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COVID-19, Containment and Consumption

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Abstract

We assess the impact of the COVID-19 pandemic on consumption indicators by estimating the effects of government-mandated containment measures and of the willingness of individuals to voluntarily physically distance to prevent contagion. To do this, we use weekly panel regressions across Canadian provinces to study how differences in both containment measures and voluntary physical distancing affect consumption, proxied by transaction data. We also conduct a similar panel analysis across 28 advanced economies using retail mobility data as a proxy for in-person consumption of goods and services. Two main findings are broadly robust across a variety of tests and specifications. First, indicators of both government containment measures and voluntary physical distancing are negatively correlated with consumption indicators, with the latter relationship showing variation over time. Second, contact-intensive and other highly restricted sectors in Canada were generally more affected by increases in the stringency of government containment measures and voluntary physical distancing. In contrast, the impact from voluntary physical distancing on spending categories deemed essential by some Canadian provincial governments was muted relative to the impact on other categories.

Topics: Coronavirus disease (COVID-19), Domestic demand and components

JEL codes: C23, D12, E65, I18

Résumé

Dans cette analyse, nous évaluons l'incidence de la pandémie de COVID-19 sur des indicateurs de la consommation en estimant les effets des mesures sanitaires imposées par le gouvernement et ceux de la distanciation physique volontaire en vue de prévenir la contagion. Pour ce faire, nous utilisons des régressions sur données de panel hebdomadaires pour l'ensemble des provinces canadiennes afin d'étudier comment les différences dans les mesures gouvernementales et la distanciation physique volontaire influent sur la consommation, mesurée par des données transactionnelles. Nous effectuons aussi une analyse de panel similaire pour 28 économies avancées en utilisant des données sur la mobilité dans des commerces pour représenter la consommation de biens et services en personne. Deux résultats principaux se dégagent de notre recherche et demeurent robustes à la suite de différents tests et changements de spécifications. Premièrement, les indicateurs des mesures gouvernementales et de la distanciation physique volontaire sont négativement corrélés avec ceux de la consommation, et la relation entre la distanciation physique volontaire et la consommation présente une variation au fil du temps. Deuxièmement, les secteurs à forte proximité physique et ceux grandement touchés par les restrictions au Canada sont généralement ceux qui ont subi le plus de répercussions du resserrement des mesures gouvernementales et de la distanciation physique volontaire. En revanche, l'incidence de la distanciation physique volontaire sur les catégories de dépenses jugées essentielles par certains gouvernements provinciaux a été plus modérée que sur d'autres catégories de dépenses.

Sujets : Maladie à coronavirus (COVID-19), Demande intérieure et composantes

Codes JEL : C23, D12, E65, I18

1. Introduction

Consumer spending has been a key contributor to both the collapse in global economic activity at the onset of the COVID-19 pandemic and the subsequent economic rebound. Disentangling the underlying drivers of consumer spending throughout the pandemic is challenging due to the multitude of factors that were at play. Some of these factors were unprecedented and include the imposition of containment measures by policy-makers to prevent the spread of the virus as well as the possible voluntary behavioural response to the virus, either to avoid infection or limit its spread.

An important question is how much of the changes in consumption are due to government-mandated containment measures or to voluntary physical distancing. Assessing the relative importance of these factors can help inform the strength and speed of the consumption recovery as vaccinations progress and the prevalence of the virus diminishes. This is particularly important as containment measures are relaxed and households face the decision of when to resume spending in high-contact sectors.

Given the unprecedented nature and rapid evolution of COVID-19, finding appropriate high-frequency indicators that capture the effects of the pandemic is desirable. We use high-frequency transaction and mobility data to proxy for consumption, and new case numbers and a stringency index to proxy for voluntary physical distancing and containment measures, respectively. To show that our results are robust, we perform in section 6 robustness analysis on each indicator. Since the sample covering COVID-19 is relatively short, we mitigate this drawback by exploiting cross-sectional variations across either Canadian provinces or a set of advanced economies between March 2020 and February 2021. This generally captures the first two waves of the pandemic.

To better understand how COVID-19 affects consumption through voluntary physical distancing and government containment measures, we proceed as follows:

1. We provide scatterplots comparing our transaction- and mobility-based consumption indicators with high-frequency indicators of voluntary physical distancing and the stringency of government containment measures.
2. Based on the insights obtained from these scatterplots, we use a panel regression framework to estimate the sensitivity of our consumption indicators to changes in voluntary physical distancing and the stringency of government containment measures. This allows us to control for other sources of cross-sectional heterogeneity.

The key results from the panel regression framework suggest that both government containment measures and voluntary physical distancing negatively influence consumption. Voluntary physical distancing, in particular, shows a distinct time variation over the course of the pandemic, with its impact proving most negative during the first and second waves. In contrast, government containment measures show a more persistent negative contribution throughout the pandemic. Some heterogeneity is observed at a sectoral level, with containment measures and voluntary physical distancing weighing more heavily on contact-intensive sectors such as restaurants and entertainment. Containment measures, in contrast, appear to have had a positive but insignificant relationship with spending in businesses that are not as highly restricted such as grocery and liquor stores. This could be indicating a substitution away from dine-in restaurants and bars.

Our results are in line with those obtained in previous research. Early studies using US data show that voluntary physical distancing was an important determinant of consumer spending and economic activity

during the downturn period. For example, Goolsbee and Syverson (2020) show that in the pandemic's first wave (March 1 to May 16, 2020), fear of infection played a larger role than legal restrictions. Further, Cronin and Evans (2020) find that self-imposed, precautionary behaviour accounts for a large fraction of the overall decline in discretionary mobility following the arrival of COVID-19. Additional findings by Maloney and Taskin (2020) using mobility data suggest that the number of COVID-19 cases drives most of the decrease in mobility, with muted contributions from non-pharmaceutical interventions such as closing non-essential businesses, sheltering in place and school closures.

The prevalence of the fear of the virus during the pandemic is also highlighted in work by Aum, Lee and Shin (2020) who estimate the causal effect of the virus outbreak on labour market outcomes in South Korea. This is one of the few countries where the government avoided mandated lockdowns, choosing instead to conduct intensive testing and contact tracing. By extending their causal effect estimates to the United States and United Kingdom, the authors find that at most half of the job losses in those countries can be attributed to lockdown measures. Panel regression work by the International Monetary Fund across 128 countries also shows mobility tends to have a negative and significant relationship with both government lockdown measures and the spread of the virus. The relative importance of these factors at the start of the pandemic was roughly the same in emerging-market economies, but voluntary physical distancing was more prevalent in advanced economies (International Monetary Fund 2020).

The remainder of this paper is organized as follows. Section 2 presents the data used. Section 3 discusses insights from the first wave of COVID-19. Section 4 presents the panel regression framework. Section 5 presents the results at the national and sectoral level and across advanced economies. Section 6 presents robustness checks for our main results, and section 7 concludes.

2. Data

We proxy household consumption across the 10 Canadian provinces with the value of debit and credit card transactions collected by Moneris, Canada's largest provider of mobile, online and in-store payment services. Although these transaction data differ from official estimates of household expenditures, our proxy represents the best consumption indicator available at a high frequency.[1] Although Moneris transactions cover close to 40% of the consumption basket only, these data are found to have a strong historical relationship with consumption.[2]

Transaction data are not consistently available for the 28 advanced economies in our sample.[3] Instead, we use retail mobility data from Google as a proxy for in-person consumption of goods and services. This consumption indicator is an aggregate measure of both the frequency of visits and the length of time spent at retail locations such as restaurants, cafés and shopping centres. It shows the percentage change in this aggregate indicator relative to a baseline value.[4]

[1] Unlike household final consumption expenditures as estimated in the national accounts, transaction data most likely under-represent automated fund transfers. In addition, a certain share of these transactions could represent business activity.

[2] More precisely, we find a year-over-year correlation of 98% between both variables over the period from the first quarter of 2017 to the third quarter of 2020.

[3] The advanced economies included in the sample are Australia, Canada, Denmark, Israel, Japan, New Zealand, Norway, Sweden, Switzerland, United States, United Kingdom and 17 euro area countries (excluding Cyprus and the Netherlands).

[4] The baseline value is the median value from the five-week period between January 3 and February 6, 2020. For more details, see COVID-19 Community Mobility Reports.

To assess the effects of government-imposed containment measures in Canada, we use the Bank of Canada COVID-19 stringency index, a measure the Bank constructed for each province based on a methodology developed by the University of Oxford's Blavatnik School of Government.[5] The provincial stringency index is a simple measure of the severity of government policies and is designed to be applied across different jurisdictions over time. It is a daily time series using public information regarding policies on forced closures, containment measures, restrictions and public health campaigns. The Bank adapted the Oxford methodology to better capture slight differences in policy settings across provinces. This was done through refined measurements of the original policies considered as well as the incorporation of additional government policies. For instance, the Bank's measurements of workplace closures build on the original methodology by factoring in whether businesses are permitted to switch to adapted selling models (e.g., curbside pickup). In addition, the Bank's stringency index tracks enforcement mechanisms in place for individuals and businesses to adhere to mandated regional policies. In addition to the stringency index, Bank staff have developed alternative measures to evaluate internally other dimensions of government policies. These alternative measures are used later as robustness checks.

For the advanced economies in our sample, we rely on each country's daily index from the Oxford COVID-19 Government Response Tracker. Specifically, we choose to focus on the stringency index that records the strictness of "lockdown style" policies that primarily restrict people's behaviour.

As the number of infections rise, people tend to voluntarily reduce mobility and contact with others because of the fear of contracting the virus. Thus, to proxy voluntary physical distancing we use daily data on new confirmed COVID-19 cases. These data are from the Government of Canada's daily epidemiological summary webpage for Canada and from Our World in Data for the set of advanced economies.[6] The data are aggregated to a weekly frequency by summing the daily observations and are transformed into per capita cases to render them comparable across panel units.[7] In the robustness checks in section 6, we also consider alternative COVID-19 indicators such as deaths and test positivity rates. These generally remain consistent with our main results.

Our weekly data cover the COVID-19 pandemic between the first week of March 2020 and the last week of February 2021. Consequently, the samples capture the first two waves of the pandemic for most of the countries covered.

3. COVID-19 and consumption: Insights from the first wave

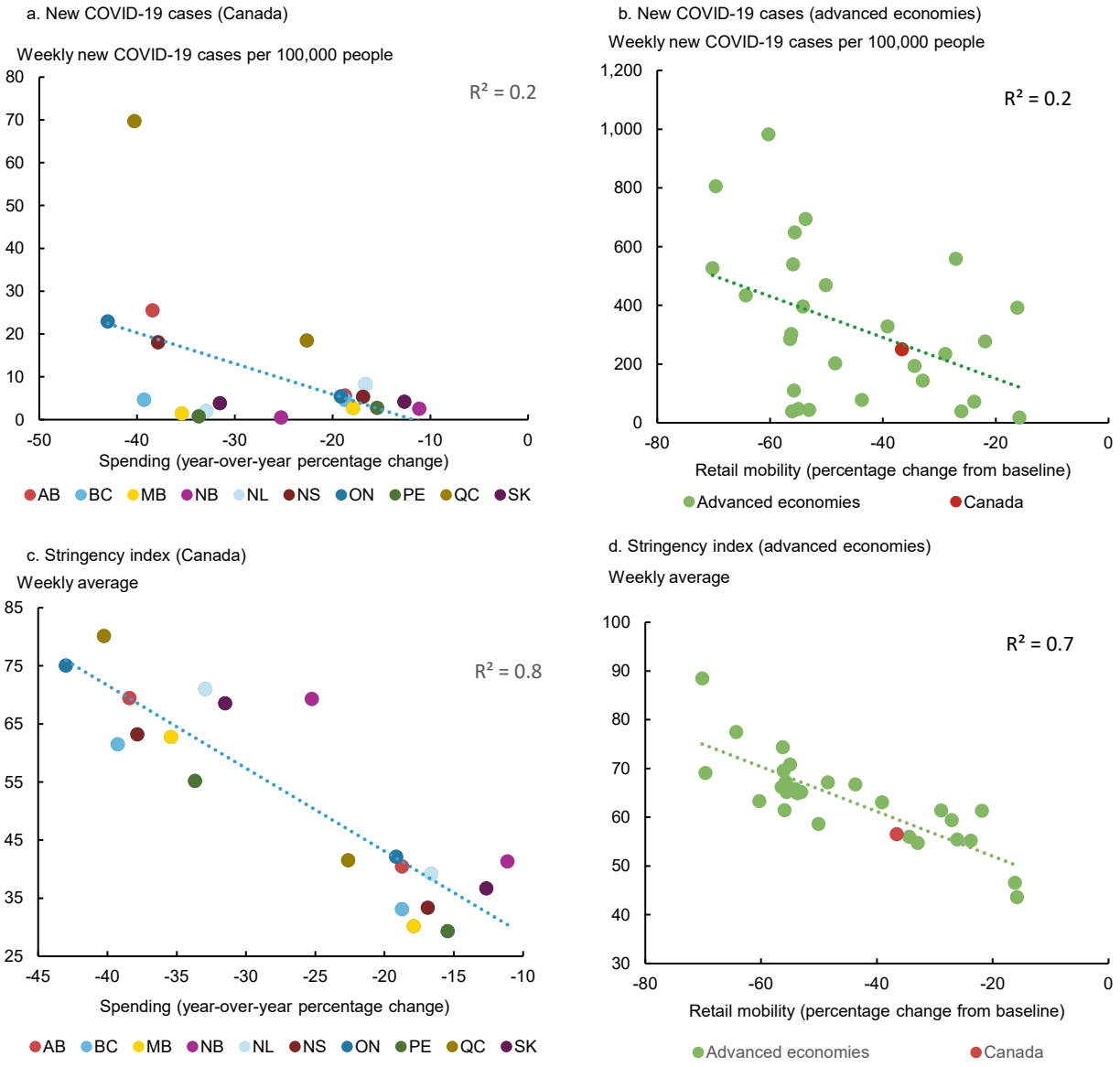
We start by comparing our transaction- and mobility-based consumption indicators with our stringency index and COVID-19 cases during the first wave. The purpose of this exercise is to draw preliminary insights on the bilateral relationship between our consumption indicators and these pandemic-related indicators.

We find an inverse relationship between the number of COVID-19 cases per capita and our consumption indicators in the early months of the pandemic (March and April 2020). Provinces and countries experiencing higher new infections per capita saw larger contractions in the consumption indicators (**Chart 1**, panel a and panel b). We also find that, during this period, regions and countries that experienced more stringent government-induced lockdowns typically saw larger contractions in the consumption indicators (**Chart 1**, panel c and panel d). These results are consistent with our panel regression estimates discussed in section 5.

[5] For more details on the Oxford index, see the COVID-19 Government Response Tracker. For information on and the provincial stringency measures, see Cheung et al. (2021).
[6] Data for Canada are from the Public Health Agency of Canada. For details, see "COVID-19 daily epidemiology update."
[7] In the rest of this paper, "new cases" refers to "new cases per capita."

Unlike the scatter plots, however, the panel framework controls for both factors simultaneously by including them jointly in the estimation.

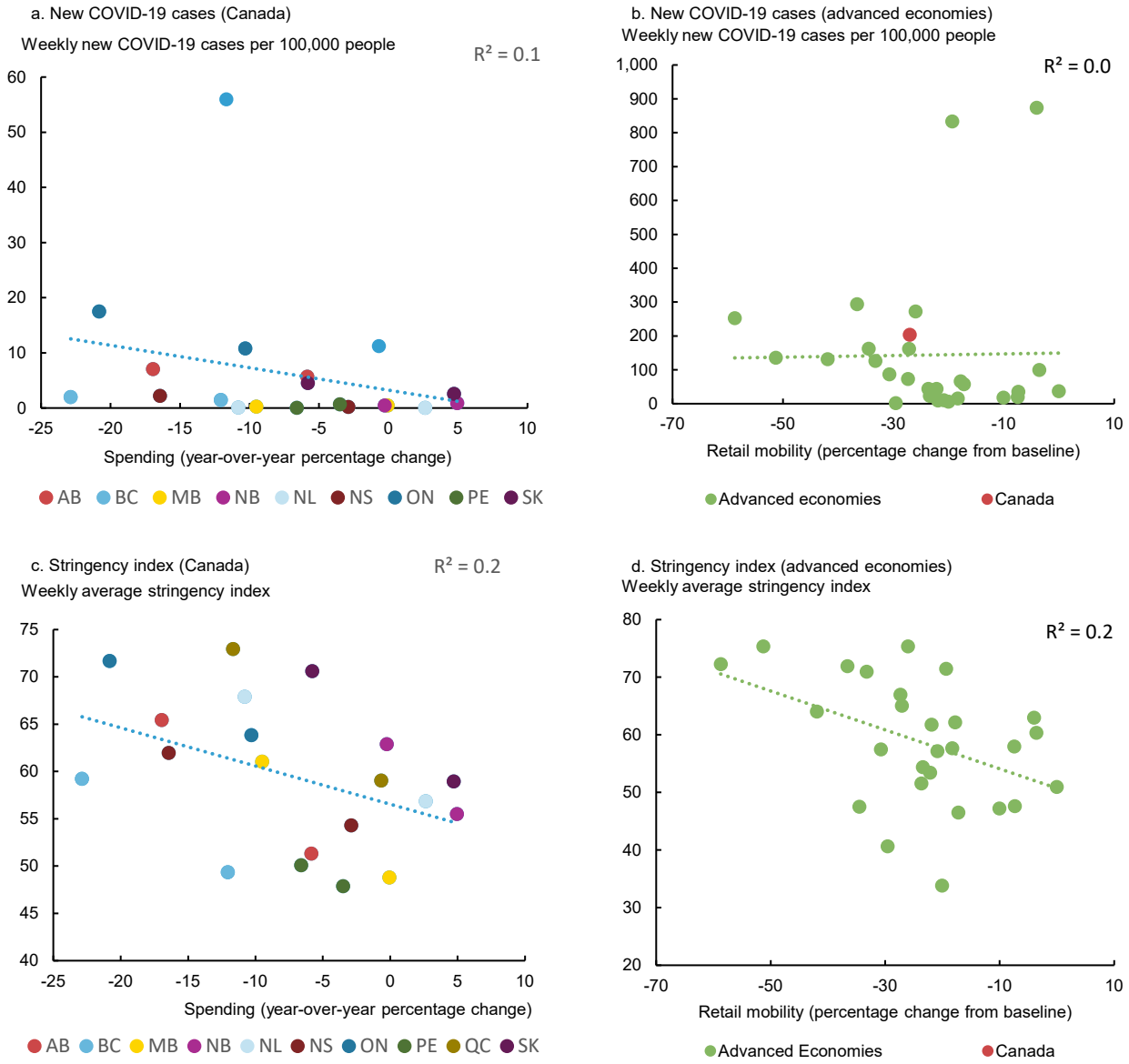
Chart 1: Declines in consumption indicators were linked to a higher number of new cases and stringency at the start of the first wave



Note: The panels show the averages of weekly values for March and April 2020. For spending, we present the average year-over-year percentage change in Moneris spending data across the weeks in March and April 2020. Retail mobility is measured as the average percentage change in Google's retail mobility indicator relative to a baseline value across the weeks in March and April 2020.The baseline value for Google's retail mobility indicator is the median value from the five-week period between January 3 and February 6, 2020.
Sources: Moneris, Government of Canada, Google, University of Oxford, Bank of Canada and Bank of Canada calculations

As the recovery unfolded in May and June 2020, however, the data show that these relationships weakened (**Chart 2**). Over time, factors such as pandemic fatigue, behavioural adaptation by firms and households to the new conditions, or the adoption of more targeted government measures could have contributed to these findings. Overall, these preliminary findings suggest that both containment measures and virus incidence played a role in the declines in consumption over the downturn, yet their prevalence as the pandemic continued might have varied. To address more formally the relative importance of these two factors and assess whether their impact might have been time-dependent, we introduce a panel regression framework in the next section.

Chart 2: Consumption indicators' links to new cases and stringency weakened over the recovery from the first wave



Note: The panels show the averages of weekly values for May and June 2020. For spending, we present the average year-over-year percentage change in Moneris spending data across the weeks in May and June 2020. Retail mobility is measured as the average percentage change in Google's retail mobility indicator relative to a baseline value across the weeks in May and June 2020. The baseline value for Google's retail mobility indicator is the median value from the five-week period between January 3 and February 6, 2020.
Sources: Moneris, Government of Canada, Google, University of Oxford, Bank of Canada and Bank of Canada calculations

4. Panel regression model

As shown in the previous section, the relationship between our consumption indicators, government-mandated measures and voluntary physical distancing may vary across different phases of the pandemic. To allow for time variation related to the evolution of the pandemic, we use as our benchmark specification the following model:

$$y_{it} = \alpha_i + \beta_1 D_t^m + \beta_2 Stringency_{it} + \beta_3 COVID_{it} + \beta_4 D_t^m * COVID_{it} + u_{it}, \quad (1)$$

where y_{it} is the consumption indicator for province or country *i* at week t, α_i is the individual-specific effect, $Stringency_{it}$ is the weekly year-over-year change in the stringency index, $COVID_{it}$ is the weekly year-over-

year change in the log of new confirmed COVID-19 cases per capita, D_t^m is a weekly month-of-the-year dummy and u_{it} is the idiosyncratic error term.[8, 9, 10] The specification includes a monthly interaction term with new confirmed COVID-19 cases (i.e., $D_t^m * COVID_{it}$) that can capture whether the marginal impact of the virus path has varied over the course of the pandemic.

To control for province- or country-specific characteristics, monthly patterns and heteroskedasticity, the benchmark specification is estimated using fixed effects, a monthly dummy and robust standard errors, respectively. The selection of the fixed-effects model is supported by the Hausman test, which rejects the null hypothesis in favour of consistent random-effects estimators. Notably, monthly interaction terms with the stringency index are excluded from the benchmark specification because initial tests revealed most terms to be insignificant.[11]

Our model specification is not inconsistent with more traditional models that emphasize disposable income, interest rates, exchange rates and consumer confidence as drivers of consumption. This is partly because voluntary physical distancing and government containment measures likely influenced these drivers during the pandemic. For example, consumer confidence may have been affected by elevated levels of precautionary behaviour driven by fear of the virus, while government containment measures likely had direct impacts on income. In addition, we note that part of the time variation in disposable income, interest rates, exchange rates and consumer confidence may have been absorbed by the month-of-the-year dummies that we include in our regressions.

5. Results

5. 1. Estimates for Canada at the aggregate level

We present below the regression output from our benchmark specification in equation 1. Table 1 shows the estimated impact of government-imposed measures on spending (β_2), and Chart 3 plots the impact of voluntary physical distancing over time ($\beta_3 + \beta_4$).

As expected, the estimated impact on our consumption indicator of government-imposed measures and voluntary physical distancing in Canada are negative, suggesting that a higher number of new confirmed cases and more severe containment measures are associated with lower consumer spending. For the stringency index, the time-invariant coefficient suggests that a one-point year-over-year increase in the measure translates into a 0.4 percentage point decline in year-over-year growth of the household spending indicator that uses Moneris data.

[8] The consumption indicator for each province is measured as the year-over-year growth of total consumer spending from Moneris. For each advanced economy included in our sample, the consumption indicator is expressed as a deviation relative to a baseline value. We take the log of new COVID-19 cases plus one to avoid losing observations at the start of the time period.

[9] Note that endogeneity is not an important concern since it is unlikely that spending and mobility induce new cases and stringency measures within the same week (due to the virus's transmission time of at least five days). In addition, our results are robust to including lagged instead of contemporaneous regressors. Finally, potential issues related to multicollinearity are mitigated by the fact that, on average, over our sample, new cases seem to lead stringency measures by about two weeks. However, endogeneity and multicollinearity concerns can become more relevant at lower frequencies.

[10] New COVID-19 cases are per 100,000 capita for Canada and other advanced economies.

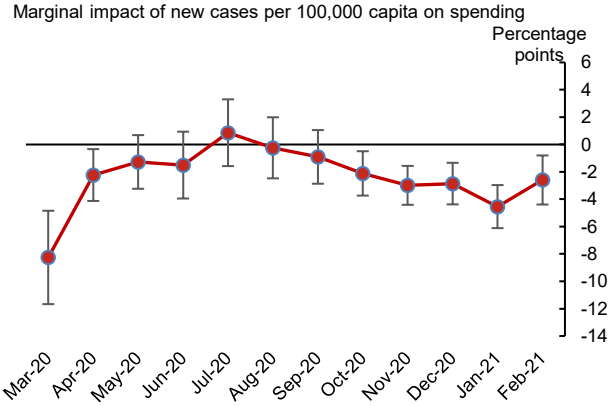
[11] See **Chart A-4** in the Appendix for the results from this specification.

The estimated effect of voluntary physical distancing on our consumption indicator appears to have changed as the pandemic has ensued (**Chart 3**). In particular, the model suggests that physical distancing has a more negative contribution on spending during the start of both the first and second waves than over the summer months in 2020. Interestingly, the impact of voluntary physical distancing during the first wave also appears to have been more negative than during the second wave (e.g., March 2020 relative to January 2021). This could be interpreted as households and firms adapting to restrictions and becoming more familiar with new ways to consume, such as online shopping and curbside pickup. Alternatively, this time variation in the voluntary physical distancing effect could reflect consumers becoming less risk-averse to the virus path and thus more willing to engage in economic activity. Overall, the model suggests that a 100% increase in the number of new COVID-19 cases per capita reduced year-over-year spending as measured by Moneris by about 8.3 percentage points at the start of the pandemic compared with 4.5 percentage points at the height of the second wave.[12]

Table 1: Impact of government-imposed measures, regression results—Canadian provinces
Equation 1 with fixed effects and robust standard errors

Variable	Coefficient	p-value
Stringency index β_2	**-0.36**	**0.00**
Overall R^2		0.66
Groups		10
Observations		520

Chart 3: The resurgence of cases in winter 2021 had a smaller impact than in March 2020
Marginal impact of new cases per 100,000 capita on spending



Note: This chart shows the impact of new COVID-19 cases per 100,000 capita in Canadian provinces over time ($\beta_3 + \beta_4$), with a 90% confidence interval.

Chart 4 shows the historical decomposition of the year-over-year growth of the Moneris spending indicator using our benchmark specification conditioning on the observed national paths for the stringency index and new COVID-19 cases (**Chart 5**).

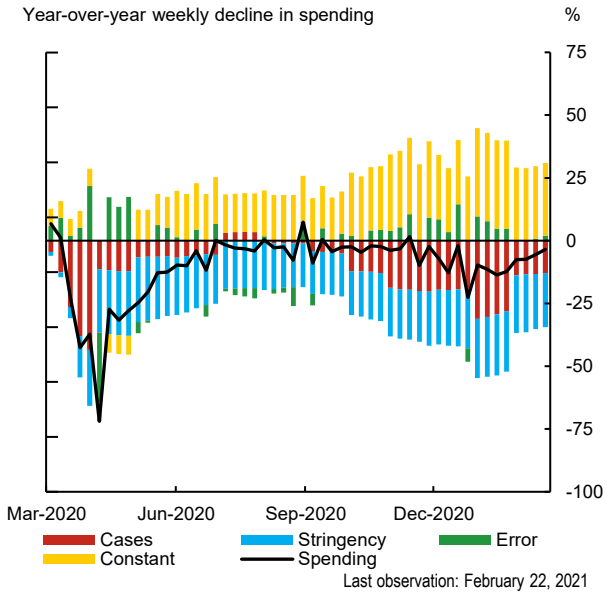
The historical decomposition of the model reveals a negative contribution from government-imposed restrictions since the beginning of the pandemic (**Chart 4**, blue bars). At the start of the first and second waves, when restrictions tightened, the impact from government containment measures is more pronounced. Yet, these measures remain a prominent and consistent drag on year-over-year spending growth in the summer months, as the level of stringency remains elevated.

The contribution from voluntary physical distancing to our consumption indicator over the pandemic shows more variation (**Chart 4**, red bars), consistent with the time-varying results shown earlier for this factor. The decomposition shows spending to be most negatively affected by voluntary physical distancing during Canada's first and second waves, periods when new infections were flaring. Interestingly, the contribution from this factor is more negative during the first than during the second wave, despite the number of cases in the latter being much higher. This reflects results discussed earlier showing that voluntary physical distancing had a smaller impact on our consumption indicator during the second wave. It is also unsurprising that the decomposition shows little impact from voluntary physical distancing over the summer months, when

[12] For perspective, new infections per capita in Canada quintupled from March 24 to April 26, 2020, roughly the peak of the first wave, while the stringency index increased by about 20 points over the same period.

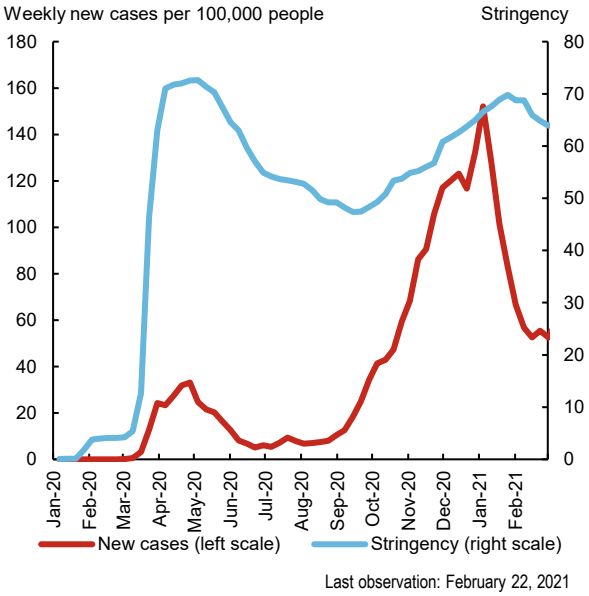
both new infections and the estimated impact of this factor on our consumption indicator were low. Also notable are the green and yellow bars in **Chart 4**. The green bars reflect other non-fixed provincial effects not captured by the model, which could include, for instance, the role of fiscal and monetary policy. The yellow bars account for fixed effects that control for province-specific characteristics that could have influenced spending during the course of the pandemic.

Chart 4: Both new case numbers and stringency measures contributed to the decline in spending



Sources: Moneris, Government of Canada and Bank of Canada calculations

Chart 5: After falling over the summer months, both stringency measures and new case numbers increased throughout the autumn



Sources: John Hopkins Coronavirus Resource Center, Bank of Canada and Bank of Canada calculations

5. 2. Estimates for Canada at the sectoral level

Conventional spending indicators suggest that the effects of the government response and of virus incidence have been uneven across spending categories. In this section, we assess this unevenness in relation to the impact of both government containment measures and voluntary physical distancing across sectors.

We start by estimating our benchmark specification at a sectoral level by replacing total transactions with sector-specific consumption indicators. In particular, we assess how mandatory government restrictions and voluntary physical distancing have affected three different spending categories: contact-intensive, essential and non-essential. **Table 2** shows the estimated impact of government-imposed measures ($Stringency$), and **Chart 6** shows the estimated impact of voluntary physical distancing ($COVID$) on these sector-specific transactions.

The results suggest that the effects on spending from the government containment measures have generally been larger for contact-intensive categories relative to our benchmark model, reflecting that more restrictive measures were usually implemented for these sectors (**Table 2**). For instance, the effect on transactions made at restaurants was about two times larger than for total transactions. Transactions made on goods deemed as non-essential by some provincial governments, such as those at clothing stores, were also severely hit by the containment measures. In contrast, the estimated relationships between government-mandated restrictions and indicators of spending deemed as essential, such as at grocery stores, were close to zero or

positive. Although not significant, the positive relationship for groceries could reflect various elements, including substitution away from dine-in restaurants.

Despite its variability across time, the voluntary physical distancing effect on contact-intensive activities and on the non-essential goods consumption indicator appear to be generally larger relative to total spending (**Chart 6**).[13] For instance, the COVID-19 effect on transactions related to entertainment remains roughly larger than our benchmark specification throughout the entire sample. Higher risk related to these types of activities likely explain this larger effect. Interestingly, our indicator for spending on clothing was also among the most affected by voluntary physical distancing. Fewer social interactions in the context of the pandemic might have resulted in less incentive for households to buy new clothes.

In addition, the impact of voluntary physical distancing across sectors reveals some heterogeneity over time. For instance, we find that the size of the physical distancing impact across sectors at the beginning of the pandemic shows generally more variability than during the remainder of our sample. While these changes in the marginal effect over time partially reflect a change in voluntary physical distancing behaviour, this could also reflect less-binding government restrictions for certain sectors. In addition, we find that while the negative impact of voluntary physical distancing tended to diminish between the first and second waves, certain sectors such as hotels enjoyed a more pronounced improvement in spending relative to other sectors. These findings could suggest that while firms and consumers have adapted their behaviour throughout the pandemic, different degrees of complexities may have weighed on sectors' abilities to adapt to the new conditions.

Table 2: Regression results at the sectoral level—Canadian provinces

Impact of government-imposed measures

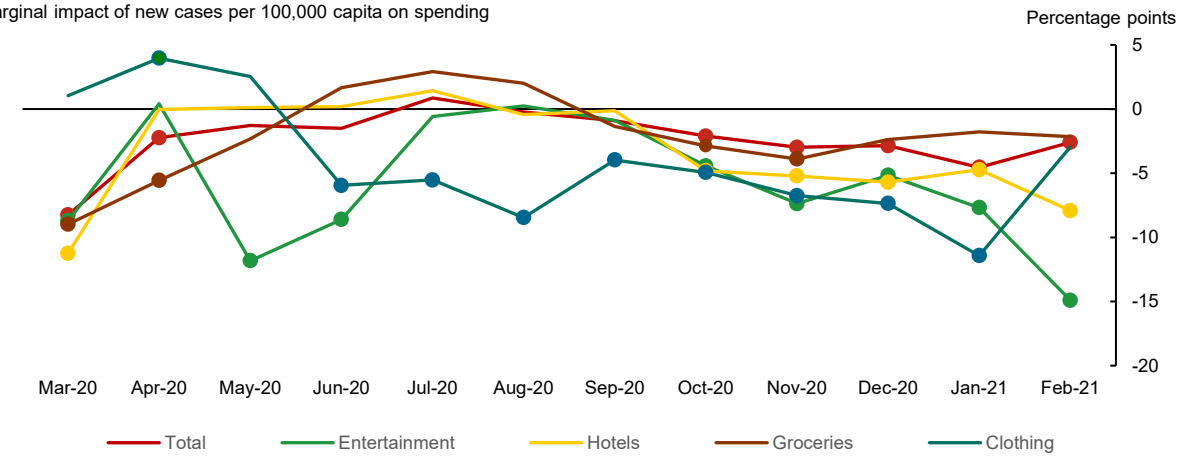
		Contact-intensive			Essential		Non-essential	
	Total spending	**Restaurants**	**Entertainment**	**Hotels**	**Groceries**	**Alcohol**	**Clothing**	**Specialty**
Stringency index	-0.4***	-0.9***	-0.9***	-0.7***	0.2	-0.1	-1.3***	-0.6***
	(-4.4)	(-10.7)	(-4.8)	(-8.6)	(1.8)	(-0.4)	(-8.9)	(-5.2)
Overall R^2	0.66	0.79	0.59	0.68	0.12	0.12	0.66	0.48
Sample size	520	520	520	520	520	468	520	520

Note: T-statistics in parentheses. This model specification takes the same form as equation 1.
*** p <0.001, ** p < 0.01, * p < 0.05

[13] For the complete version of the chart, see **Chart A-5** in the Appendix.

Chart 6: The impact of voluntary physical distancing has varied across sectors over time

Marginal impact of new cases per 100,000 capita on spending



Note: This chart shows the impact of new COVID-19 cases per 100,000 capita over time (β_3+ β_4). Dots represent monthly estimates with statistical significance at the 90% confidence level.

5. 3. Estimates for advanced economies

We present the regression output from our benchmark specification in equation 1 for advanced economies. **Table 3** shows the estimated impact of government-imposed measures on the consumption indicator (β_2), and **Chart 7** plots the impact of voluntary physical distancing over time ($\beta_3 + \beta_4$).

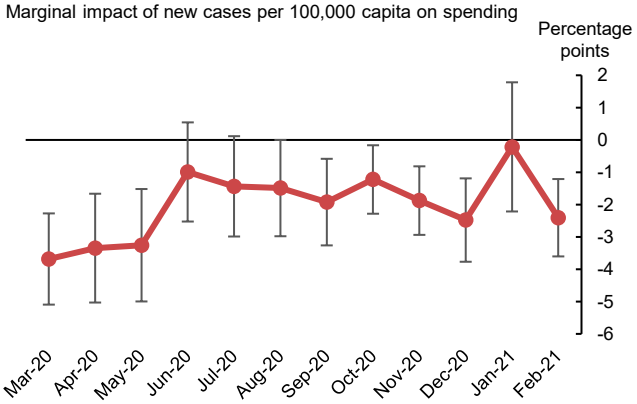
Consistent with the Canadian results, countries with more severe viral outbreaks and tighter containment measures are associated with a fall in the consumption indicator.

The time-invariant coefficient on the stringency index suggests that a one-point increase in the measure translates into a 0.8 percentage point decline in the consumption indicator relative to its baseline. Similar to the impact in Canadian provinces, the impact of voluntary physical distancing also varies over time across advanced economies (**Chart 7**). The consumption indicator was more sensitive to new COVID-19 cases during the first and second waves than in the intervening summer months. Furthermore, voluntary physical distancing across advanced economies appeared to have been less prevalent during the second wave after controlling for the level of government-mandated containment measures. This could also reflect consumers becoming less risk-averse to the virus due to pandemic fatigue. On average, a doubling of new cases reduced the consumption indicator by 4.0 and 2.0 percentage points during the first and second waves, respectively.

Table 3: Impact of government-imposed measures, regression results—advanced economies
Equation 1 with fixed effects and robust standard errors

Variable	Coefficient	p-value
Stringency index β_2	**-0.76**	**0.00**
Overall R^2		0.67
Groups		28
Observations		1483

Chart 7: The resurgence of cases in October 2020 had a smaller impact than in March 2020



Note: This chart shows the impact of new COVID-19 cases per 100,000 capita in advanced economies over time ($\beta_3 + \beta_4$), with a 90% confidence interval.

6. Robustness

To test the robustness of our results, we estimate a few alternative specifications of our benchmark model. For brevity, we present additional results for our sample of Canadian provinces only. More precisely, we conduct the following tests:

- Augment our benchmark model to include spending-relevant covariates such as employment conditions, consumer confidence, interest rates and exchange rates[14]
- Choose a different indicator than the stringency index to reflect the intensity of government restrictions
- Replace our baseline measure of voluntary physical distancing with an alternative proxy
- Integrate lags from the stringency index and from the change in the number COVID-19 cases
- Assess the robustness of our results after we weight each panel unit by its share of national consumption[15]
- Check the robustness of our results using an alternative high-frequency consumption indicator

We start by assessing how integrating spending-relevant covariates into our panel regression framework affects our results. To reflect weekly employment conditions at the provincial level, we follow these steps:

1. Control for the number of job postings listed on the employment website Indeed
2. Use the Bank of Canada's Daily Internet Survey of Confidence (DISC) employment index, which measures household sentiment about contemporaneous and forward-looking employment conditions
3. Control for overall consumer sentiment toward the Canadian economy using results from the DISC survey

[14] The fiscal response during the pandemic has likely been an important factor in explaining consumption dynamics. However, we are not aware of a measure that captures this factor that is available across provinces and at a high frequency.
[15] For our dataset, we exclude Yukon, the Northwest Territories and Nunavut from national consumption.

4. Account for interest rates by using three separate measures—the prime rate offered by the six major chartered banks in Canada, the five-year conventional mortgage rate and the Bank of Canada's weekly effective household interest rate
5. Control for exchange rates with the Bank of Canada's nominal Canadian effective exchange rate index

The effects of voluntary physical distancing and containment measures on our consumption indicator generally remain negative and significant after separately adding each of the controls considered (see **Table A-1** in the Appendix).[16] Moreover, these controls are insignificant along our variables of interest.

We then substitute the Bank's stringency index with alternative government response indicators constructed by Bank staff and assess how this affects our results. In particular, we replace the stringency index in our benchmark specification with a containment index, a containment and health index, and a government response index.[17] **Table A-2** in the Appendix lists the containment, health and fiscal policies included in each measure. We find that our estimates of both voluntary physical distancing and government containment measures remain negative and significant for all alternative specifications (**Table A-3** in the Appendix).

We then measure how changing the proxy for voluntary physical distancing affects our regression results. To do so, we substitute the change in new COVID-19 cases with the change in the number of deaths, the number hospitalized and the test positivity rate.[18, 19] We find that the results of the voluntary physical distancing coefficient remain in negative territory for all the alternatives and, with the exception of the test positivity rate, significant (**Table A-4** in the Appendix).[20]

In addition, to make sure that our results do not reflect reverse causality between spending and our independent variables, we substitute the stringency index and the change in the number of new COVID-19 cases with their lags in our benchmark specification. We find that the effect from voluntary physical distancing on our consumption indicator remains robust when lagged by one week (**Table A-5** and **Chart A-1** in the Appendix). The relationship between our consumption indicator and the first lag of our stringency index remains negative and significant.

To reflect the relative importance of each province in our national assessment of the voluntary physical distancing and stringency effects, we then weight each panel unit by its nominal share of total Canadian consumption. While the effect of new COVID-19 cases on our consumption indicator during the start of both waves is mostly negative, as in our benchmark specification, the confidence intervals around these estimates are wider (**Table A-6** and **Chart A-2** in the Appendix). The stringency effect on spending remains negative and significant.

[16] To simplify the presentation of the results of certain robustness checks, we refer only to parameter β_3. However, monthly interactions were included in all robustness checks presented.
[17] We also tested with a combination of alternative sub-indexes used to construct the overall stringency index and found the results to be broadly consistent with our main specification.
[18] Just as for new COVID-19 cases, the change in the number of deaths and the number of hospitalizations and test positivity rates are on a per 100,000 capita basis.
[19] To assess the effect of voluntary physical distancing alone, one could use the residuals from a reduced form regression of cases on stringency and then regress spending on these residuals. Implementing this approach yields results similar to those captured in our benchmark specification for the effect of cases on spending. We want to also assess the relative importance of both containment and voluntary physical distancing and therefore choose to regress spending on both factors.
[20] For overseas economies, however, we find that both death rates and test positivity rates are statistically significant for explaining changes in retail mobility.

For a final robustness check, we use the year-over-year growth rate of weekly Interac debit transactions as an alternative consumption indicator. As with the Moneris transactions, we find a negative effect both from voluntary physical distancing and from government-mandated restrictions (**Table A-7** and **Chart A-3** in the Appendix). As in our benchmark specification, we find that the estimated effect of voluntary physical distancing was more pronounced during the start of both the first and second waves than over the intervening summer months.[21]

7. Concluding remarks

In line with the existing literature on consumer spending during COVID-19, we use a panel regression framework to estimate relationships between containment measures, voluntary physical distancing and consumption indicators. In Canada and other advanced economies, the effect of voluntary physical distancing on spending exhibits significant time variation over the course of the pandemic, contributing most negatively to the consumption indicator during the first and second waves. This time variation could reflect the private sector's adaptation and learning over time. In contrast, government containment measures show a more persistent, negative contribution. This persistence reflects that government-mandated containment measures were held in place for long periods in our sample. Further analysis of Canadian consumption by sector suggests that voluntary physical distancing and government containment measures weighed most heavily on contact-intensive industries, consistent with higher exposure to the virus and more restrictive measures affecting these industries.

The panel regression framework we use is flexible, which means further analysis could pursue several avenues. Future research may include using the framework to:

- assess which individual policies have had the greatest impact on economic outcomes.
- expand the analysis to investigate the period when COVID-19 vaccines became widely available. Given the variation in immunization campaigns across countries over 2021, analyzing the timing of national vaccination campaigns could yield additional insights related to their impact on the consumption indicator.

[21] Workplace mobility was used as an alternative proxy for economic activity in advanced economies. We find that while the severity of the virus had a significant negative impact on workplace mobility during the first wave, the impact continued to diminish over the summer months. Mobility was not significantly affected by the second wave of the virus.

Appendix

Table A-1: Robustness checks with spending-relevant covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Stringency index	-0.36***	-0.39***	-0.33***	-0.61***	-0.354***	-0.352***	-0.379***	-0.349***
	(-4.38)	(-4.63)	(-3.83)	(-4.16)	(-4.23)	(-3.79)	(-4.50)	(-3.90)
New COVID-19 cases per 100,000 capita	-4.54***	-4.78***	-4.54***	-7.22	-4.56***	-4.58***	-4.48***	-4.59***
	(-4.73)	(-4.94)	(-4.74)	(-1.11)	(-4.75)	(-4.72)	-4.66)	(-4.75)
Job postings		-0.10						
		(-1.79)						
Bank of Canada DISC employment index			0.84					
			(1.94)					
Bank of Canada DISC question on overall economy				-28.25				
				(-0.86)				
Bank of Canada Canadian effective exchange rate					0.69			
					(1.06)			
Prime mortgage rate						1.42		
						(0.28)		
Five-year mortgage rate							-13.46	
							(-1.08)	
Bank of Canada weekly effective household interest rate								7.34
								(0.47)
Overall R^2	0.66	0.64	0.67	0.74	0.67	0.67	0.67	0.67
Sample	520	520	520	184	520	520	520	520

Note: T-statistics are in parentheses. For conciseness, the table presents only parameter β_3, which reflects the COVID-19 effects for our reference period (December 2020). However, monthly interactions have been included in each model specification. DISC is the Daily Internet Survey of Confidence.

*** p <0.001, ** p < 0.01, * p < 0.05

Table A-2: Policy indicators in provincial COVID-19 indexes					
ID	**Description**	**Stringency (benchmark)**	**Containment**	**Containment and health**	**Government response**
C1	School and university closures	✓	✓	✓	✓
C2	Workplace and office closures	✓	✓	✓	✓
C3	Public event cancellations and restrictions	✓	✓	✓	✓
C4	Restrictions on private gatherings	✓	✓	✓	✓
C5	Public transport closures	✓	✓	✓	✓
C6	Stay-at-home requirements	✓	✓	✓	✓
C7	Restrictions on intraprovincial travel (between cities or regions within a province)	✓	✓	✓	✓
C8	Restrictions on arrivals of international travellers	✓	✓	✓	✓
C9	Restrictions on interprovincial travel (between provinces)	✓	✓	✓	✓
C10	Enforcement mechanisms for individuals	✓	✓	✓	✓
C11	Enforcement mechanisms for firms	✓	✓	✓	✓
H1	Public information campaigns	✓		✓	✓
H2	Testing policy			✓	✓
H3	Contact tracing			✓	✓
E1	Income support for households				✓
E2	Debt/contract relief for households				✓

Table A-3: Robustness checks with other indexes for the containment effect

	(1)	(2)	(3)	(4)
New COVID-19 cases per 100,000 capita	-4.54***	-5.08***	-4.50***	-4.91***
	(-4.73)	(-5.39)	(-4.66)	(-5.24)
Stringency index	-0.36***			
	(-4.38)			
Containment and health index		-0.31***		
		(-3.53)		
Containment index			-0.34***	
			(-4.27)	
Government response index				-0.36***
				(-4.20)
Overall R^2	0.66	0.66	0.66	0.67
Sample	520	520	520	520

Note: T-statistics are in parentheses. For conciseness, the table presents only the parameter β_3, which reflects the COVID-19 effects for our reference period (December 2020). However, monthly interactions have been included in each model specification.
*** p <0.001, ** p < 0.01, * p < 0.05

Table A-4: Robustness checks with other proxies for voluntary physical distancing

	(1)	(2)	(3)	(4)
Stringency index	-0.36***	-0.67***	-0.63***	-0.66***
	(-4.38)	(-12.82)	(-7.55)	(-12.84)
New COVID-19 cases per 100,000 capita	-4.54***			
	(-4.73)			
Deaths		-7.13**		
		(-2.96)		
Positivity rate			-19.46	
			(-0.40)	
Hospitalization				-0.53**
				(-2.72)
Overall R^2	0.66	0.64	0.63	0.65
Sample	520	520	456	520

Note: T-statistics are in parentheses. For conciseness, the table presents only the parameter $\beta_{3,}$ which reflects the COVID-19 effects for our reference period (December 2020). However, monthly interactions have been included in each model specification.
*** p <0.001, ** p < 0.01, * p < 0.05

Table A-5: Key findings of robustness check with lagged independent variables
Equation (1) with fixed effects and robust standard errors

Variable	Coefficient	p-value
Stringency index (1 lag)	**-0.38**	**0.00**
Overall R^2		0.63
Groups		10
Observations		520

Chart A-1: Marginal impact of lagged new COVID-19 cases on spending over time
Including 90% confidence interval

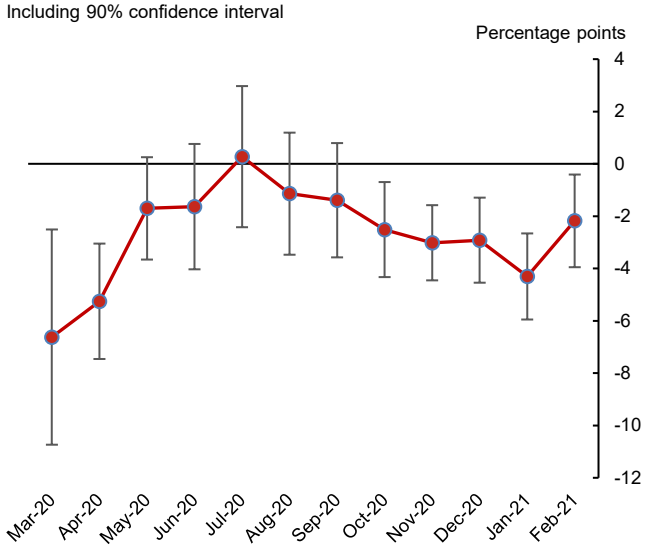


Table A-6: Key findings of robustness check with regional weighting
Equation (1) with fixed effects and robust standard errors

Variable	Coefficient	p-value
Stringency index β_1	**-0.55**	**0.00**
Overall R^2		0.63
Groups		10
Observations		520

Chart A-2: Marginal impact of new COVID-19 cases on spending over time with regional weighting
Including 90% confidence interval

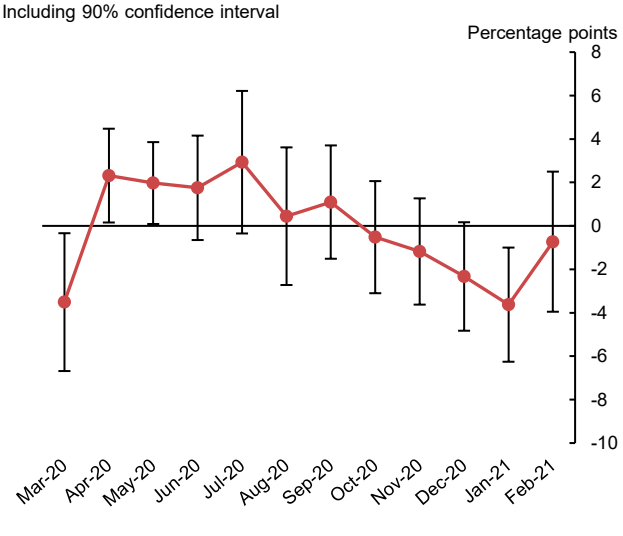


Table A-7: Key findings of robustness check with Interac transactions as the dependent variable
Equation (1) with fixed effects and robust standard errors

Variable	Coefficient	p-value
Stringency index β_1	**-0.39**	**0.00**
Overall R^2		0.66
Groups		10
Observations		520

Chart A-3: Marginal impact of new COVID-19 cases on spending over time with Interac as the dependent variable

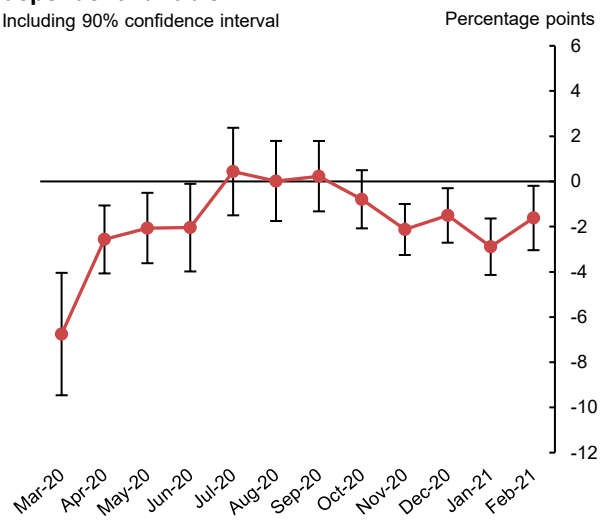
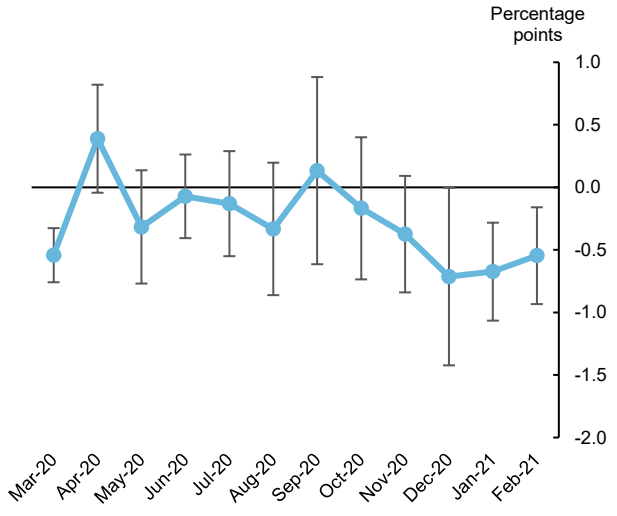


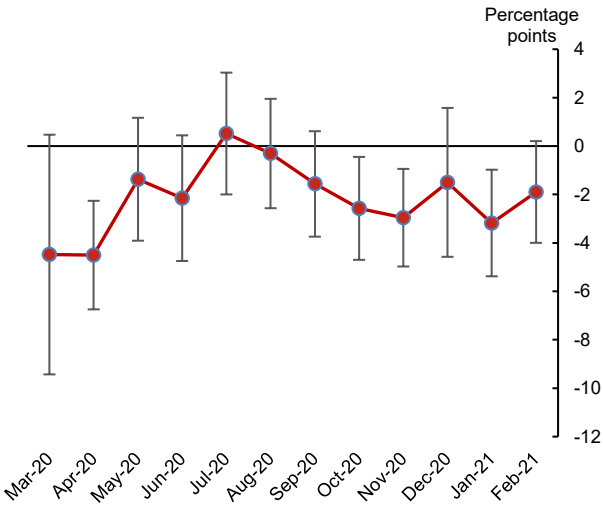
Chart A-4: Key findings of robustness check adding stringency interaction terms

Equation (1) with fixed effects and robust standard errors, including 90% confidence interval

a. Marginal impact of stringency on spending over time



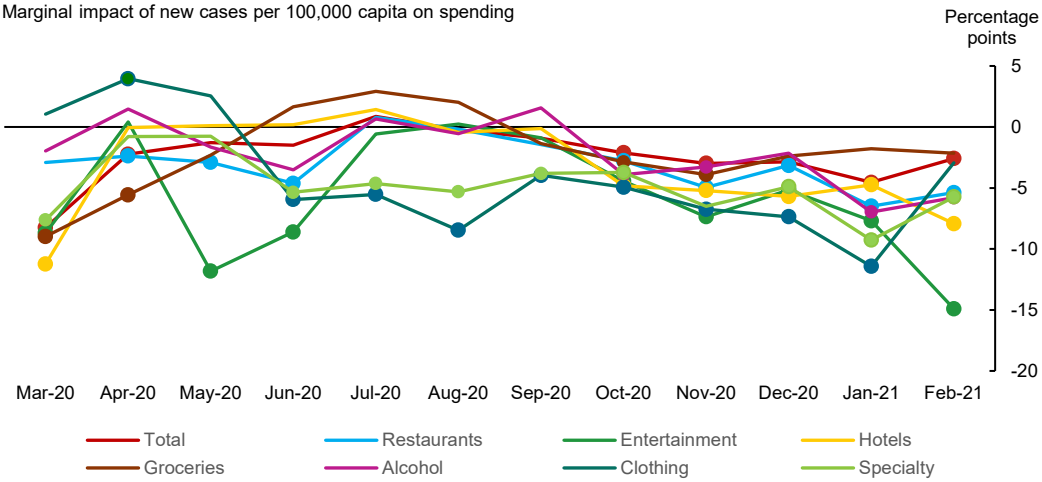
b. Marginal impact of new cases on spending over time (log; $\beta_2 + \beta_3$)



Note: Overall R^2: 0.68, groups: 10, observations: 520

Chart A-5: The impact of voluntary physical distancing over time has varied across sectors

Marginal impact of new cases per 100,000 capita on spending



Note: This chart shows the impact of new COVID-19 cases per 100,000 capita over time (β_3+ β_4). Dots represent monthly estimates with statistical significance at the 90% confidence level.

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