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COVID-19 and Housing Prices: Australian Evidence with Daily Hedonic Returns

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\textbf{ABSTRACT}

Using daily hedonic housing price index for five Australian capital cities, we document a negative relationship between prior COVID-19 cases and daily housing returns. Specifically, the daily housing return drops by 0.35 basis points or 1.26 percentage points annually for every doubling of newly confirmed COVID-19 cases in a state. We also examine the effect of government lockdown orders on housing returns and find insignificant results. These findings are robust under alternative pandemic proxies such as total active COVID-19 cases and other model specifications. Overall, our paper contributes to the literature on the geographic spread of pandemics and real estate prices.

1. Introduction

The onset of COVID-19 since early 2020 brought unprecedented changes to many aspects of the economy, including the housing market. Residential real estate is not only one of the major assets for household wealth, but also constitutes a crucial part of a nation’s economy. A sudden drop in housing prices may result in negative equity, which has adverse impacts on the stabilization of the economy. To tackle the COVID-19 pandemic, governments across the world employ various containment policies (see Narayan et al., 2021). The policies usually alleviate the pandemic transmission, however, by reducing economic activities (Atkeson 2020), which might incur even heavier economic loss (Lin and Meissner, 2020). Although the literature on COVID-19 and its economic impact grows at an exponential speed, limited attention has been paid on how COVID-19 affects the real estate markets.

In this study, we examine COVID-19’s effect on housing prices by focusing on two groups of factors: 1) epidemiological factors, including COVID-19 severity measures, such as newly confirmed cases, and total active cases; and 2) policy interventions, including lockdowns, social distancing orders, or relaxations of such containment measures. The general intuition is that COVID-19 sends negative shocks to the consumption and housing related expenditure (see, e.g., Baker et al., 2020), and that both types of factors are expected to affect housing prices negatively. Nevertheless, the significance and magnitude of each factor remain unclear.

Our main findings are that the prevalence of COVID-19 significantly negatively impacts the Australian housing market, while policy interventions are statistically insignificant. Every doubling of newly confirmed COVID-19 cases in a state leads to a fall in returns by 0.35 basis points in daily terms or 1.26 percentage points annually. Moreover, our findings are robust to using various proxies of COVID-19 prevalence and different time lags.

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2. Literature Review

It is predicted that both COVID-19 itself and containment policies will result in huge losses to an economy (see Atkeson, 2020; Eichenbaum, et al., 2020). As COVID-19 spreads across countries, there is a growing literature on the empirical evidence of the pandemic’s impacts in various markets. For example, Ling, Wang, and Zhou (2020) investigate the effects of the pandemic on commercial real estate price in the U.S.; Narayan et al., 2021 analyze different types of lockdown policies on stock market returns in G7 countries; Dave et al. (2020) look into a specific containment policy “shelter-in-place” in the U.S.; Ortmann, Pelster, and Wengerek (2020), focusing on a more micro level, scrutinize the behavioral influences of investors; Lin and Meissner (2020) suggest that the state-level lockdown policy is destructive to the consumption sector with no significant containment effect on the pandemic. Overall, the current literature implies that COVID-19 and containment policies both have strong and significant impacts on various aspects of the economy.

Specifically, our work is more related to the literature on the effects of pandemics on the housing market. Seminal work by Wong (2008) finds that the 2003 SARS outbreak had a clear negative impact on house prices in Hong Kong. In addition, from a historical perspective, Francke and Korevaar (2020) document that both the 17th-century plague in Amsterdam and 19th-century cholera in Paris resulted in significant declines in housing prices. Ling, Wang, and Zhou (2020) investigate COVID-19’s effect on REITs. To the best of our knowledge, we are the first to examine COVID-19 directly on residential housing market at the daily level, which complements existing literature on COVID-19’s impacts.

3. Data and Method

3.1. Data

We use CoreLogic daily capital city hedonic home value indices for five Australian capital cities from the five major states1 (see Appendix A for a map), including Sydney (capital of the state of New South Wales, NSW), Melbourne (capital of Victoria, VIC), Brisbane (capital of Queensland, QLD), Perth (capital of Western Australia, WA) and Adelaide (capital of South Australia, SA). The hedonic regression imputation method (“hedonic method” for short) has long been employed as the preferred indexing method for residential real estate market, in order to partition out idiosyncratic features in determining price change (e.g., Rosen, 1974). The data is provided by Rozetta Institute (formerly SIRCA).

According to CoreLogic (2018), the hedonic indices are constructed in three steps. First, hedonic regressions involving quality attributes such as geographic location are conducted to estimate the effects of certain attributes on housing prices (different groups of attributes for different indices). Second, the value of each property on each day is predicted using the hedonic regression coefficients. Lastly, the corresponding indexed price for the required residential real estate portfolio is calculated as a statistic of its components’ prices.

All hedonic housing price indices of the five capital cities have a baseline value of 100 as at 31/12/2009. The indices offer a comprehensive measure of the housing market situation, as approximately 98% of Australian residential properties are included in CoreLogic database. Unlike other housing prices indices, the index is updated daily to reflect recent housing transactions.2 This allows for more timely and granular analysis of the housing market during the COVID-19 outbreak than other indices that are at monthly frequencies and reported with a lag. For example, the Australian Bureau of Statistics monthly residential price index series releases with a three-month lag.3

For other data sources, COVID-19 cases data (daily confirmed, daily deaths, and daily recovered) of the five Australian states are retrieved from the Johns Hopkins University Coronavirus Research Center (see https://coronavirus.jhu.edu/). We also calculate total active cases and cumulative infected cases based on this data. The sample period for all variables is set between Jan 1, 2020 and July 30, 2020. Although the first COVID-19 case in Australia was reported in NSW on Jan 25, 2020, we start our sample from Jan 1, 2020 as the first reported case of COVID-19 globally was on Dec 31, 2019.4

Table 1 summarizes statistics of the variables we use. In addition, Appendix B reports lockdown and relaxation dates affecting housing markets with corresponding variable names, while Appendix C serves as a glossary of all variables that we use. Specifically, Australia has a nationwide timing of lockdown on March 24, 2020, but different states have different timings of relaxation policies. The state of Victoria is the only state with a second lockdown due to a second wave of infections during our sample period.

Table 1 Panel A reports the summary statistics for the main variables in our analysis. From row 1, the daily hedonic index returns, HPR, has a low daily average value of 0.003% but is highly volatile, with a maximum of 0.305% and a minimum of -0.374%. The second row indicates that Covid also has a high variation, peaking at 694 cases and averaging at 15.042 per day. In contrast, the deaths toll is relatively low for our sample period.

As for correlations, Table 1 Panel B suggests that the three proxies of COVID-19 prevalence are all negatively correlated with HPR. Figure 1 shows the variation of HPR for each capital city in our sample. We observe the housing returns for all five states has already

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1 There are no daily indices for the remaining capital cities for the Australian Capital Territory (Canberra), Northern Territory (Darwin) and Tasmania (Hobart).
2 CoreLogic claims 60% of sales are captured before being communicated to the Valuer General within each state.
3 For example, the March 2020 index series point was released in June 2020.
4 Source: https://www.who.int/news/item/27-04-2020-who-timeline—covid-19
Table 1
Descriptive Statistics
The table reports descriptive statistics for key variables. The sample includes daily hedonic indices for five capital cities in the states of NSW, VIC, QLD, WA and SA in Australia. Price index data is from CoreLogic RP Data via Rozetta Institute (formerly SIRCA). State level COVID cases is from Johns Hopkins University COVID-19 Center GitHub. The sample period is from Jan 1, 2020 to Jul 30, 2020. See Appendix C for description of variables. Panel A reports summary statistics and Panel B reports the correlation matrix of variables.

| Variable | Mean | Std. Dev | Median | Min | P25 | P75 | Max | N   |
|----------|------|----------|--------|-----|-----|-----|-----|-----|
| HPR      | 0.003| 0.050    | 0.006  | -0.374 | -0.023 | 0.030 | 0.305 | 1,060 |
| Covid_{s,1} | 15.042| 54.300   | 0.000  | 0.000 | 0.000 | 6.000 | 694.00 | 1,060 |
| Deaths_{s,1} | 0.164| 0.827    | 0.000  | 0.000 | 0.000 | 0.000 | 13.00  | 1,060 |
| Total_Active_{s,1} | 229.186| 608.560  | 8.000  | 0.000 | 0.000 | 219.000 | 5770.00 | 1,060 |

Panel A: Summary Statistics

| Variable | HPR | Covid_{s,1} | Deaths_{s,1} | Total_Active_{s,1} |
|----------|-----|-------------|--------------|-------------------|
| HPR      | 1.00 | -0.09       | -0.07        | -0.08             |
| Covid_{s,1} | 1.00 | 0.100       | 0.71         | 0.79              |
| Deaths_{s,1} | 1.00 | 0.100       | 0.71         | 0.79              |
| Total_Active_{s,1} | 1.00 | 0.100       | 0.71         | 0.79              |

Panel B: Correlation Matrix for Hedonic Index Regression

started to show a declining trend before the nationwide lockdown. The declining trend is more severe for the two largest states that had the most COVID-19 infections, NSW and VIC, while being least severe for SA that had the least COVID-19 infections. This observation makes the relationship between the lockdown and housing returns unclear.

Figure 2 illustrates the overall relationship between COVID-19 cumulative cases and HPR, along with the shock of the nationwide lockdown. Overall, they have a clear negative trend. In particular, the cumulative cases increase sharply before the nationwide lockdown is implemented, and then plateaus afterwards, before finally taking a second rise. What remains unclear is how significant the negative relationship is, which is to be tested in the main regression of this paper.

3.2. Method

We use the following regression framework to test the effect of COVID-19 on housing price returns:

\[ HPR_{st} = a + \beta_1 Lock_{s,t-1} + \beta_2 Relax_{s,t-1} + \beta_3 VIC\_Lock2 + \beta_4 Log(1 + Covid_{s,t-1}) + \beta_5 Mkt\_HPR_{st} + \gamma_{STATE} + \delta_{s} + \mu_{s,t} + \tau_{s,t} + \epsilon_{st} \]

(1)

Where \( HPR_{st} \) is the daily hedonic index return for city \( s \) on day \( t \), in percentage. \( Lock_{s,t-1} \) is a dummy of 1 during the first period where a city in state \( s \) went into lockdown, zero otherwise. \( Relax_{s,t-1} \) is a dummy of 1 during the period after the relaxation where state \( s \) relaxed lockdown rules, zero otherwise. \( VIC\_Lock2 \) is a dummy of 1 for Melbourne when it went into its second lockdown, zero otherwise. \( Covid_{s,t-1} \) is the daily reported number of COVID-19 cases in state \( s \) on day \( t-1 \). \( Mkt\_HPR_{st} \) is the daily return in percentage of the national 8 city hedonic index. The first summation term controls for spillover effects of COVID-19 from other states. The second summation term accounts for lagged \( HPR_{st} \) for autocorrelation of returns. To select the optimal time lag, we apply auto-regressions on the variable \( HPR_{st} \) for each state, and select the model based on AIC criteria. The optimal time lag is 5, as it has the lowest AIC statistic in the three largest states of Australia — NSW, VIC, and QLD. Refer to Appendix C for detailed definitions of all variables, including the exact periods for \( Lock_{1} \), \( Relax_{1} \) and \( VIC\_Lock2 \). \( \mu_{s,t} \) denotes state fixed effects. \( \tau_{s,t} \) denotes day of week and month fixed effects. For robustness, we also use alternative COVID-19 measures such as the prior day’s deaths, the prior day’s number of active cases (total reported cases less deaths less recovered) and 14-day lagged COVID-19 measures.

4. Empirical Analysis

4.1. Baseline Results

Table 2 reports our regression results estimating the effects of implementation and relaxation of lockdowns, as well as daily local COVID-19 cases, on daily hedonic index returns (HPR). Panel A summarizes the baseline results where 1-day lagged effects are examined, Panel B applies a 14-day lag to the main explanatory variables to accommodate for the possible delay in real estate negotiation and contracting process.

Panel C uses alternative COVID-19 measures Deaths and Total_Active. The overall finding is that lockdown related measures have no significant effect on daily housing returns. On the other hand, lagged increments of daily cases show significant negative effects as expected. In addition, a weak substitution effect is observed, namely, more cases in one state might potentially increase returns in other states’ housing markets.
Daily hedonic index return ($HPR$) is taken to be the dependent variable in all ten regressions of Table 2. For Column 1 of Panel A and B, we look into the plain effects of lockdown related measures, without $Covid$ (the logarithm of local daily new cases with lag). The effects of first lockdown (Lock1), first relaxation (Relax1), and Victoria’s second lockdown (VIC_Lock2) are statistically insignificant. This is still the case even in Columns 2 and 3 for both Panel A and B, where the effects of daily local cases and cross-state spillover effects of cases are controlled for, respectively. Nevertheless, the effects of the average housing market return, $Mkt\_HPR$, is always positive significant.

Column 2 of Panel A reveals significantly negative effects (with a coefficient of -0.005) from daily cases on $HPR$. Specifically, for every doubling of COVID-19 cases, the daily return falls by 0.35 basis points ($\log (2) \cdot 0.005$). The impact is equivalent to a fall of 1.26 percentage points in the annual return on average per doubling of COVID-19 cases in the prior day. Combining with the maximum value of $Covid$ (694 cases) as of July 27, 2020, the corresponding fall in return is 0.03% daily or 11.94% annually. As for the 14-day lagged case (Column 2, Panel B), the pattern is similar, but the corresponding coefficient is of higher significance (at 1% level) and lower magnitude (-0.004).

For spillover effects from other states onto local housing market return, the corresponding regression results are in Column 3 of Panel A and B. The only significant coefficient is that of $Other\_NSW \cdot \log (1 + NSW\_Covid_{t-1})$, with a value 0.002. Namely, every doubling of confirmed cases in New South Wales incurs an increase of 0.13 ($\log (2) \cdot 0.002$) basis points in daily return, or 0.5 percentage points in annually return of other states’ housing market. For 14-day lagged regressions (Panel B), the coefficients are insignificant. In general, more confirmed cases in one state (especially for a large state) induces higher returns in housing markets of other states, consistent with COVID-19 spread from highly infected states to other states.

As a convention in the literature, the number of daily confirmed cases is the most frequently used proxy of COVID-19 prevalence (e.g., Ling et al., 2020). However, there are several alternative COVID-19 measures that are equivalently valid, e.g., the number of daily deaths and total active cases. Panel C summarizes the regression results of the model involving the alternative COVID-19 measures, which might serve as a robustness check. Deaths is negative but statistically insignificant (Column 1 and 2), which might result from the low death toll. On the other hand, Total_Active shows strong negative impacts on housing market return at 1% significance. The coefficients for both lags are -0.007, which implies every doubling of active cases results in 0.49 basis points of fall in return daily, and 1.77 percentage points annually. Since Total_Active is much larger than daily cases in magnitude (with a maximum value of 5770), this result might suggest that COVID-19 has a much greater negative impact on housing market returns than the conventional literature would expect. E.g., plugging in the average value of Total_Active (229.186 cases), the fall in return is 13.88% annually and 0.038% daily. Notwithstanding, the direction of impact is consistent with the model under daily confirmed cases as the measure.
5. Conclusion

The COVID-19 pandemic has caused global economic hardship. Due to its recency, little is known about its effect on residential real estate, the predominant asset held by households, due to lack of frequent and timely housing return data. Our paper overcomes these limitations by employing daily real estate hedonic indices for five Australian capital cities of the major states.

Using daily capital city housing returns and state specific COVID-19 cases and lockdown periods, we find housing returns negatively related to prior day COVID-19 cases and no effect from any policy interventions we consider (both state and national level lockdowns and relaxations). Specifically, for every doubling of newly confirmed COVID-19 cases in the prior day, returns fall by 0.35 basis points daily, or 1.26% annualized. Alternatively, using total active cases as a measure of COVID-19 severity, we find for every doubling of total active COVID-19 cases in the prior day, housing market returns fall by 0.49 basis points daily, or 1.77% annualized.

We find weak evidence of a spillover effect with prior-day cases of COVID-19 in the largest Australian state, NSW being positively related with other capital city housing returns. Every doubling of confirmed cases in New South Wales lead to a rise by 0.13 basis points daily or 0.5% annually in other states’ returns in housing market. Substitution effects might have played a role. Our findings are robust to using a 14-day lagged COVID-19 variables. Future work may look at individual sales price data and the effect of restrictions such as limits on open house inspections.

CRediT authorship contribution statement

Maggie R. Hu: Conceptualization, Methodology, Writing – review & editing, Supervision. Adrian D. Lee: Conceptualization, Data curation, Methodology, Writing – review & editing. Dihan Zou: Methodology, Data curation, Formal analysis, Writing – original draft.

Appendix A. Map of Australia with CoreLogic RP Data Hedonic Capital City Indices
### Table 2
Hedonic Index Regressions

The table reports coefficients based on the following basic regression:

\[
\text{HPR}_{it} = a + \beta_1 \text{Lock}_1 + \beta_2 \text{Relax}_1 + \beta_3 \text{VIC}_2 \text{Lock}_2 + \beta_4 \text{Log}(1 + \text{Covid}_t-1) + \beta_5 \text{Mkt}_i \text{HPR}_t + \sum_{n=1}^{5} \delta_n \text{STATE}_n + \mu_i + \epsilon_{it}
\]

The first summation term controls for spillover effects of COVID-19 from other states. The second summation term accounts for lagged HPR in case of autocorrelation of returns. \(\mu_i\) are state fixed effects. \(\tau_t\) are day of week and month fixed effects. See Appendix C for descriptions of other variables. Price index data is from CoreLogic RP Data via Rozetta Institute (formerly SIRCA). State level COVID-19 cases is from Johns Hopkins University COVID-19 Center GitHub. The sample period is from Jan 1, 2020 to Jul 31, 2020. Panel A reports the baseline model. Panel B reports the baseline model but with 14 day lagged key explanatory variables. Panel C uses alternative COVID-19 measures Deaths and Total_Active. Standard errors are in parentheses. ***, **, * signifies statistical significance at the 1, 5 and 10 percent level, respectively.

#### Panel A: Baseline Regression

| Dependent Var: | (1) HPR | (2) HPR | (3) HPR |
|----------------|---------|---------|---------|
| Lock1          | 0.006   | 0.015   | 0.004   |
| (0.016)        | (0.018) | (0.018) |
| Relax1         | 0.009   | 0.016   | 0.006   |
| (0.017)        | (0.018) | (0.018) |
| VIC_Lock2      | 0.003   | 0.028   | 0.028   |
| (0.017)        | (0.021) | (0.019) |
| Log(1+Covid)   | -0.005**| -0.005* | 0.005*  |
| (0.001)        | (0.002) | (0.007) |
| Mkt_HPR        | 0.826** | 0.832** | 0.824** |
| (0.247)        | (0.244) | (0.242) |
| Other_NSW*Log(1+NSW_Covid) | 0.002* | (0.001) | (0.002) |
| Other_VIC*Log(1+VIC_Covid) | 0.001 | (0.001) | (0.002) |
| Other_QLD*Log(1+QLD_Covid) | 0.003 | (0.002) | (0.003) |
| Other_SA*Log(1+SA_Covid) | -0.001 | (0.001) | (0.003) |
| Other_WA*Log(1+WA_Covid) | 0.002 | (0.002) | (0.003) |
| Constant       | -0.005  | -0.001  | -0.001  |
| (0.006)        | (0.005) | (0.003) |
| HPR (# Lags)   | 5       | 5       | 5       |
| State F.E.     | Yes     | Yes     | Yes     |
| Weekday and Month F.E. | Yes     | Yes     | Yes     |
| Observations   | 1,060   | 1,060   | 1,060   |
| Adj. R-squared | 0.315   | 0.323   | 0.326   |

#### Panel B: 14 Day Lagged Explanatory Variables

| Dependent Var: | (1) HPR | (2) HPR | (3) HPR |
|----------------|---------|---------|---------|
| Lock1_{t-14}  | 0.006   | 0.004   | 0.003   |
| (0.010)        | (0.010) | (0.012) |
| Relax1_{t-14}  | 0.003   | -0.002  | -0.004  |
| (0.015)        | (0.015) | (0.017) |
| VIC_Lock2_{t-14}| -0.010  | 0.002   | 0.007   |
| (0.016)        | (0.014) | (0.015) |
| Log(1+Covid)_{t-14} | -0.004*** | -0.005** |
| (0.001)        | (0.001) | (0.007) |
| Mkt_HPR        | 0.826** | 0.813** | 0.825** |
| (0.252)        | (0.251) | (0.254) |
| Other_NSW*Log(1+NSW_Covid)_{t-14} | 0.001 | (0.001) | (0.002) |
| Other_VIC*Log(1+VIC_Covid)_{t-14} | 0.001 | (0.001) | (0.002) |
| Other_QLD*Log(1+QLD_Covid)_{t-14} | 0.002 | (0.002) | (0.003) |
| Other_SA*Log(1+SA_Covid)_{t-14} | -0.001 | (0.001) | (0.003) |
| Other_WA*Log(1+WA_Covid)_{t-14} | 0.002 | (0.002) | (0.004) |
| Constant       | -0.005  | -0.002  | -0.001  |
| (0.006)        | (0.006) | (0.005) |
| HPR (# Lags)   | 5       | 5       | 5       |

(continued on next page)
The picture depicts the map of Australia with state borders and the CoreLogic RP Data daily capital city hedonic index level and the Australia all dwellings index. Picture is taken from the Australian Securities Exchange website on 26 Aug, 2020. The cities are Sydney (capital of the state of NSW), Melbourne (capital of VIC), Brisbane (capital of QLD), Perth (capital of WA) and Adelaide (capital of SA).

Table 2 (continued)

| Panel B: 14 Day Lagged Explanatory Variables |       |       |       |
|--------------------------------------------|-------|-------|-------|
| Dependent Var:                             | HPR   | HPR   | HPR   |
| State F.E.                                 | Yes   | Yes   | Yes   |
| Weekday and Month F.E.                     | Yes   | Yes   | Yes   |
| State S.E.                                 | Yes   | Yes   | Yes   |
| Observations                               | 1,060 | 1,060 | 1,060 |
| Adj. R-squared                             | 0.316 | 0.321 | 0.322 |

Panel C: Alternative COVID-19 Measures

|                          |       |       |       |       |
|--------------------------|-------|-------|-------|-------|
| Dependent Var:           | HPR   | HPR   | HPR   | HPR   |
| Lock1                    | 0.006 | 0.007 | 0.027 | 0.012 |
| (0.016)                  | (0.010) | (0.019) | (0.011) |
| Relax1                   | 0.009 | 0.003 | 0.023 | -0.000 |
| (0.016)                  | (0.015) | (0.018) | (0.015) |
| VIC_Lock2                | 0.011 | -0.007 | 0.046* | 0.010 |
| (0.015)                  | (0.014) | (0.019) | (0.010) |
| Log(1+Deaths_{t-1})      | -0.006 | (0.007) |
| Log(1+Deaths_{t-14})     | -0.005 | (0.006) |
| Log(1+Total_Active_{t-1})|       | -0.007*** |       | (0.001) |
| Log(1+Total_Active_{t-14})|       |       | -0.007*** | (0.002) |
| Mkt_HPR                  | 0.825** | 0.828** | 0.846** | 0.814** |
| (0.247)                  | (0.251) | (0.242) | (0.247) |
| Constant                 | -0.004 | -0.004 | 0.010 | 0.008 |
| (0.006)                  | (0.006) | (0.007) | (0.009) |
| HPR (# Lags)             | 5     | 5     | 5     | 5     |
| State F.E.               | Yes   | Yes   | Yes   | Yes   |
| Weekday and Month F.E.   | Yes   | Yes   | Yes   | Yes   |
| State S.E.               | Yes   | Yes   | Yes   | Yes   |
| Observations             | 1,060 | 1,060 | 1,060 | 1,060 |
| Adj. R-squared           | 0.315 | 0.315 | 0.340 | 0.333 |
Appendix B. Lockdown and Relaxation Dates Affecting Housing Market and Period Name

| State       | Announcement Date | Start Date       | Period       | Relation to Housing                                                                 |
|-------------|-------------------|------------------|--------------|-------------------------------------------------------------------------------------|
| Australia   | 22/03/2020        | 23/03/2020       | N/A          | Nationwide lockdown begins. Essential travel only. Auctions and private viewings not  |
|             |                   |                  |              | explicitly banned.                                                                    |
| Australia   | 24/03/2020        | 26/03/2020       | Lock1        | Ban of physical auctions and public viewings. Private inspection allowed.             |
| NSW         | 3/05/2020         | 9/05/2020        | Relax1       | Auctions and public viewings allowed.                                                |
| VIC         | 11/05/2020        | 13/05/2020       | Relax1       | Auctions and public viewings allowed, up to 10 attendees.                           |
| VIC         | 24/05/2020        | 1/06/2020        | Relax1       | Auctions and public viewings allowed, up to 20 attendees.                           |
| VIC (Melb)  | 7/07/2020         | 9/07/2020        | VIC_Lock2    | Ban of auctions and public viewings. Private inspection allowed. This ban affected   |
|             |                   |                  |              | the capital city of Melbourne only.                                                 |
| QLD         | 26/04/2020        | 2/05/2020        | Relax1       | Auctions still banned. Public viewings allowed, up to 5 attendees.                  |
| QLD         | 31/05/2020        | 1/06/2020        | Relax1       | Auctions and public viewings allowed, up to 20 attendees.                           |
| WA          | 26/04/2020        | 27/04/2020       | Relax1       | Auctions and public viewings allowed, up to 10 attendees.                           |
| WA          | 10/05/2020        | 18/05/2020       | Relax1       | Auctions and public viewings allowed, up to 20 attendees.                           |
| SA          | 8/05/2020         | 11/05/2020       | Relax1       | Auctions and public viewings allowed, one person per four square metres.             |

Appendix C. List of Variables

| Variable  | Description                                                                 |
|-----------|-----------------------------------------------------------------------------|
| HPR       | Daily hedonic index returns for an individual city, in percentage.          |
| Mkt_HPR   | Daily return in percentage of the national 8 city hedonic index.             |
| Covid     | Daily reported COVID-19 cases in state.                                      |
| WCovid    | Past 5 days’ total daily reported COVID-19 cases.                           |
| Deaths    | Daily reported COVID-19 deaths in state.                                     |
| WDeaths   | Past 5 days’ total daily reported COVID-19 deaths.                          |
| Total_Active | Total reported COVID-19 cases, less total deaths and less total recovered.   |
| Lock1     | Period during first lockdown for each state. Dummy of 1 if date is between  |
|           | the following periods for each state, zero otherwise. NSW: Mar 26, 2020      |
|           | to May 8, 2020. VIC: Mar 26, 2020 to May 12, 2020. QLD: Mar 26, 2020 to May |
|           | 1, 2020. WA: Mar 26, 2020 to Apr 26, 2020. SA: Mar 26, 2020 to May 10, 2020.|
| Relax1    | Period during first relaxation of measures allow for open home/ public       |
|           | inspections. Dummy of 1 if date is between the following periods for each    |
|           | state, zero otherwise. NSW: May 9, 2020 to Jul 30, 2020. VIC: May 13, 2020  |
|           | to Jul 9, 2020. QLD: May 2, 2020 to Jul 30, 2020. WA: Apr 27, 2020 to Jul     |
|           | 30, 2020. SA: May 11, 2020 to Jul 30, 2020.                                |
| VIC_Lock2 | Period during the state of Victoria’s second lockdown where face to face     |
|           | auctions and in person inspections (private and public) were banned. Dummy   |
|           | of 1 for the state of VIC if the date is between Jul 9, 2020 to Jul 30, 2020;|
|           | 0 otherwise.                                                               |
| Other_STATE| Dummy of 1 if the state is not STATE, where STATE is either NSW, VIC, QLD,  |
|           | WA or SA. 0 otherwise.                                                     |
| STATE_Covid | Daily reported COVID-19 cases for STATE, where STATE is either NSW, VIC,    |
|           | QLD, WA or SA. 0 otherwise.                                                |

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