}$ is the average of the “retail”, “grocery and pharmacy”, and “workplaces” Google mobility indicators. Province-level 7-day moving averages are plotted.
Notes: We plot the coefficient estimates on mask policy, with 95% confidence intervals, from equation [1], for different initial dates of the sample. The initial sample date in the baseline specifications reported in Table 1 is May 15. The left panel corresponds to baseline column (3) in Table 1; the right panel corresponds to column (4) in Table 1.

Notes: We plot the coefficient estimates on mask policy, with 95% confidence intervals, in the upper panel and the estimates on business/gathering policy in the lower panel, from equation [1] for different initial dates of the sample. The initial date in our baseline specification (Table 2) is March 11. The left panels correspond to column (3) in Table 2; the right panels correspond to column (4) in Table 2.
Notes: We plot the coefficient estimates on mask policy, with 95% confidence intervals, in equation [1] for different lag values. The lag used in the baseline specifications in Table 1 is 14 days. The left panel corresponds to column (3) in Table 1; the right panel corresponds to column (4) in Table 1.

Notes: We plot the estimates on mask policy in the upper panel and the business/gathering policy in the lower panel, in equation [1] for different lag values. The lag in our baseline specification (Table 2) is 14 days. The left panels correspond to column (3) in Table 2; the right panels correspond to column (4) in Table 2.
Figure B8: Canada – Weekly cases, deaths and tests (growth rate)

 weekly growth in tests, $\Delta \ln(\Delta T)$

 weekly growth in deaths, $\Delta \ln(\Delta D)$

 weekly growth in cases, $\Delta \ln(\Delta C)$
Figure B9: Canada – Weekly cases, deaths and tests (level)
Figure B11: Counterfactuals – Canada (Table 2 mask estimate)

Notes: The left panel assumes that mask mandates were adopted in all provinces on July 7 (the adoption date in Toronto and Ottawa). The right panel assumes that mask mandates were not adopted in any province. We use the mask mandate coefficient estimate -0.613 from column (4) of Table 2. The counterfactual mean value (the green or red solid lines) and confidence bands (shaded area) are displayed.

Figure B12: Counterfactuals – Mask mandates in Alberta and British Columbia

Notes: The figure assumes mask adoption on July 15 for two provinces that have not yet adopted mask mandates, specifically British Columbia (BC, left panel) and Alberta (AB, right panel). The counterfactual uses the mask mandate coefficient estimate -0.613 from Table 2, column (4). The counterfactual mean value (the solid line) and confidence bands (shaded area) are displayed.
Figure B13: Canada - mask mandates and weekly deaths growth

Canadian provinces

Notes: Average log weekly death growth in provinces with vs. without mask mandates 28 days prior.
## Definitions and data sources

Table C1: Policy indicators and aggregates

| Non-Essential Travel | restrictions - international | 1: travelers that are neither citizens nor residents 0.5: same as 1, but US citizens allowed |
|----------------------|------------------------------|-------------------------------------------------------------------------------------------------|
|                      | restrictions - inter-provincial | 1: residents of all other provinces 0.5: residents of some other provinces |
|                      | self-isolation - international | 1: required (by provincial or federal government) 0.5: recommended (by provincial or federal government) |
|                      | self-isolation - inter-provincial | 1: required of residents of all other provinces 0.5: required of residents of some other provinces, or recommended |
| Primary and Secondary Schools | schools closed | 1: no classes (includes Spring and Summer breaks) 0.5: part-time classes; 0: classes in session |
| Business and Gathering Regulations | non-essential and retail business | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | personal services business | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | restaurants | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | bars and nightclubs | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | places of worship | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | events and gatherings | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | recreation, gyms and parks | 0: no or lowest restrictions; 1: strictest restrictions; values between 0 and 1: partial restrictions |
|                      | indoor gatherings maximum | 1: no gathering allowed; $x \in [0.5, 1]$: limit of $100(1-x)$ $x \in [0,0.5]$: limit of $25/x$ |
| Long-Term Care (LTC) Regulations | visiting restrictions | 1: no visits (with limited exceptions such as end of life) 0.5: number of visitors restricted |
|                      | single-site work requirement$^1$ | 1: requirement in effect 0.5: requirement with explicit later implementation deadline |
| Mandatory Masks | indoor public places$^2$ | 1: mask mandate in effect; 0: no mandate |
|                      | provincial declaration of emergency$^3$ | 1: in effect; 0: not in effect |

Notes: 1. We do not consider recommendations or requirements limited to outbreak facilities. 2. We do not consider limited mask mandates such as applying only to transit or personal service establishments. 3. We do not use the provincial declarations of emergency in our empirical analysis as they are mostly legal tools enabling other restrictions rather than restrictions per se.
Table C2: Ontario public health regions and date of mask mandate

|   | Public Health Region                          | Date of Mask Mandate  |
|---|----------------------------------------------|-----------------------|
| 1 | Algoma Public Health Unit                    | July 17, 2020         |
| 2 | Brant County Health Unit                     | July 20, 2020         |
| 3 | Chatham-Kent Health Unit                     | August 14, 2020       |
| 4 | Durham Region Health Department              | July 10, 2020         |
| 5 | Eastern Ontario Health Unit                  | July 07, 2020         |
| 6 | Grey Bruce Health Unit                       | July 17, 2020         |
| 7 | Haldimand-Norfolk Health Unit                | August 01, 2020       |
| 8 | Haliburton, Kawartha, Pine Ridge District Health Unit | July 13, 2020    |
| 9 | Halton Region Health Department              | July 22, 2020         |
| 10| Hamilton Public Health Services              | July 20, 2020         |
| 11| Hastings and Prince Edward Counties Health Unit | July 10, 2020     |
| 12| Huron Perth District Health Unit             | July 17, 2020         |
| 13| Kingston, Frontenac and Lennox & Addington Public Health Unit | June 27, 2020 |
| 14| Lambton Public Health                        | July 31, 2020*       |
| 15| Leeds, Grenville and Lanark District Health Unit | July 07, 2020  |
| 16| Middlesex-London Health Unit                 | July 18, 2020         |
| 17| Niagara Region Public Health Department      | July 31, 2020         |
| 18| North Bay Parry Sound District Health Unit   | July 24, 2020         |
| 19| Northwestern Health Unit                     | August 17, 2020       |
| 20| Ottawa Public Health                         | July 07, 2020         |
| 21| Peel Public Health                           | July 10, 2020         |
| 22| Peterborough Public Health                   | August 01, 2020       |
| 23| Porcupine Health Unit                        | July 23, 2020         |
| 24| Region of Waterloo, Public Health            | July 13, 2020         |
| 25| Renfrew County and District Health Unit      | July 14, 2020         |
| 26| Simcoe Muskoka District Health Unit          | July 13, 2020         |
| 27| Southwestern Public Health                   | July 31, 2020         |
| 28| Sudbury & District Health Unit               | July 17, 2020         |
| 29| Thunder Bay District Health Unit             | July 24, 2020         |
| 30| Timiskaming Health Unit                      | July 24, 2020         |
| 31| Toronto Public Health                        | July 07, 2020         |
| 32| Wellington-Dufferin-Guelph Public Health     | June 12, 2020         |
| 33| Windsor-Essex County Health Unit             | June 26, 2020         |
| 34| York Region Public Health Services           | July 17, 2020         |

*Lambton Public Health did not enact a mask mandate as of the end of August 2020. However, the City of Sarnia, which has 58% of Lambton’s population according to the 2016 Census, enacted a mask mandate on July 31, 2020. The mask variable for Lambton is coded as 0.5 from July 31, 2020 onward.*
Table C3: Canada COVID-19 official data sources

| Province                        | Cases | Deaths | Tests |
|---------------------------------|-------|--------|-------|
| Alberta (AB)                    | link  | link   | link  |
| British Columbia (BC)           | link  | link   | link  |
| Ontario (ON)                    | link  | link   | link  |
| Quebec (QC)                     | link  | link   | link  |
| Saskatchewan (SK)               | link¹ | link   | link  |
| Nova Scotia (NS)                | link  | link   | link  |
| Manitoba (MB)                   | link² | link   | link  |
| Newfoundland and Labrador (NL)  | link¹ | link   | link  |
| New Brunswick (NB)              | link  | link   | link  |
| Prince Edward Island (PE)       | link  | link   | link  |

Notes: 1. Saskatchewan and Newfoundland and Labrador do not revise their posted data series. We made data adjustments based on subsequent revisions announced in government bulletins; 2. The Manitoba tests numbers were manually collected from the COVID-19 provincial government bulletins.

**Weather.** We downloaded historical weather data for the largest city in each province from Weather Canada. The data provide daily information on 11 variables: maximum temperature (°C), minimum temperature (°C), mean temperature (°C), heating degree-days, cooling degree-days, total rain (mm), total snow (cm), total precipitation (mm), snow on the ground (cm), direction of maximum wind gust (tens of degrees), and speed of maximum wind gust (km/h). We only use the temperature and precipitation data in Table A11 as possible factors determining outside vs. inside activity.

**News.** We collected data from ProQuest Canadian Newsstream, a subscription service to all major and small-market daily or weekly Canadian news sources. We recorded the number of search results for each day from Feb 1, 2020 to Aug 20, 2020 by searching the database for the keywords “Coronavirus” or “COVID-19”. We only counted the results with source listed as “newspaper” since other sources, such as blogs or podcasts, tend to duplicate the same original content.
Table C4: YouGov survey questions

| Survey item     | Question                                                                                                                                 |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|
| i12_health_2    | Washed hands with soap and water                                                                                                        |
| i12_health_3    | Used hand sanitiser                                                                                                                     |
| i12_health_6    | Avoided going out in general                                                                                                            |
| i12_health_12   | Avoided small social gatherings (not more than 2 people)                                                                                   |
| i12_health_13   | Avoided medium-sized social gatherings (between 3 and 10 people)                                                                             |
| i12_health_14   | Avoided large-sized social gatherings (more than 10 people)                                                                                |
| i12_health_15   | Avoided crowded areas                                                                                                                    |
| i12_health_20   | Avoided touching objects in public (e.g. elevator buttons or doors)                                                                        |

Notes: The data source is YouGov. Possible responses to each survey item are “Always”, “Frequently”, “Sometimes”, “Rarely”, and “Not at all”. For Table A13, we create a binary variable taking value 1 if the response is “Always” and 0 otherwise. For Table A14, we create a binary variable taking value of 1 if the respondent answered either “Always” or “Frequently” and 0 otherwise.

All data used in the paper are available at github.com/C19-SFU-Econ/data.

Lags Determination

As discussed in Section 3.1, we assume a lag of 14 days between a change in policy or behaviour and its hypothesized effect on weekly case growth, and a lag of 28 days between such a change and its effect on weekly death growth.

First, we consider the lag between infection and a case being reported. As most identified cases of COVID-19 in Canada are symptomatic, we focus on symptomatic individuals. For most provinces cases are listed according to the date of report to public health. In provinces where the dates instead refer to the public announcement, we shifted them back by one day, as announcements typically contain the cases reported to public health on the previous day. The relevant lag therefore has two components:

1. Incubation period: Most studies suggest an average incubation period of 5-6 days, for example, 5.2 days in Li et al. (2020), 5.5 days in Lauer et al. (2020), 5.6 days in Linton et al. (2020), 6.4 days in Backer et al. (2020).

2. Time between symptoms onset and reporting of the case to public health: the Ontario data contain an estimate of the symptom onset date (“episode date”) for each case. For our sample period the average difference between the date of report and the episode date is 4.8 days (median: 4 days) including only values from 1 to 14 days, and 6.3
days (median: 5 days) including only values from 2 to 28 days. We assume that the lags in Ontario and in other provinces are similar, and use a value of 5-6 days between symptom onset and report to public health authorities.

Adding these together implies that the typical lag between infection and a positive case being reported to public health is around 11 days.

Second, we consider the effect of weekly averaging on the appropriate lag for our analysis. Suppose a policy or behavioural change starts on date $t$, impacting the daily growth in infections between dates $t-1$ and $t$ and in each subsequent day. Then, assuming a lag of 11 days between infection and case reporting, case counts $C$ are affected from date $t+11$ onward. Our outcome variable $\Delta \log(\Delta C)$ thus would react to the original policy or behavioural change on date $t+11$. The change is complete on $t+23$, when the week from $t+17$ to $t+23$ is compared to the week from $t+10$ to $t+16$. The midpoint of the change is $t+17$.

Choosing a lag of $l$ days implies that the policy/behaviour variable phases in from $t+l$ to $t+l+6$. To match the midpoint of this phase-in to the midpoint of the change in the outcome variable, we set $l=14$. The chosen lag matches the lag used by other authors who study COVID-19 policy interventions, e.g., Chernozhukov et al. (2020). We explore sensitivity to alternative lags in Section 4.3.

With respect to deaths, our data are, in most cases, backdated (revised by the authorities ex-post) to the actual date of death. The medical literature suggests that the mean time from symptom onset to death is around 19 days: 20 days in Wu et al. (2020), 17.8 days in Verity et al. (2020), 20.2 days when accounting for right truncation in Linton et al. (2020), 16.1 days in Sanche et al. (2020), etc., that is, two weeks longer than our estimate of the time from symptom onset to reporting of a positive test result. We accordingly set the lag used in our analysis of the death growth rate (Section 4.6) to 28 days.

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Figures

Figure 1

Event study of self-reported mask usage – Canada. Notes: The outcome is a binary variable taking value 1 if the respondent respectively answered “Always” (in the left panel) or “Always” or “Frequently” (in the right panel) to “Thinking about the last 7 days, how often have you worn a face mask outside your home?” The figure plots the estimates from a version of equation (2) where the mask policy variable is replaced by the interaction of a variable denoting being in the treatment group (imposed mask mandate) with a series of dummies for each week, ranging from 6 weeks before the mask mandate to 6 weeks after (T=–6 to +5, where T=0 is the mandate implementation date). The reference point is 1 week before the implementation (T=–1). Wild bootstrap (cgmwildboot) standard errors with 5,000 repetitions clustered by province are used to construct the confidence intervals. Sample weights are used.
Figure 1

Policy aggregates - Canada. Notes: The figure plots the numerical values of the 5 policy aggregates (Mask, Business/gathering, School, Travel and Long-term care, LTC) over time, for each of the 10 provinces. The mask policy values for ON reflect the gradual adoption of mandates (see Fig. 1) and the respective PHU population sizes.
Ontario - mask mandates and weekly case growth. Notes: The figure plots the average log weekly case growth $\Delta \log(DC)$ in the PHUs with mask mandate (blue) and without (red) mask mandate 14 days prior.

Figure 1
Counterfactuals. Notes: The top left panel assumes that mask mandates were adopted in all PHUs on June 12 (date of the first mask mandate in Ontario). The top right panel assumes that mask mandates were not adopted in any PHU. The bottom left panel assumes that mask mandates were adopted in all Canadian provinces on July 7 (the adoption date in Toronto and Ottawa). The bottom right panel assumes that mask mandates were not adopted in any province. We use the mask estimate (-0.376) from column (4) of Table 1. The counterfactual mean value (the green or red solid lines) and confidence bands (shaded area) are displayed. The ‘counterfactual’ line is initially set equal to the observed weekly case value and diverges from it after 14-day lag from the policy implementation.
Figure 1

Ontario - mask mandates over time. Notes: There are a total of 34 public health units (PHU) in Ontario. See SI Appendix Table C2 for the exact date of mask mandate implementation in each PHU.
Figure 1

Canada - mask mandates and weekly case growth. Notes: The figure plots the average weekly case growth $\Delta \log(\Delta C)$ in the provinces with mask mandate (blue) vs. without mask mandate (red) 14 days prior. The figure assumes a July 7 mandate date for Ontario (when Toronto and Ottawa's PHUs adopted mask mandates), and July 18 for Quebec (province-wide mandate).