The Effect of Stay-at-Home Orders on Canadian Housing Prices

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Abstract

In this study, I use data from the Canadian Real Estate Association and the Oxford COVID-19 Government Response Tracker to assess the impact of COVID-19 safer-at-home policies on housing prices in ten Canadian Census Metropolitan Areas. I use a two-way fixed effects difference-in-differences model to provide evidence on the relationship between policies to prevent COVID-19 spread and the real estate market. The findings show an increase in housing prices by about 5% in the baseline specification as a result of the introduction of a stay-at-home policy in Canada. I also document a similar result using a trend specification, in which the estimates are still positive. However, the estimate shrank by two-thirds when adding leads and lags to the model.

Keywords: Housing prices, Covid-19, Stay-at-Home Orders, Two-Way Fixed Effects.

1. Introduction

After the 1918 influenza pandemic, a new pandemic appeared early in 2020. The coronavirus pandemic, also known as the COVID-19 pandemic, is an ongoing global pandemic caused by severe acute respiratory syndrome. In December 2019, the first case of coronavirus was reported in China, more precisely in the city of Wuhan. The World Health Organization (WHO) declared the coronavirus to be a worldwide pandemic on March 11th 2020. To help prevent the spread of this disease, there are several precautionary measures that can be taken, for example: wearing a face mask, staying at home, avoiding large gatherings, maintaining social distancing, closing schools and closing workplaces. On the one hand, these restrictions are known to be effective in slowing down the spread of COVID-19 (Calvo et al., 2020). On the other hand, these policies have resulted in a slowdown of economic activity. Research has shown a clear decrease in consumer expenditures (Chetty et al., 2020), an increase in unemployment (Béland et al., 2020a) and worsening mental health and well-being (Brodeur et al., 2020b; Davillas et al., 2020 and de Pedraza et al., 2020). However, lockdown orders resulted in some positive outcomes. For instance, an improvement in carbon emissions has decreased air pollution. Therefore, it resulted in a decline in respiratory health problems (Dutheil et al., 2020).

This research investigates the impact of lockdowns on Canadian Metropolitan Area (CMA) housing markets. The chosen CMAs are the following: Vancouver Island, Victoria, Calgary, Winnipeg, Regina, Ottawa, Montréal, Saint John (New Brunswick), Halifax, and St. John's (NL). The chosen cities are among the largest cities in the country. I use monthly housing data from the Canadian Real Estate Association (CREA) for the Canadian cities from January

2019 to July 2022. [1] CREA provides a composite benchmark housing price and prices for five housing types, for example, one- and two-storey single family homes, townhouses and apartments. In addition, lockdown data come from the Coronavirus Government Response Tracker.[2] It supplies a cross-national database that compiles policies and interventions across the world and subnational government responses to COVID-19. Fortunately, they have data at a provincial level for Canada. These statistics are updated in real time. The stay-at-home requirement is represented in the estimated models by a binary indicator; a value of zero means there is no measure in place and 1 means that the province strongly recommends staying at home. According to the Coronavirus Government Response Tracker, lockdowns were implemented at different times based on each province's decision.

To assess the impact of stay-at-home orders on housing prices, I use the two-way fixed effects difference-in-differences strategy (TWFE DD) and utilize the variation generated by differences in shutdowns across time and cities. My findings indicate that housing prices are positively affected by stay-at-home orders. The results remain statistically significant and positive even after trying different thresholds for the shutdown variable.

The rest of the paper is structured as follows. Part 2 contains details of the literature review, while Part 3 provides details about the identification strategy. Part 4 describes the data. Part 5 presents the main results and their interpretation. Finally, Part 6 concludes.

1 Housing prices are available here: https://www.crea.ca/housing-market-stats/canadian-housing-market-stats/.

2 The lockdown data are available here: https://www.bsg.ox.ac.uk/research/research-projects/covid-19-governmentresponse-tracker.

2. Literature Review

This paper communicates with several economic channels. First, it contributes to an emergent literature about housing markets during COVID-19. Recent research by D'Lima et al. (2020) provides an analysis of the effects of government shutdown orders during the pandemic on the housing market in the U.S. In this paper, the authors use data on real estate transactions between January 2019 and December 2020, and control for time, location and property characteristics in their model in order to attenuate some concerns about sample selection. They document a significant decrease in listings during the re-opening and shutdown intervals. Meanwhile, Qian et al. (2021) investigate the impact of COVID-19 on the Chinese real estate market. Using the difference-in-differences method, the authors use data on confirmed COVID-19 cases and monthly data on housing prices and community-level variables between October 2019 and April 2020. They find a negative relationship between housing prices and confirmed COVID-19 cases in Chinese communities. Furthermore, the housing price decline persisted for another three consecutive months. Another study conducted using U.S. data examined the early impact of COVID-19 on the housing market (Yoruk, 2020). This study used data from Zillow's web traffic at a city level starting mid-March 2020. To evaluate the effect, the author sets up a difference-in-differences type model with time, city and state fixed effects. After the early shutdown orders, despite the increase in the web pages views (web user traffic) on home sales pages, new listings decreased by 21% and home sales fell by 24%.

Second, the paper contributes to the literature on the effects of health crises on residential real estate. It is also connected to research done on the pandemic of 1918 in the U.S. by Almond (2006). On one hand, the research indicates a decline in educational attainment, a decline in income and a decline in socioeconomic status during the pandemic. On the other hand, the pandemic led to an increase in rates of physical disability. Similarly, Ambrus et al. (2020) address the impact of the cholera epidemic of 1854 on the urban landscape. The authors examine the impact on housing prices of a cholera epidemic in a London neighborhood. They employ a spatial regression discontinuity (RD) design and conclude that housing prices not only dropped at the time, but remained persistently lower over the following 160 years. Also, Adda (2016) addresses the impact of viral diseases on economic activity in France between 1984 and 2010. The author uses a within-region analysis and exploits quasi-experimental variation to assess the importance of policies decreasing relational contacts such as school closure or the closure of public transportation networks. As a result of the implementation of these measures, the spread of the epidemic depends mainly on the characteristics of the disease. Moreover, such measures are effective mainly in young generations. Finally, Béland et al. (2020b) document the impact of COVID-19 on mental health outcomes in Canada. Using the Canadian Perspectives Survey Series (CPSS), the authors collected data on mental health, financial concerns and employment concerns in Canada. The results of their ordered probit regression suggest that people who express fear about their financial situation and losing their job are more likely to stay at home and be unable to work because they were infected.

Third, this paper contributes to a growing literature on the socioeconomic consequences of government policies. In a recent paper, Béland et al. (2020 a) examine the short-term impacts of the pandemic and evaluate the consequences of lockdown orders on employment and wages in the U.S. To evaluate this impact, they use a difference-in-differences approach that compares the states that issued a lockdown order with those that did not. They conclude that COVID-19 increased the unemployment rate and decreased both hours of work and labour force participation, especially for younger, non-white, not married and less-educated workers. In addition, Forsythe et al. (2020) show that firms had decreased job vacancies starting the 2nd week of March 2020. This phenomenon was coordinated with the increase in UI claims in the U.S. Another paper, Bullinger et al. (2021), addresses the effects of Stay-at-Home (SAH) orders on domestic violence using a difference-in-differences strategy. The authors find that the SAH order announcement increased time spent at home, but there was a subsequent increase in domestic violence-related calls for police service. Finally, research conducted by Boman and Gallupe (2020) examine the extent to which governmental responses (lockdowns) to COVID-19 impacted crime events in the U.S. They find that there was a significant decrease in calls for service to law enforcement. However, homicides and shootings remained constant.

The last channel this paper contributes to focuses on the environment. Brodeur et al. (2021a) examine the effects of stay-at-home policies on car crashes and pollution in the U.S. Using the difference-in-differences method, they explore the hypothesis that safer-at-home policies decreased particulate matter concentrations (PM2.5) and collisions. The authors find that the stay-at-home orders led to a 20% decline in vehicle collisions and a 25% reduction in the particulate matter concentration. Another relevant work is Dang and Trinh (2020). They provide cross-national evidence for 164 countries on the impact of pandemic lockdowns on PM2.5 and NO_2 concentrations. Using a regression discontinuity design approach, the researchers find that levels of both pollutants declined during the stay-at-home orders by around 5 percent. Finally, Xuelin et al. (2020) investigate the impact of the COVID-19 outbreak on urban transportation and air quality in eight major cities in Canada. Due to stay-at-home policies, motor gasoline consumption, CO_2 emissions, traffic volume and congestion level significantly decreased. Moreover, urban air quality improved significantly during the pandemic.

This study builds on the existing literature on the impact of the recent 2020 pandemic on the housing market. As has already been discussed, several studies have addressed the topic of housing price changes in cities following a lockdown policy in different countries, for example, the U.S. and China. However, there seems to be a lack of studies concerning the effect of COVID-19 on housing prices in Canadian cities. Due to these deficiencies, I decided to try to fill this gap.

3. Data

In this section, I describe the data used in this paper.[3] First, I provide information on housing prices from the Canadian Real Estate Association (CREA). Second, I describe the data about lockdowns in Canada from Oxford's Blavatnik School database. Third, the socioeconomic variables included as control variables are presented. These include fine particulate matter (PM2.5), median age, education level, Gross Domestic Product, household income, population estimates, the unemployment rate, and the crime severity index. Table 1 provides summary statistics for the variables used in this study.

3.1 Housing Prices

The Canadian Real Estate Association (CREA) provides data on composite benchmark housing prices and the quantity of houses sold at a monthly frequency across Canada from January 2005 to the present.[4,5] The estimates are collected from Canada's Multiple Listing

[3] Table A1 in the appendix provides more details about the collected data.
[4] The municipalities for which data are currently available are Vancouver Island, Victoria, Greater Vancouver, Fraser Valley, Okanagan Valley, Calgary, Edmonton, Regina, Saskatoon, Guelph, Hamilton Burlington, Oakville-Milton, Barrie & District, Greater Toronto, Niagara Region, Ottawa, Greater Montréal, and Greater Moncton. CREA plans to add more markets in the future.
[5] For more details about composite benchmark prices: www.crea.ca/files/mls-hpi-data/english/HPI_Methodology-June-2022-rev-ENG.pdf.

Service (MLS), a database used by real estate brokers to post their client's homes for sale. For this study, the following major cities were selected: Vancouver Island, Victoria, Calgary, Winnipeg, Regina, Ottawa, Saint John (New Brunswick), Halifax, St. John's (NL) and Montréal. Housing price is measured by CREA's composite benchmark measure of the prices of different categories of homes. It includes one- and two-storey single family homes, townhouses and apartments. Furthermore, seasonally unadjusted benchmark housing price data were selected for January 2019 to July 2022. This sample period was selected to include the pre/post COVID period. According to Table 1, the mean value of the dependent variable *Price* is 12.89, and the corresponding raw value of *Composite* is 427,277.[6] This means that the sample average price of houses in Canada is about $427,277.

3.2 Lockdown Data

Canadian provinces had different approaches to mitigating COVID-19 spread. The Oxford COVID-19 Government Response Tracker (OxCGRT) implemented by Oxford's Blavatnik School of Government provides a systematic cross-national measure to understand how government responses have evolved over the full period of the pandemic.

For the ten provinces of Canada, the containment and closure policies included: i) school closings, ii) workplace closings, iii) cancellation of public events, iv) restrictions on gathering size, v) stay-at-home requirements, vi) restrictions on internal movement and vii) restrictions on international travel. For this study, I extracted data on stay-at-home orders in each Canadian province. Due to the complexity of the data and a lack of time I decided to exclude the rest of the variables.

[6] Note that the dependent variable is in logarithmic form.

For stay-at-home orders, the original variable takes a value of zero when there is no measure, one when the province recommends not leaving the house and a value of two when the province requires not leaving the house with exceptions only for daily exercise, grocery shopping and essential trips. Since the website did not provide monthly data, the daily data are collected and transformed to get monthly data. I assigned a value of one to the variable *Shutdown* when the number of days in a month under lockdown exceeds the number of non-lockdown days and 0 otherwise. I focus on the province-level shutdown orders because in Canada these types of decisions are taken at the provincial level. Therefore, province and city shutdown dates are the same.

Table 2 presents the earliest shutdown and rollback dates by province. Nearly all provinces implemented a stay-at-home order starting in mid-March 2020. Out of 10 provinces, Manitoba was the first Canadian province to require a do-not-leave-the-house order (see Table 1). According to the Government Response Tracker (OxCGRT), several provinces had shutdowns and rollbacks at multiple times from March 2020 to July 2022. Figure 1 provides a visual of lockdown and rollback by Canadian cities from January 2019 to July 2022.
After the introduction of vaccinations, many provinces lifted their restrictions, except for Saskatchewan, Manitoba and Newfoundland and Labrador. They held the stay-at-home restrictions in place until February 2022. Further, Ontario, Saskatchewan, Quebec and Newfoundland implemented more severe policies than the other provinces. However, these policies did not last as long.

3.3 Socioeconomic Variables

In this section, I describe the set of chosen control variables that might influence housing prices in Canada outside the pandemic period**.** These variables are collected from different data sources and are available at different frequencies. Therefore, I had to use several methods to convert the data to a monthly basis, such as Denton's method, the linear method and monthly average. Tables A1 and A2 in the appendix contain details on the method for each control variable. Note that some of these variables are endogenous and thus potentially bad control variables. I thus show in all tables specifications with only city and time fixed effects.

3.3.1 Particulate Matter Concentrations

As a pollution indicator, I collect data on fine particulate matter concentration (PM2.5). As mentioned before, stay-at-home orders may impact air pollution, suggesting that this is potentially a bad control variable. I nonetheless include it in some models.

This pollutant is a combination of tiny airborne particles that can be inhaled into the lungs. These particles can be released by vehicles, industrial facilities, or natural sources like forest fires. Fine particulate matter concentration data for major Canadian cities from January 2019 to July 2022 were collected. However, there is a lack of data for some cities, especially Montréal and Ottawa. Specifically, data were not available for these two cities from January 2022 to July 2022. More details are provided in Table A2 in the appendix.

Pollution data for Victoria, British Columbia were taken from Victoria Topaz Station. Also, data for Vancouver were collected from Horseshoe Bay station and Vancouver Airport Station. In Winnipeg, the monitor was on Ellen Street. This station is close to the downtown area. The monitoring station selected for Ottawa, Ontario was the downtown station. Calgary had several active stations, for example Calgary Central-Inglewood, Calgary Northwest and Calgary Southeast. The station chosen in Nova Scotia was the Halifax station located in the Johnston Building in the central air zone region. Fine particulate matter concentration (PM2.5) for Saskatchewan was collected from the Regina region.[7] The data were from the core long-term program of the Ministry of Environment of Saskatchewan. Montréal, Quebec has several stations. Therefore, I computed the average concentration over more than ten stations. The air monitoring data for St. John's, Newfoundland and Saint John, New Brunswick were collected from NAPS stations.[8,9]

Cities collect PM2.5 data on an hourly or daily basis. Therefore, I averaged the data to obtain monthly values. Table A2 in the appendix contains the details for each city.

3.3.2 Median Age, Population Estimates and Unemployment Rate

Population and unemployment rate data were collected from the Labour Force Survey (LFS) for all ten CMAs from January 2019 to July 2022. An estimate of the population aged 15 and over for the cities concerned is published on a monthly frequency. Also, I add unemployment rate in some models although it is clearly a bad control.

Statistics Canada also publishes data on the characteristics of the Canadian population. Therefore, I was able to collect annual data on the median age of each city from 2019 to 2021.

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[7] These data were provided by Chris Grey of the Environmental Protection Branch, Ministry of Environment, Government of Saskatchewan.

[8] These data were provided by Lawrence Barrie from Department of Environment and Climate Change. The data could also be found on the NAPS website: https://data.ec.gc.ca/data/air/monitor/national-air-pollution-surveillance-naps-program/Data-Donnees/?lang=en.

[9] These data were provided by Susan Mowers from University of Ottawa for 2021 and 2022. She collected the data from https://www.elgegl.gnb.ca/AirNB/en/SamplingLocation/Index. The rest of the years are from NAPS.

3.3.3 Educational Level

Educational level statistics were collected from Real Time Remote Access (RTRA Statistics Canada) for the ten CMA cities. The data are available on a monthly frequency from January 2019 to July 2022 for people with a bachelor's degree.

3.3.4 Crime Severity Index

I also collected annual data on crime severity by CMA from Statistics Canada for January 2019 to December 2021. They define Crime as "acts or omissions that are forbidden by the Criminal code of Canada."[10] The **Crime severity index** considers the volume and the gravity of crime. For information, the index is calculated according to the weight assigned to each offence; the more serious the average sentence, the higher the weight for that offence. As a result, more serious offences have a greater impact on changes in the index. Again, this is potentially a bad control and is excluded from the baseline specification.

3.3.5 Gross Domestic Product and Income per Household

The last control variables used are seasonally unadjusted gross domestic product and income per household.[11] Both were collected from the Conference Board of Canada's E-Data portal by CMA quarterly data. Using Denton's method, the data were transformed from quarterly to monthly. However, data on these variables for Prince Edward Island were not available.

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[10] This is the definition used by Statistics Canada. See https://www23.statcan.gc.ca/imdb/p3Var.pl?Function=DEC&Id=252233.

[11] Note that the gross domestic product is in logarithmic form.

Hence, this province was excluded from this study.[12] Again these control variables are not the best and excluded from the baseline specification.

4. Empirical Strategy

To assess the impact on housing prices in response to the restriction policy, I will use a two-way fixed effects (TWFE) difference-in-differences model, where I compare monthly housing prices in cities under a stay-at-home order to those that were not under such an order. The model to be estimated is the following:

$$Y_{ct} = \alpha + \beta\, Shutdown_{ct} + X'_{ct}\,\rho + \varphi_t + \theta_c + \varepsilon_{ct}, \quad (1)$$

where the dependent variable Y_{ct} is the natural logarithm of the housing price in city c at time t. $Shutdown_{ct}$ takes a value equal to one if the province had issued a stay-at-home order at time t and zero otherwise. The coefficient of interest in this specification is β. It captures the extent to which a shutdown influences the housing price positively or negatively. Finally, θ_c and φ_t are city fixed effects and time fixed effects respectively. City fixed effects are used to make a comparison across cities and not within cities. They control for all characteristics of a city *c* that do not change over time. Time fixed effects control for factors that change over time but are common to all cities at a given point in time, for example an increase in protests across the country. The fixed time effects also help to control for seasonality in housing activity.

The vector X_{ct} contains a variety of control variables that might influence housing prices in Canada outside the pandemic period. As discussed in section 3, it includes total population, the unemployment rate, the educational level of the population, gross domestic product, the

[12] Details about the conversion of yearly data to monthly data and calculations used to estimate values for 2022 are provided in appendix Table A1.

crime severity index, household income, median age and fine particulate matter concentration (PM2.5). Most of these variables are bad controls, and thus excluded in the baseline specification. Even though time and city fixed effects account for factors that vary across time and cities, they do not capture factors that vary across both city and time period. Therefore, factors such as the unemployment rate, GDP and income per household must be considered. Including the unemployment rate, GDP and income per household allows the model to capture changes in the local economy that could impact stay-at-home decisions and the performance of the housing market. Further, to ensure the validity of the difference-in-differences method the parallel trends assumption must be satisfied. It requires that that housing markets in cities that adopted the stay-at-home policy at a given time compared to those that did not follow a common trend in the absence of the policy.

In addition, as suggested by Angrist and Piscke (2009), I estimate a modified version of equation (1) that also includes a city-specific linear time trend. The term $\gamma_c \times t$ lets housing prices display a linear trend over time to account for trends that may not be captured by the control variables. To do so, I adjust my model as follows:

$$Y_{ct} = \alpha + \beta\, Shutdown_{ct} + X'_{ct}\,\rho + \varphi_t + \theta_c + \gamma_c \times t + \varepsilon_{ct}. \qquad (2)$$

The last specification is a dynamic equation. It examines the effect of stay-at-home policies on housing prices in the months before and after the introduction of the order. The time frame is 6 months prior and post the implementation of the regulation. The specification is as follows:

$$Y_{ct} = \alpha + \sum_{j=-6}^{6} \beta_j\, Shutdown_{c(t-j)} + X'_{ct}\,\rho + \varphi_t + \theta_c + \gamma_c \times t + \varepsilon_{ct}. \qquad (3)$$

This type of specification is also recommended by Angrist and Pischke (2009).

4.1 Threats to Identification

A potential issue is that in this particular application, each city (province) implemented and removed stay-at-home orders at different points in time. Hence, this makes comparison in terms of the policy treatment difficult and results in a potentially biased estimator (Goodman-Bacon and Marcus, 2020), as the coefficient of *Shutdown* is in fact a weighted average of all possible two groups/two periods estimates. Recent studies such as Goodman-Bacon and Marcus (2020), Dave et al. (2021), Baker et al. (2022) and Goodman-Bacon (2021) have pointed out this problem. Baker et al. (2022) recommend using the Goodman-Bacon (2021) decomposition to determine what precisely the TWFE model is estimating when the timing of treatments differs across cross-sectional units. In my case, there are many cities and years, so I would have to examine several combinations. They also suggest using alternative estimators such as that of Callaway and Sant'Anna (2021). Their estimator relies on group-time-specific treatment effects that help account for treatment heterogeneity, then aggregating them to measure the total overall treatment effect. Both methods are beyond my expertise, so I will not attempt them in this study.

5. Results

Table 3 provides the main results of specification (1). In all columns, the dependent variable is the natural log of housing prices. I regress the natural log of housing prices on the binary indicator *Shutdown*. Column 1 provides a model with only city and time fixed effects. Column 2 adds exogenous control variables. The remaining columns add the potentially endogenous control variables. All specifications include panel-robust standard errors.[13] As mentioned above, data for particulate matter concentration for the city of Ottawa and the city of

[13] Tables A3 provides results for specifications 1 using robust standard errors clustered at the province-level.

Montréal are not available for 2022. To determine if this has an effect on the coefficient of $Shutdown_{ct}$, I estimated two versions of each specification, one including PM2.5 and one excluding PM2.5.[14]

The estimated coefficient of *Shutdown* is positive and statistically significant at the 1% level in all columns. In the first column, an introduction of a stay-at-home order increases housing prices by 3.9 percentage points. Since I control for city, time fixed effects and the exogenous control variables, column 2 is the preferred specification. Implementing a lockdown policy increases housing prices by 5.6 percentage points. In column 3, I do not control for particulate matter concentration while in column 4 I do. Including the rest of the control variables in columns 3 and 4 in Table 3 reduces *Shutdown's* coefficients in comparison to the coefficient in column 2 of the same table. The point estimates in these two columns suggest that the introduction of a shutdown policy increased housing prices by 4.6 percentage points and 4.5 percentage points respectively.

Table 4 shows the results for equation (2). In columns 1-3, the dependent variable is once again the natural log of housing prices. All columns include the variable of interest as well as city and time fixed effects. Column 1 does not include any control variables. The estimate of *Shutdown* is statistically significant at the 1% level and suggests that a lockdown policy increases housing prices by 3.6 percentage points. Column 2 provides results without particulate matter concentration (PM2.5). The estimate is positive and statistically significant at the 5% level. Column 3 presents the estimates with particulate matter concentration (PM2.5) included as a

[14] To determine whether city and time fixed effects should be added in columns 5 and 6, it is in principle possible to perform a hypothesis test. However, due to the use of panel-robust standard errors with a small number of clusters (namely, 10), the rank of the variance-covariance matrix of the coefficients is significantly reduced (Cameron and Miller, 2015). Therefore, the overall F-statistic is not available. In addition, the R^2 values are not directly comparable and therefore have not been included in the tables of results. See Wooldridge (1991).

control variable. The estimated coefficient of *Shutdown* in this column is positive and statistically significant at the 1% level. The results suggest that implementing the stay-at-home policy increases the price by 1.9 percentage points in comparison to a 4.5 percentage point increase in column 4 of Table 3. Adding city-specific trends causes some of the coefficients of the control variables to become significant and others to become insignificant. The coefficients of the unemployment rate and gross domestic product are now statistically significant at a 5% and a 1% level respectively. The coefficient of the crime severity index is still significant at the same level. However, median age does not have a statistically significant coefficient anymore.

Finally, Table 5 provides the results of the last specification, equation (3). It shows the impact of shutdown orders on housing prices six months before and after the implementation of the stay-at-home policy. All columns include the variable of interest, *Shutdown*, and city and time fixed effects. Column 1 includes once again city and time fixed effects and shows a positive and statistically significant result at the 1% level. Column 2 presents the estimates with particulate matter concentration (PM2.5) excluded. It shows a positive and significant (at the 1% level) estimated coefficient for the immediate impact of the introduction of a shutdown order, of 1.6 percentage points. Adding leads and lags to the equation shrinks the effect by 64%. The estimates have gone from 4.5 percentage points in column 4 of Table 3 to 1.6 percentage points for the dynamic model in Table 5, column 3. In addition, the results show a positive and statistically significant estimate three months following the issuance of the stay-at-home order at a 1% level. This implies that the effect of lockdown on housing prices has lasted 3 months after the policy implementation. Furthermore, when summing the statistically significant estimates of column 3 of Table 5, the total effect of introducing a stay-at-home policy increases housing prices by 6.3%.

In columns 4 and 5 of Table 5, I include a city-specific linear time trend in the dynamic specification. Adding a trend to specification (3) lets housing prices display a linear trend over time to account for trends that may not be captured by the control variables. The results for this equation imply that the introduction of a lockdown policy to prevent the spread of COVID-19 led to an immediate increase in housing prices by 1.2 percentage points when particulate matter concentration is included in the equation. These alternative estimates are statistically significant at the 1% level. As can be seen in column 5, in the second and third month after implementing the shutdown policy housing prices rose by an additional 0.7 and 0.5 percentage points. The estimates are statistically significant at the 5% and a 10% level. This implies that housing prices increases lasted 2 months after the implementation of the policy. Also, the estimated coefficients of *Shutdown* are statistically significant at the 5% level and the 1% level for the 1st and 2nd month prior to the policy implementation. This implies that the effect of a lockdown on housing prices started two months before the introduction of the policy, suggesting that people may have anticipated the lockdowns.

One limitation of the panel-robust standard errors is that they do not correct for cross-sectional dependence. Therefore, I perform Pesaran's CD test for column 4 of Table 3 to check for the presence of cross-sectional dependence. The CD test strongly rejects the null hypothesis of no cross-sectional dependence.[15] Therefore, I use Driscoll-Kraay standard errors to correct for the presence of heteroskedasticity, autocorrelation and cross-sectional dependence. Table 6 presents the results using Driscoll-Kraay standard errors.[16] Comparing the results for the baseline specification (column 2 of Table 3 and column 2 of Table 6), the coefficients are still significant

[15] The result of Pesaran's test of cross-sectional independence is -4.634 for the model that does not include PM2.5 and -5.194 for the model that includes PM2.5. Both p-values are 0.0000.

[16] Due to a collinearity issue, the constant in Column 3 of Table 4 is omitted.

at a level of 1%. In other words, using Driscoll-Kraay standard errors did not change the level of significance.[17] However, in Table 6 column 1, the coefficient of *Shutdown* is statistically significant at a 5% level in comparison to a 1% level in Table 3 column 1.

In Tables 7 and 8, I perform several robustness checks. First, as mentioned in section 3, the Oxford COVID-19 Government Response Tracker assigns a value of two to the shutdown variable when the province requires not leaving the house with exceptions for daily exercise, grocery shopping and essential trips. Out of 430 observations in the sample, 25 have a value of 2. However, in creating the variable *Shutdown* I decided to switch the 25 observations with a code of 2 to a code of 1. Therefore, I now investigate how the results change when those 25 observations with more severe stay-at-home restrictions are dropped from the sample. The first two columns of Table 7 reproduce the previous results in columns 3 and 4 of Table 3, while the last three columns display the results when observations to which the COVID-19 Government Response Tracker had assigned a value of 2 were dropped from the sample. The estimated increase in price from a safer-at-home-order is statistically significant at a 1% level in all columns. Although I have a smaller sample size in columns 4 and 5, establishing a lockdown order still results in a statistically significant increase in housing prices by 4.4 percentage points.

Table 8 presents regression results that include a shorter time window for lockdown. Initially I assigned a value of one to the variable *Shutdown* when the number of days in a month under lockdown exceeds 15 days and 0 otherwise. For the robustness check, I decided to try several modifications of this rule. Specifically, I assigned *Shutdown* a value of 1 when there were at least 5 days ,7 days or 9 days of a stay-at-home order during the month. I included time and city fixed effects in all the new equations. Columns 1 and 2 reproduce the results in columns 1

[17] Tables A4 and A5 provide results for specifications 2 and 3 using Driscoll-Kraay standard errors.

and 4 of Table 3, while columns 2, 3, 4 and 5 present results with time windows of 5 days, 7 days, and 9 days. In all equations the results show an increase in housing prices following the introduction of a provincial shutdown order. The new results in columns 3-5 are statistically significant at the 1% level, as compared to the 1% level in the first two columns. However, despite the changes in the shutdown threshold, the magnitude of the estimates does not change a great deal.

6. Conclusion

This paper examines the effect of stay-at-home policies on housing prices in ten Canadian Census Metropolitan Areas from January 2019 to July 2022. As a result of the introduction of a shutdown policy to slowdown the spread of COVID-19, there has been an increase in housing prices in Canada. The two-way fixed effects coefficients suggest an increase in housing prices in Canada of 5.6% when a stay-at-home order is introduced. Several other models were estimated for Vancouver Island, Victoria, Calgary, Winnipeg, Regina, Ottawa, Saint John (New Brunswick), Halifax, St. John's (NL) and Montréal. All specifications lead to the same basic conclusion as the baseline specification. Using different specifications, the results are all positive and statistically significant. I performed various robustness checks and the results remain positive and statistically significant. Further, the estimated dynamic model indicates that housing prices began to rise a month prior to the introduction of a stay-at-home order and continued to rise for another two months after the introduction of a stay-at-home order. After summing the statically significant estimates, the total effect of introducing a stay-at-home policy increases housing prices by about 5%.

However, this study does have some limitations. Studying the impact of a shutdown on a socioeconomic variable is subject to its own methodological issues. The latest studies on the two-way fixed effects difference-in-differences model have identified a number of challenges when policies are introduced at different points in time. In the case of COVID-19, policies to contain its spread were implemented and lifted at a different point in time for each city, so these issues apply to the models estimated here. In the presence of heterogeneity in treatment effects, the TWFE estimator may be a biased estimator. Future research can use the Goodman-Bacon (2021) decomposition for two groups/two periods (2×2) models to assess the extent of the bias in a systematic way. Another appropriate method is the estimator proposed by Callaway and Sant'Anna (2021). Given these potential problems, my research should be regarded as a preview to identify the link between lockdown and the price of housing in Canada.

Finally, the Canadian Real Estate Association (CREA) provides details of housing prices for one- and two-storey single family homes, townhouses and apartments. So, it would be a good idea to repeat this study using the prices of different types of housing. Given the short time span currently available, there is room for improvement.

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Table 1. Summary Statistics

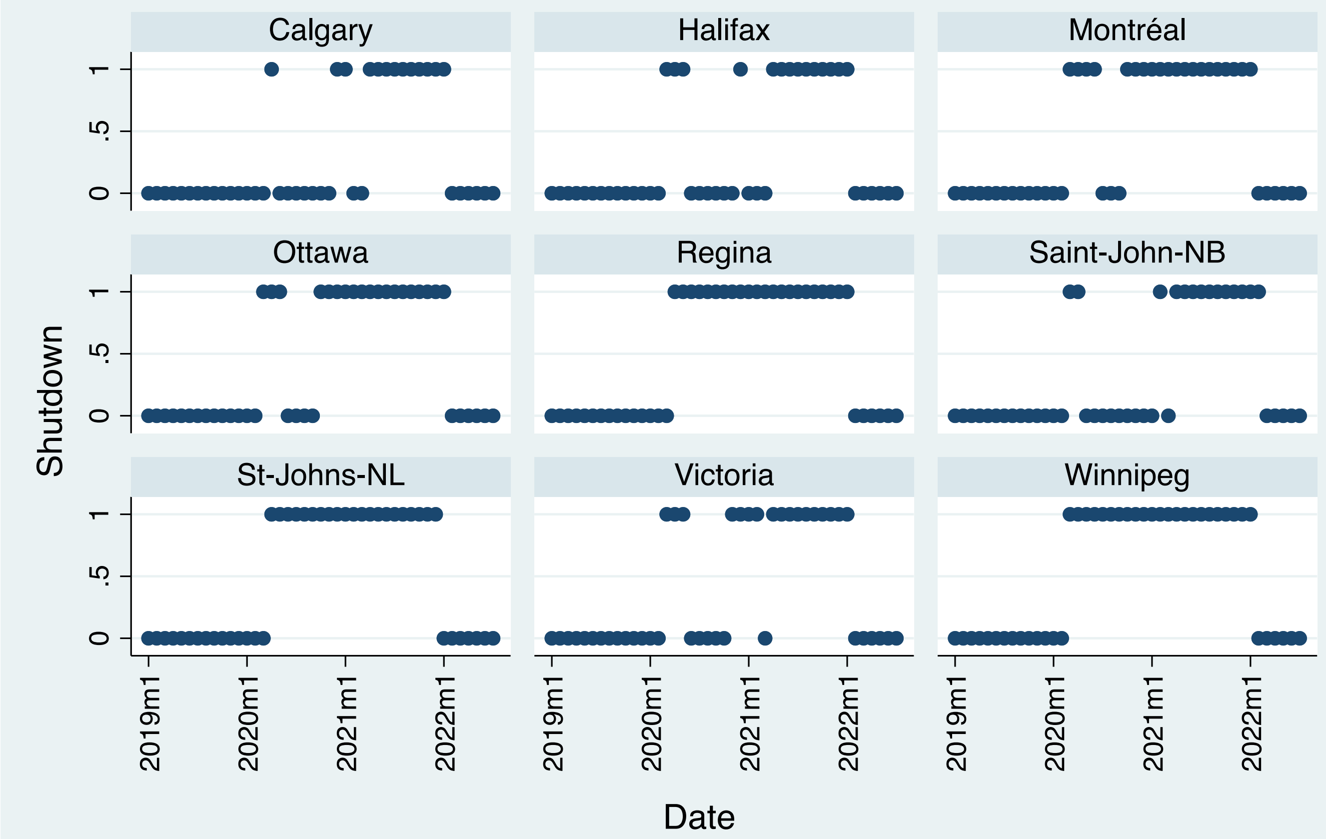
Variable	Obs	Mean	Std. Dev.	Min	Max
Price	430	427277.63	174037.95	175000	985500
Shutdown	430	.419	.494	0	1
Population	430	1003.336	1081.424	108.4	3672.5
Unemployment rate	430	7.086	2.395	2.9	15.3
Crime Severity Index	430	77.111	24.163	45.857	136.691
ln (GDP)	430	10.566	1.126	8.592	12.288
Median Age	430	40.343	2.27	36.6	44.573
Income Per Household	430	69355.621	69570.283	5769.337	254151.2
Particulate Matter 2.5	416	6.073	2.723	2.163	34.757
Proportion Bachelor	430	.248	.056	.111	.379
ln (Price)	430	430	12.887	.394	12.073
Month	430	6.093	3.392	1	12
Year	430	2020.326	1.052	2019	2022

Table 2. Shutdown Orders Across Canada (earliest dates)

Province	**City**	**Shutdown**	**Rollback**
British Columbia	Victoria Vancouver	March 17, 2020	May 19, 2020
Alberta	Calgary	March 30, 2020	May 14, 2020
Saskatchewan	Regina	March 23, 2020	February 12, 2022
Manitoba	Winnipeg	March 13, 2020	February 17, 2022
Ontario	Ottawa	March 16, 2020	May 19, 2020
Quebec	Montréal	March 16, 2020	June 22, 2020
New Brunswick	Saint John	March 16, 2020	April 24, 2020
Nova Scotia	Halifax	March 22, 2020	June 5, 2020
Newfoundland and Labrador	St John's	March 17, 2020	February 7, 2022

Note: This table represents the earliest dates of Shutdowns and the earliest date of removal of the latter

Figure 1. Shutdowns by Canadian Cities



Note: This figure graphs the shutdown order or rollback from January 2019 to July 2022 for 9 selected Canadian Cities. Vancouver is not included in the figure because it is located in the same province as Victoria and therefore experienced the same shutdowns and rollbacks.

Table 3. Effect of Shutdown Orders on Sale Price, Model (1)

	(1) Housing Price	(2) Housing Price	(3) Housing Price	(4) Housing Price
Shutdown	0.0386***	0.0556***	0.0455***	0.0445***
	(5.89)	(6.01)	(5.04)	(5.21)
Population		0.00156***	0.000573	0.000544
		(3.66)	(0.65)	(0.59)
Unemployment rate			-0.00123	-0.00186
			(-0.33)	(-0.50)
Crime Severity Index			-0.00325	-0.00334*
			(-1.75)	(-1.91)
ln (GDP)			0.152	0.126
			(0.57)	(0.48)
Median Age		-0.397***	-0.449***	-0.455***
		(-8.14)	(-7.65)	(-9.24)
Income per Household			0.00280	0.00345
			(1.49)	(1.80)
Proportion Bachelor		0.0261	-0.0984	-0.106
		(0.10)	(-0.38)	(-0.43)
PM25				0.000438
				(0.81)
Constant	12.73***	27.08***	28.66***	29.21***
	(480.74)	(13.77)	(5.93)	(6.65)
City FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	430	430	430	416

Notes: This table presents the regression estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. Panel- robust standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 4. Effect of Shutdown Orders on Sale Price, Model (2)

	(1) Housing Price	(2) Housing Price	(3) Housing Price
Shutdown	0.0358***	0.0225**	0.0192***
	(5.41)	(3.19)	(3.45)
Population		0.00219	0.00137
		(1.78)	(1.11)
Unemployment rate		-0.00773**	-0.00725**
		(-2.95)	(-2.67)
Crime Severity Index		-0.00268*	-0.00206*
		(-2.19)	(-2.07)
ln (GDP)		-0.196	-0.206*
		(-0.91)	(-1.02)
Median Age		-0.0183	0.0951
		(-0.09)	(0.65)
Income per Household		0.00372	0.00296
		(1.66)	(1.17)
Proportion Bachelor		0.0689	0.122
		(0.53)	(1.13)
PM25			0.000393*
			(2.06)
Constant	12.73***	13.40	9.800
	(1125.33)	(1.60)	(1.46)
City FE	Y	Y	Y
Time FE	Y	Y	Y
Trend	Y	Y	Y
Observations	430	430	416

Notes: This table presents the regression estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Panel-robust standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 5. Effect of Shutdown Orders on Sale Price Using Leads and Lags, Model (3)

	(1) Housing Price	(2) Housing Price	(3) Housing Price	(4) Housing Price	(5) Housing Price
Shutdown	0.0160***	0.0163***	0.0162***	0.0116***	0.0118***
	(3.79)	(3.84)	(3.77)	(4.01)	(3.90)
$Shutdown_{t-1}$	0.00413	0.0119*	0.0118*	0.00869**	0.00841**
	(0.69)	(2.15)	(2.15)	(2.49)	(2.44)
$Shutdown_{t-2}$	-0.00149	0.00559	0.00547	0.00479*	0.00454*
	(-0.35)	(1.06)	(1.04)	(1.86)	(1.84)
$Shutdown_{t-3}$	-0.00105	0.00585	0.00575	0.00548	0.00555
	(-0.23)	(1.39)	(1.30)	(1.55)	(1.48)
$Shutdown_{t-4}$	0.000925	0.00736	0.00727	0.00592	0.00551
	(0.18)	(1.75)	(1.79)	(1.23)	(1.19)
$Shutdown_{t-5}$	-0.00725	0.00486	0.00474	0.00424	0.00417
	(-1.06)	(1.51)	(1.44)	(1.20)	(1.16)
$Shutdown_{t-6}$	-0.0243	-0.00207	-0.00236	-0.00125	-0.00161
	(-1.65)	(-0.42)	(-0.47)	(-0.30)	(-0.38)
$Shutdown_{t+1}$	0.00599*	0.0118***	0.0119***	0.00501	0.00460
	(2.12)	(4.20)	(3.93)	(1.36)	(1.24)
$Shutdown_{t+2}$	0.00902***	0.0137***	0.0138***	0.00774**	0.00745**
	(3.54)	(4.94)	(5.37)	(2.37)	(2.37)
$Shutdown_{t+3}$	0.00711*	0.00889***	0.00891***	0.00520*	0.00519*
	(2.24)	(3.43)	(3.39)	(1.93)	(1.90)
$Shutdown_{t+4}$	-0.0000904	0.00113	0.00117	0.000362	0.000174
	(-0.03)	(0.36)	(0.38)	(0.19)	(0.09)
$Shutdown_{t+5}$	0.000768	0.00357	0.00350	0.000200	0.000153
	(0.26)	(1.20)	(1.18)	(0.08)	(0.06)
$Shutdown_{t+6}$	0.00501	0.00595	0.00591	0.000193	0.000557
	(0.85)	(1.37)	(1.18)	(0.06)	(0.16)
Population		0.000289	0.000233	0.000910	0.000817
		(0.29)	(0.24)	(0.62)	(0.54)
Unemployment rate		0.0000665	0.0000743	-0.00333*	-0.00355*
		(0.03)	(0.03)	(-1.92)	(-2.03)
Crime Severity Index		-0.00170	-0.00172	-0.00210**	-0.00204**
		(-1.02)	(-1.03)	(-3.02)	(-2.86)
ln (GDP)		0.0405	0.0400	-0.261	-0.264

		(0.16)	(0.16)	(-1.57)	(-1.60)
Median Age		-0.389***	-0.389***	-0.0786	-0.0665
		(-5.26)	(-5.32)	(-0.45)	(-0.38)
Income per Household		0.00370	0.00390	0.00166	0.00162
		(1.65)	(1.73)	(0.72)	(0.71)
Proportion Bachelor		-0.149	-0.140	0.0824	0.0722
		(-0.80)	(-0.77)	(0.64)	(0.57)
PM25			0.0000179		0.000191
			(0.04)		(0.75)
Constant	12.73***	27.55***	27.56***	17.81**	17.45*
	(556.80)	(5.09)	(5.13)	(2.30)	(2.18)
City FE	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Trend	N	N	N	Y	Y
Observations	370	370	368	370	368

Notes: This table presents the regression estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Panel-robust standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 6. Effect of Shutdown Orders on Sale Price, Model (1)

	(1) Housing Price	(2) Housing Price	(3) Housing Price	(4) Housing Price
Shutdown	0.0386**	0.0556***	0.0455***	0.0445***
	(2.13)	(4.07)	(4.25)	(4.29)
Population		0.00156***	0.000573	0.000544
		(6.73)	(1.14)	(1.15)
Unemployment rate			-0.00123	-0.00186
			(-0.68)	(-0.90)
Crime Severity Index			-0.00325***	-0.00334***
			(-4.68)	(-4.62)
ln (GDP)			0.152	0.126
			(1.41)	(1.06)
Median Age		-0.397***	-0.449***	-0.455***
		(-9.52)	(-11.18)	(-10.86)
Income per Household			0.00280**	0.00345***
			(2.18)	(3.18)
Proportion Bachelor		0.0261	-0.0984	-0.106
		(0.20)	(-0.70)	(-0.73)
PM25				0.000438
				(0.52)
Constant	12.98***	0	0	29.75***
	(717.16)	(.)	(.)	(16.22)
City FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	430	430	430	416

Notes: This table presents the regression of the dynamic model estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Driscoll-Kraay standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. Also, the constant for column 3 was omitted due to a collinearity issue. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 7. Effect of Shutdown Orders on Sale Price Using a Subsample

	(1) Housing Price	(2) Housing Price	(3) Housing Price	(4) Housing Price	(5) Housing Price
Shutdown	0.0455***	0.0445***	0.0417***	0.0435***	0.0436***
	(5.04)	(5.21)	(5.26)	(5.20)	(5.00)
Population	0.000573	0.000544		0.000281	0.000267
	(0.65)	(0.59)		(0.36)	(0.34)
Unemployment rate	-0.00123	-0.00186		-0.000626	-0.000892
	(-0.33)	(-0.50)		(-0.15)	(-0.21)
Crime Severity Index	-0.00325	-0.00334*		-0.00379**	-0.00378**
	(-1.75)	(-1.91)		(-2.31)	(-2.36)
ln (GDP)	0.152	0.126		0.162	0.145
	(0.57)	(0.48)		(0.67)	(0.60)
Median Age	-0.449***	-0.455***		-0.466***	-0.467***
	(-7.65)	(-9.24)		(-10.78)	(-12.18)
Income per Household	0.00280	0.00345		0.00338*	0.00381**
	(1.49)	(1.80)		(2.24)	(2.44)
Proportion Bachelor	-0.0984	-0.106		-0.192	-0.175
	(-0.38)	(-0.43)		(-0.87)	(-0.82)
PM25		0.000438			-0.0000679
		(0.81)			(-0.14)
Constant	28.66***	29.21***	12.74***	29.58***	29.81***
	(5.93)	(6.65)	(488.38)	(7.44)	(7.94)
City FE	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Observations	430	416	405	405	391

Notes: This table presents the regression estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Panel-robust standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 8. Robustness Check, Model (1)

	(1) Shutdown >15	(2) Shutdown >15	(3) Shutdown >5	(4) Shutdown >7	(5) Shutdown >9
Shutdown	0.0386***	0.0445***	0.0378***	0.0426***	0.0448***
	(5.89)	(5.21)	(3.91)	(4.47)	(4.36)
Population		0.000544	0.000604	0.000637	0.000642
		(0.59)	(0.62)	(0.66)	(0.68)
Unemployment rate		-0.00186	-0.00289	-0.00290	-0.00267
		(-0.50)	(-0.82)	(-0.87)	(-0.77)
Crime Severity Index		-0.00334*	-0.00342*	-0.00338*	-0.00332*
		(-1.91)	(-1.95)	(-1.93)	(-1.90)
ln (GDP)		0.126	0.155	0.123	0.119
		(0.48)	(0.56)	(0.46)	(0.45)
Median Age		-0.455***	-0.450***	-0.456***	-0.456***
		(-9.24)	(-8.86)	(-9.14)	(-9.26)
Income per Household		0.00345	0.00335	0.00329	0.00326
		(1.80)	(1.64)	(1.64)	(1.65)
Proportion Bachelor		-0.106	-0.128	-0.124	-0.114
		(-0.43)	(-0.52)	(-0.50)	(-0.46)
PM25		0.000438	0.000453	0.000472	0.000483
		(0.81)	(0.80)	(0.85)	(0.86)
Constant	12.73***	29.21***	28.67***	29.21***	29.25***
	(480.74)	(6.65)	(6.26)	(6.57)	(6.65)
City FE	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Observations	430	416	416	416	416

Notes: This table presents the regression of the dynamic model estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Panel-robust standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Appendix

Table A1. Data Sources

Source	Table name and table number	Variable chosen	Frequency	Downloaded Period	Estimated Period	Calculation details
Statistics Canada	Crime severity index and weighted clearance rates, Canada, Provinces, territories and Census Metropolitan Areas. (35-10-0026-01)	Crime severity Index	Yearly	2011-2021	Estimated 2022 and estimated monthly data.	Average of the last 6 years was used to estimate 2022 Denton method was used to estimate monthly data from 2011 to 2022.
Statistics Canada	Labour force characteristics, three-month moving average, seasonally adjusted. (14-10-0380-01)	Seasonally unadjusted unemployment rate and population	Monthly	2011-2022		

Statistics Canada	Population estimates, July 1, by Census Metropolitan Area and Census Agglomeration. (17-10-0135-01)	Median Age	Yearly	2011-2021	Estimated 2022 and estimated monthly data.	Linear Method to project for 2022. -St-John's, Montréal, Ottawa and Victoria (2011-2021 for projection) -Saint-John (from 2016 to 2021). -Winnipeg (from 2018 to 2021) -Regina (from 2017 to 2021). -Calgary (from 2015 to 2021) -Vancouver (from 2019 to 2021) - Halifax previous year data was used
Real Time Remote Access (Statistics Canada)		Education Level	Monthly	2011-2022		
Conference Board of Canada's E-Data		Gross Domestic Product and Income per household.	Quarterly	2011-2022		Denton method was used to transform the data from quarterly to monthly

Table A2. Particulate Matter Concentrations Stations

City	Active Station	Frequency	Span	Calculation
Victoria	-Victoria Topaz	Daily	January 2011-July 2022	The hourly pollutant concentration monitored daily was used to compute a monthly frequency level.
Vancouver	-Vancouver International Airport - Horseshoe Bay	Daily	January 2011-July 2022	
Regina	Regina	Daily	January 2012-July 2022	
Calgary	-Calgary Central-Inglewood -Calgary Northwest -Calgary Southeast	Hourly	January 2011-July 2022	
Winnipeg	-Winnipeg Ellen St.	Daily	January 2011-July 2022	
Montréal	-Montréal Airport -Anjou -Caserne17 -Echangeur Decarie -Hochelaga-Maison-Neuve	Hourly	January 2011-December 2021	

	-Montréal-Sainte-Anne-De-Bellevue -Rivière-Des-Prairies -Saint-Dominique -Saint Joseph -Saint-Jean-Baptiste -York Roberval			
Ottawa	-Ottawa Downtown	Hourly	January 2011-December 2021	
Saint John	-Saint John – Forest Hills -Saint John – West Side -Saint John – Champlain - Heights -Saint John – Castle Street -Saint John – Saint John Street	Daily	January 2011-July 2022	
St John’s	-St. John’s Mt. Pearl	Daily	January 2012-July 2022	

Halifax	-Halifax Johnston PM	Daily	January 2011- July 2022	

Table A3. Effect of Shutdown Orders on Sale Price, Model (1)

	(1) Housing Price	(2) Housing Price	(3) Housing Price	(4) Housing Price
Shutdown	0.0386***	0.0556***	0.0455***	0.0445***
	(5.81)	(5.87)	(4.77)	(4.89)
Population		0.00156***	0.000573	0.000544
		(3.64)	(0.65)	(0.58)
Unemployment rate			-0.00123	-0.00186
			(-0.37)	(-0.56)
Crime Severity Index			-0.00325	-0.00334*
			(-1.72)	(-1.89)
ln (GDP)			0.152	0.126
			(0.55)	(0.46)
Median Age		-0.397***	-0.449***	-0.455***
		(-8.01)	(-7.49)	(-8.94)
Income per Household			0.00280	0.00345
			(1.49)	(1.80)
Proportion Bachelor		0.0261	-0.0984	-0.106
		(0.10)	(-0.40)	(-0.45)
PM25				0.000438
				(0.77)
Constant	12.73***	27.08***	28.66***	29.21***
	(477.94)	(13.56)	(5.76)	(6.39)
City FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	430	430	430	416

Notes: This table presents the regression estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. Robust standard errors clustered at the province-level reported in parentheses. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table A4. Effect of Shutdown Orders on Sale Price With Trend, Model (2)

	(1) Housing Price	(2) Housing Price
Shutdown	0.0225***	0.0192***
	(4.64)	(5.26)
Population	0.00219***	0.00137
	(2.96)	(1.27)
Unemployment rate	-0.00773***	-0.00725***
	(-2.82)	(-3.48)
Crime Severity Index	-0.00268***	-0.00206***
	(-6.68)	(-5.29)
ln (GDP)	-0.196	-0.206
	(-1.36)	(-1.51)
Median Age	-0.0183	0.0951
	(-0.54)	(1.50)
Income per Household	0.00372***	0.00296*
	(3.38)	(1.97)
Proportion Bachelor	0.0689	0.122
	(0.82)	(1.34)
PM25		0.000393
		(0.79)
Constant	0	0
	(.)	(.)
City FE	Y	Y
Time FE	Y	Y
Trend	Y	Y
Observations	430	416

Notes: This table presents the regression of the dynamic model estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Driscoll-Kraay standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table A5. Effect of Shutdown Orders on Sale Price Using Leads and Lags, Model (3)

	(1) Housing Price	(2) Housing Price	(3) Housing Price	(4) Housing Price
Shutdown	0.0162^{***}	0.0163^{***}	0.0118^{***}	0.0116^{***}
	(2.78)	(2.83)	(2.83)	(2.78)
$Shutdown_{t-1}$	0.0118^{**}	0.0119^{**}	0.00841^{***}	0.00869^{***}
	(2.38)	(2.40)	(2.91)	(3.02)
$Shutdown_{t-2}$	0.00547	0.00559	0.00454	0.00479
	(1.04)	(1.07)	(1.53)	(1.63)
$Shutdown_{t-3}$	0.00575	0.00585	0.00555	0.00548
	(0.84)	(0.89)	(1.28)	(1.34)
$Shutdown_{t-4}$	0.00727	0.00736	0.00551	0.00592
	(1.03)	(1.01)	(0.87)	(0.92)
$Shutdown_{t-5}$	0.00474	0.00486	0.00417	0.00424
	(0.83)	(0.86)	(0.84)	(0.84)
$Shutdown_{t-6}$	-0.00236	-0.00207	-0.00161	-0.00125
	(-0.35)	(-0.31)	(-0.26)	(-0.21)
$Shutdown_{t+1}$	0.0119^{**}	0.0118^{**}	0.00460	0.00501
	(2.46)	(2.59)	(1.32)	(1.58)
$Shutdown_{t+2}$				
	0.0138^{**}	0.0137^{**}	0.00745^{**}	0.00774^{**}
	(2.51)	(2.46)	(2.19)	(2.28)
$Shutdown_{t+3}$				
	0.00891^{*}	0.00889^{*}	0.00519^{*}	0.00520^{*}
	(1.87)	(1.87)	(1.76)	(1.77)
$Shutdown_{t+4}$				
	0.00117	0.00113	0.000174	0.000362
	(0.25)	(0.25)	(0.08)	(0.16)
$Shutdown_{t+5}$				
	0.00350	0.00357	0.000153	0.000200
	(0.80)	(0.82)	(0.06)	(0.08)
$Shutdown_{t+6}$				
	0.00591	0.00595	0.000557	0.000193
	(0.99)	(1.05)	(0.15)	(0.05)
Population	0.000233	0.000289	0.000817	0.000910
	(0.51)	(0.62)	(0.68)	(0.79)
Unemployment rate	0.0000743	0.0000665	-0.00355^{***}	-0.00333^{**}
	(0.03)	(0.03)	(-2.78)	(-2.71)
Crime Severity Index	-0.00172^{***}	-0.00170^{**}	-0.00204^{***}	-0.00210^{***}
	(-2.74)	(-2.71)	(-4.29)	(-4.63)
ln (GDP)	0.0400	0.0405	-0.264^{*}	-0.261^{*}

	(0.28)	(0.29)	(-1.79)	(-1.79)
Median Age	-0.389***	-0.389***	-0.0665	-0.0786
	(-17.34)	(-17.47)	(-0.98)	(-1.31)
Income per Household	0.00390***	0.00370***	0.00162	0.00166
	(3.70)	(3.49)	(1.30)	(1.29)
Proportion Bachelor	-0.140	-0.149	0.0722	0.0824
	(-1.13)	(-1.22)	(0.79)	(0.91)
PM25	0.0000179		0.000191	
	(0.03)		(0.42)	
Constant	0	0	0	0
	(.)	(.)	(.)	(.)
City FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Trend	N	N	Y	Y
Observations	368	370	368	370

Notes: This table presents the regression of the dynamic model estimates using a sample from January 2019 to July 2022. The dependent variable is a benchmark housing price. Shutdown takes a value of 1 if the order is adopted and 0 otherwise. All columns include city and time fixed effects. Driscoll-Kraay standard errors are used. t-statistic is noted in parentheses. Due to many decimal points, I decided to divide the income per household variable by a thousand. ***, ** and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.