



## *The impact of covid-19 pandemic on the real estate industry*

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### Abstract ;

*This paper studies the impact of the covid-19 pandemic on the real estate market. In order to examine this impact, we will use the event study methodology to examine how the stock prices of real estate companies behaved following the covid-19 outbreak. This can be done by examining the abnormal returns (ARs) and the Cumulative Abnormal Returns (CARs) and the Cumulative Average Abnormal Returns (CAARs). The sample that will be used to conduct the study contains 5 major real estate companies; Segro plc, Land Securities plc, Unite Group plc, British Land Company plc, Derwent London plc. The event window will be 58 days following the outbreak of the covid-19. The findings show negative short term CAARs, in which the CARs of the companies ranged from -0.79% to -4.10%, then followed by a small recovery with the CARs ranging from 2.34% to 3.29%. After that, significant negative CAARs were reported followed by another recovery with the CARs within the range of [-10.35, -21.32%] and [5.99%, 8.12%] respectively. These findings indicate that the covid-19 pandemic had a small short-term negative impact followed by a bigger impact in the next few weeks, then the real estate stock prices stabilise after that returning to he pre-covid levels.*

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### **Introduction:**

The covid-19 pandemic has impacted many industries in a positive or negative manner, and the real estate industry is no exception to that. According to World Health Organisation (WHO) “the corona virus disease infectious disease caused by the SARS-CoV-2 virus”, and this disease can cause mild to moderate respiratory sickness depending on the person, and it can even become a serious illness where the sick person requires medical help. Data from (WHO) shows that by the end of 2020, there were over 2.7 million confirmed cases in the UK, with the weekly increase reaching up a year high with 134k cases weekly, and the death toll went over 77,000 deaths in that time. This disease changed the norms and how the companies operate. In regard to the real estate industry, there are 3 main sectors that are involved with the real estate industry, namely; industrial real estate, commercial real estate, residential real estate. The covid-19 impacted the real estate industry differently depending on the sector. For example, the commercial real estate which includes retail, offices and hospitality properties, have been affected negatively by the pandemic. While the residential and the industrial real estate sectors have been less affected by the pandemic (Hoesli and Malle, 2021). We can see that the commercial side was more heavily influenced due to the changes of the new norms brought by the covid-19, such as working from home which led to the companies not needing the offices anymore. Moreover, social distancing changed how the way retailers had to work,

as they had to adapt to the new consumer behaviour, in which most people switched to online retailers instead of the traditional retailers (Nanda et al., 2021). Having said that, this paper does not focus on either the commercial or industrial real estate, but it focuses on the residential real estate sector and the real estate industry in general.

There were many challenges faced by the real estate industry during the pandemic. According to (Uchegara et al., 2020), the real estate industry faced many problems with their operations because of the stay-at-home policy, among them, the supply chain facing stoppages because of this policy which led to a disruption in the supply chain. In addition, there were delays to the investments that the real estate companies started and could not finish due to the covid-19, and new investments were declining because of the uncertainties brought by the covid-19, resulting in the returns not being achieved and ending up with financial crisis (Uchegara et al., 2020). Moreover, there were liquidity problems in the supply chain and the different departments of the real estate companies, as well as the tenants and the owners. However, the liquidity issues were not the only problem they were facing because of the covid-19. In order to adapt to the new environment, they had to make technological changes to the system in order to ensure the safety of the employees and the clients, as well as making sure they meet the targeted performance they were aiming for (Uchegara et al., 2020). This brings us to the next issue that was brought by the covid-19 changes to the norms, in particular social distancing that was

imposed by the government in order to sustain the safety of the employees, which brought changes to the work environments and increased the operational costs that were incurred by the real estate companies. This includes “the cost of cleaning, redesigning operational workplace, thermal checkpoints” and so on... (Uchegara et al., 2020).

Different studies have looked at how the covid-19 pandemic affected the residential real estate sector. (Tomal, 2021) and (Chu, Lu and Tsang, 2021) found that the covid-19 had a negative impact on the real estate returns. While (D'Lima et al., 2020) showed that the covid-19 impacted the sales of the real estate industry negatively. Furthermore, (D'Lima et al., 2020), (Francke and Korevaar, 2020), (Grybauskas et al., 2021), (Gupta et al., 2021) found that the covid-19 outbreak impacted the house prices as well as the rent prices negatively. Since there are many studies have looked at this topic in various different countries, this paper will have a more focused look at how the covid-19 impacted the residential real estate industry in the UK using the event study methodology, which other papers have not discussed in particular. Finally, the rest of the paper will be structured as following: literature review, methodology, analysis, findings, conclusion.

### ***Literature review and hypothesis development***

The aim from this literature review is to explore the different findings from several articles in the topic related to covid-19 and the real estate industry. Different articles

looked at different aspects of the impact of covid-19 on this sector using different methodologies. Therefore, after obtaining those findings, we can group the ones that are similar in terms of what driving factor for performance of the real estate industry was used. Those factors are regarding the impact of covid 19 on real-estate industry, which are as following; price, stock market, sales, rent, firm's returns and other factors. These factors might not be directly related to the performance of the real estate industry, but they can give us a general indication on the different ways the pandemic affected the real estate sector.

First and foremost, when looking at the literature, most of it focused on the changes of the rent prices. Firstly, one study conducted by (Grybauskas et al., 2021) looked at the impact of covid-19 on the changes of prices of properties in the city of Vilnius and found that there was a significant price response during the Pandemic, which was within 4 months period between May and August, which on average showed a negative price revision of 17.2% in rent and 10.7% in sell activities. Furthermore, the findings indicated that the average price drop in those 4 months was around 7.2% for rent and 4.2% for sell operations, which to some extent meant that the real estate industry was resilient during the pandemic as the drop was not as drastic as expected. Another study showed similar results with a few differences which focused on New York city and San Francisco, a strong price decrease in the rent was observed in the city centre areas and price increase in the suburbs during the pandemic (Gupta et al., 2021). Similarly, evidence from US housing market

indicated that the covid-19 pandemic led to a shift in housing demand from central cities to less populated areas and the suburbs (Liu and Su, 2021).

More evidence regarding the change of rent prices was shown in a study done by (Francke and Korevaar, 2020) which focused on Paris and Amsterdam, found that the rental prices in these two cities declined significantly in the first 6 months following the outbreak, which was around 2% rent price annually. However, this decline was only temporary, and the rent prices recovered afterwards. Furthermore, a study which was based on a survey questionnaire with open-ended answers, which targeted real estate agents, revealed that tenants started to expect lower rents and waited for more attractive and cheaper offers (Marona and Tomal, 2020). The overall conclusion that we can derive from these findings is that if we look at the performance of the industry from the point of view of rent, there was short term impact on the rent prices after the appearance of the covid-19 pandemic that differed in terms of price drop and length of time from a city to another.

House prices was another driver that have been looked at by the literature to identify the impact of the pandemic on the real estate industry. The overall prices of the houses had similar trend with the rent prices. As mentioned previously, in the case with city of Vilnius, there was an average price drop of 4.2% for the sell operations within the period of 4 months, which was less compared to the 7.2% price drop in the rent (Grybauskas et al., 2021). In addition, evidence from Amsterdam and

Paris study found a decline in housing price of about 5% annually following the outbreak and the 6 months after it. However, this price drop is only temporary, and they will recover once the disease was subdued (Francke and Korevaar, 2020). Another study which looked at the impact of covid 19 on the sales of the housing market. A negative relationship between the COVID-19 rate and weekly number of sales was observed, “an extreme increase in the COVID-19 rate from 0% to 1% of the county population is associated with an approximately 2.0% decrease in the frequency of housing sales” (D'Lima et al., 2020). Furthermore, house prices decreased by about 0.5% for each extra bedroom above the average number of bedrooms as a result of shutdowns in the US. On the other hand, houses with fewer bedrooms on average had an increase in price after the shutdown, which suggests that properties with more bedrooms had lower value following the shutdown. In other words, “the average price elasticity of floor area square footage decreases from 0.7% before the shutdowns to approximately 0.67% after the shutdowns in locations where shutdowns were enacted, holding all other characteristics constant.” (D'Lima, Lopez and Pradhan, 2020). These results showed a different perspective, as it did not show that the house prices have decreased following a shutdown, but also which type of houses that were affected negatively and others positively.

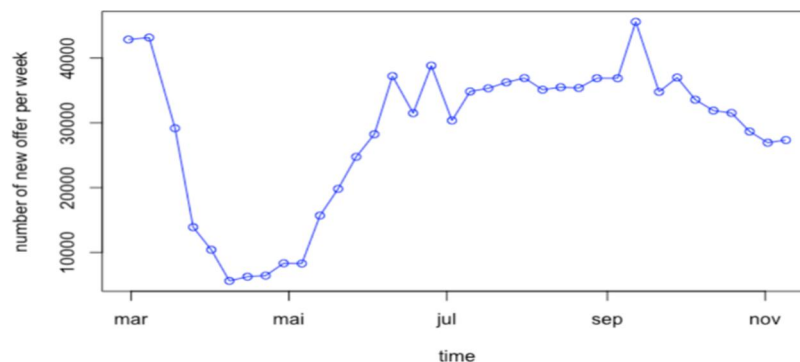
A study of the housing prices in the UK showed similar results to the findings regarding rural areas and city centres that

we looked at previously. It showed that following the lockdown in the UK, mean selling prices started to increase at country level. However, it was decreasing in London, which is the city most affected by the pandemic in the UK and where the housing market is most tense, while on the other hand, the prices were increasing in

rural areas (Bricongne et al., 2021). In addition, this study also looked the changes of the number of offers in the pandemic. It was found that the number of new offers declined by 80% during the first lockdown, which is illustrated in Figure 1 as following:

**Figure 1:** Weekly new offers (Bricongne et al., 2021)

*Source: Zoopla and authors' calculation*



The number of offers indicate whether sellers find it is as the appropriate time to sell their property. From this chart we can notice a significant drop in the number of new offers after the month of March, from above 40,000 offers to under 10,000 offers. However, we also can see a significant recovery after the month of May then it became steadier after that (Bricongne et al., 2021).

The next driver for the impact of covid-19 on the real estate industry is stock market. One study looked at the real estate stock returns during the pandemic at an international level, which revealed that the covid-19 had a negative impact on the stock returns during the first wave of the pandemic in the US, and similar results for Poland and Jordan during their second and third wave. On the other hand, the pandemic had no impact on the real estate stock returns on Australia, Turkey,

Morocco (Tomal, 2021). Lastly, one article looked at the impact of the pandemic on real estate industry focusing on the real estate firm returns, which was conducted on Chinese firms that are listed in the stock market. This study indicated that the covid-19 pandemic had a significant negative impact on the returns of real estate firms in China (Chu, Lu and Tsang, 2021).

Multiple studies took different perspectives and different approaches to assess the impact of covid-19 pandemic on the real estate industry in different countries. As mentioned before, those articles focused on the rent prices, house prices, stock returns, sales, and other qualitative approaches such as survey. This paper will provide a different perspective by firstly focusing on the UK real estate market, and looking at the performance of average aggregate price changes and its relation to the real estate companies' stock prices using a regression.

The other method that will be used would be an event study to see the short impact of the pandemic on the performance of the companies which would be defined as the stock prices.

Although the covid-19 pandemic is the main focus in this paper, it is not the only factor that influenced the performance of the real estate industry, therefore, we will cover the other factors that are not related to the covid-19, but influence the real estate sector. Firstly, A study done by (Delfim and Hoesli, 2016) looked at the impact of macro-economic factors on European non-listed real estate fund returns and found that real GDP growth, inflation, money supply and stock market returns had a positive relationship with the real estate unlisted companies. While unexpected inflation and long-term real interest rates have a negative relationship with real estate fund returns. In addition, there are environmental factors, in which a positive relationship between return on assets (ROA) of real estate firms in the UK and investment in more sustainability was found, which means “greener” companies outperform the others in the stock market (Thompson and Ke, 2012).

There are two types of factors impacting the house prices; macro and micro factors. Micro factors are related to the characteristics of the properties, while macro factors are socio-economic factors (Gok and Keceli, 2015). In terms of macro factors, a direct relationship between higher house prices and higher consumer spending growth was identified. However, both of them are driven by common factors; “reduction in interest rates,

increase in people’s access to credit, and an improvement in income expectations would all tend to boost demand for consumer goods and services, as well as demand for housing.” (Benito et al., 2006). Some other macro factors were studied in the properties in Turkey which revealed that GVA per capital as well as net migration have a positive impact on house prices, in which \$10,000 increase in GVA per capita results in an increase in the house prices of 0.74%, while 100,000 migration inflow to a region increase the house prices by 0.85% (Gok and Keceli, 2015). In terms if micro factors (factors related to the properties) “water system, pool, type of house, number of rooms, house size, locational characteristic and type of the building are the most significant variables that affect the house prices” (Selim, 2009). Other evidence from Hong Kong showed that accessibility to transports is a significant determinant of the house prices, in which the accessibility to minibuses emerges as the most influential in determining house prices. Other factors include higher level floors and presence of a park is viewed as higher quality, which means higher prices. Also, having sports facilities and shopping centres in the area, plays a significant role in influencing the house prices (So et al., 1997).

| <b>Author(s) (year)</b>      | <b>Factors</b>                 | <b>Findings</b>                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (Bricongne et al., 2021)     | House prices, number of offers | <ul style="list-style-type: none"> <li>Following the lockdown, there was a decline in the number of offers by 80%.</li> </ul> <p>The mean selling price started to increase at country-level. While it declined in London.</p>                                                                                                                                                                             |
| (Chu, Lu and Tsang, 2021)    | Firm returns                   | The firm returns of the real estate companies in China were negatively influenced by the covid-19 pandemic.                                                                                                                                                                                                                                                                                                |
| (D'Lima et al., 2020)        | Sales, prices                  | <ul style="list-style-type: none"> <li>Negative relationship was identified between the weekly sales and the number of covid-19 cases.</li> </ul> <p>Following a shutdown, the house prices in the US declined by 0.5% for each bedroom above the average number of bedrooms.</p>                                                                                                                          |
| (Francke and Korevaar, 2020) | House prices, rental prices    | Evidence from Paris and Amsterdam show that house prices and rental prices declined in the first six months of the pandemic with a 5% and 2% decrease in house prices and rental prices respectively. However, there was a recovery in both house prices and rental prices once the disease was subdued.                                                                                                   |
| (Gounopoulos et al., 2018)   | House price, stock market      | Evidence from Greece show a positive bidirectional long-term relationship between stock prices and house prices, in which 1% change in house prices results in a change of 0.59% in stock prices.                                                                                                                                                                                                          |
| (Grybauskas et al., 2021)    | House prices                   | <ul style="list-style-type: none"> <li>During the pandemic, “within 4 months period from May to August, only 17.2% and 10.7% of listings, on average, displayed a negative price revision in rent and sell activities”, which means majority of the properties were intact.</li> </ul> <p>A four-month average price drop was observed of -7.20% and -4.2% for rent and sell operations, respectively.</p> |
| (Gupta et al., 2021)         | House prices, rental prices    | A decrease in rent and house prices was observed in urban areas, while an increase in suburbs in the pandemic.                                                                                                                                                                                                                                                                                             |
| (Liu and Su, 2021)           | Housing demand                 | During the pandemic, a strong shift in housing demand from central cities to suburbs.                                                                                                                                                                                                                                                                                                                      |
| (Tomal, 2021)                | Real estate Stock returns      | <ul style="list-style-type: none"> <li>During the pandemic, there was a negative impact on the real estate stock returns in the US on the first</li> </ul>                                                                                                                                                                                                                                                 |

|                           |               |                                                                                                                                                                                                                                                                                                           |
|---------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           |               | <p>wave, while Poland and Jordan in the second and third wave respectively.</p> <p>The pandemic did not have any negative impact on the stock returns in Australia, Turkey, Morocco.</p>                                                                                                                  |
| (Benito et al., 2006)     | Macro factors | Reduction in interest rates, increase in people's access to credit, consumer spending have a positive impact on house demand.                                                                                                                                                                             |
| (Delfim and Hoesli, 2016) | Macro factors | GDP growth, inflation, money supply and stock market returns are positively linked to non-listed real estate companies performance.                                                                                                                                                                       |
| (Gok and Keceli, 2015)    | Macro factors | <ul style="list-style-type: none"> <li>\$10,000 increase in GVA per capita results in an increase in the house prices of 0.74%.</li> </ul> <p>Net migration coefficient indicates that 100,000 migration inflow to a region increase the house prices by 0.85%.</p>                                       |
| (Selim, 2009)             | Micro factors | "Water system, pool, type of house, number of rooms, house size, locational characteristic and type of the building are the most significant variables that affect the house prices"                                                                                                                      |
| (So et al., 1997)         | Micro factors | <ul style="list-style-type: none"> <li>Accessibility to transport such as; minibus, is an influential factor determinant of house prices.</li> </ul> <p>Higher level floors, presence of park, shopping mall, sports facilities are considered as attributes that affect the house prices positively.</p> |
| (Thompson and Ke, 2012)   | Macro factors | Real estate companies with more greener investments tend to outperform the other competitors.                                                                                                                                                                                                             |

### ***hypothesis development***

To answer our research question in relation to the impact of covid-19 on real estate industry performance, we would need to first set a few objectives to work towards, and hypothesis to test. Therefore, based on the literature that we studied we can come up with a few theories. Firstly, from the literature we saw a general trend of prices dropping during the pandemic as mentioned by (Grybauskas et al., 2021),

(Bricongne et al., 2021), (D'Lima et al., 2020), (Gupta et al., 2021), (Francke and Korevaar, 2020), while opposite effect was also observed in rural areas where the prices increased as illustrated by (Bricongne et al., 2021), (Gupta et al., 2021), (Liu and Su, 2021). In addition, one study investigated the relationship between house prices and the prices of stock market in Greece, in which the existence of a bidirectional long-run causal relationship

was identified between the two variables, where a 1% change of house prices leads stock prices to change by nearly 0.59% (Gounopoulos et al., 2018). Based on these findings we can come up with the following hypothesis:

H1. There is a positive relationship between average aggregate house prices and the real estate share prices.

Looking at the performance of the real estate industry from the perspective of stock returns, we can see that from the literature that the pandemic had a negative impact on the real estate stock returns in the US, Jordan, and Poland as highlighted by (Tomal, 2021), and in China (Chu, Lu and Tsang, 2021), while we did not get any effect of the pandemic on the real estate stock market in Australia, Turkey, Morocco (Tomal, 2021). Therefore, based on these findings we will see whether the pandemic had any impact on the real estate stock market in the UK, hence, we come up with the following hypothesis:

H2. The real estate stock market will induce negative abnormal returns following the outbreak of covid 19.

## Methodology

### Event Study

In order to reflect the impact of the covid-19 pandemic on the real estate market, the event study approach, which was

introduced by (Dodd and Warner 1983) and (Brown and Warner, 1985), will be conducted in order to examine the impact of this event on the event time. "The event study methodology is used to examine the relationship between the performance of the stock market and the occurrence of corporate events such as mergers and acquisitions, splits, stock dividends, bonus shares" (Singh et al., 2020).

### Event date:

As for the event date, a study done by (Singh et al., 2020) that looked at the impact of the covid-19 on the stock market in the G-20 countries using the event study methodology picked the 20<sup>th</sup> of January 2020 as the event date. The reasoning behind that is that there was an outbreak of the news in the Chinese media about the covid-19. Also, in this date an interview with Zhong Nanshan (expert group leader of National Health and Fitness Commission (NHFC), China) proposed that the covid-19 could be transmitted among people (Singh et al., 2020), and after this interview the news travelled through the world and made it to the headlines of each newspaper of many countries around the world (Singh et al., 2020). Therefore, the 20<sup>th</sup> of January 2020 is considered as the date in which the

covid-19 made a major appearance in the media.

### **Event and Estimation Window**

Since the study that will be conducted on the impact of covid-19 on the real estate performance is very similar to that of study of the impact of covid-19 on the stock markets in the G-20 countries, a similar approach to this study will be taken. Therefore, the event window that will be used in this study will be similar to that of (Singh et al., 2020). The event window will be 58 days including the event date and 57 days after the announcement of the information regarding the covid-19 being a transmittable disease, and the reasoning behind choosing this event window is that the impact of covid-19 is longer compared to that of other corporate events (Singh et al., 2020). Furthermore, this event window of (0-57) will be divided into 6 phases, which are as following: (0–9), (10–20),

(21–30), (31–40), (41–50), and (51–57).

The reasoning behind this is that the pandemic behaves differently in different phases (Singh et al., 2020). Therefore, the study will be conducted on these 6 phases separately.

In terms of the estimation window, we will use the same one as (Singh et al., 2020), which used an estimation window of 150 days. This means that we will start from day -150 until day -1, the day before the announcement. Figure 1 summarises the timeline of the event study:

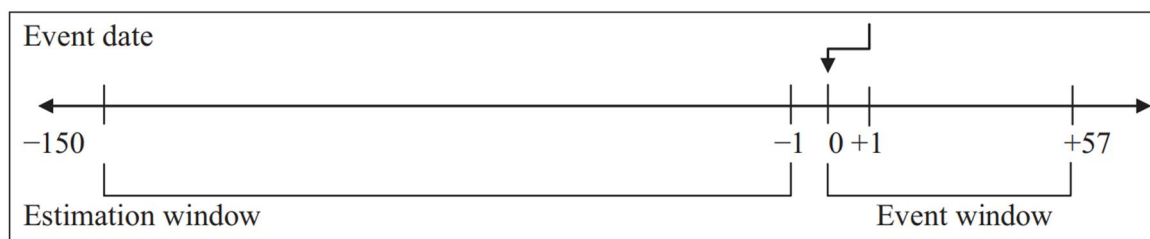


**Figure 1:** Timeline for Event Study (in days)

**Source:** (Singh et al., 2020)

### **Data Collection and Sampling:**

In order to conduct an event study, we firstly need to collect the relevant data we

need. In terms of our sample, since we will be conducting an analysis on the impact of covid-19 on real estate industry, we will

pick the 5 biggest companies in the real estate sector by market cap, and the reason behind picking the biggest companies is to get as much coverage of the real estate sector as possible. Therefore, based on data from Statista we will select the 5 top companies in real estate sector that are based in the UK as shown in the Figure 2. Hong Kong Land Holdings LD will not be included in the sample because they are based in Hong Kong instead of the UK. Therefore, the sample will include the following companies: Segro PLC (15.53b market cap), Land Securities Group plc (LAND.L) (5.97b market cap), The Unite Group plc (UTG.L) (4.20b market cap), British Land Company Plc (BLND.L) (5.12B market cap), Derwent London Plc (DLN.L) (3.63b market cap). The market caps stated along with the company name are the updated market caps that were obtained from Yahoo Finance.

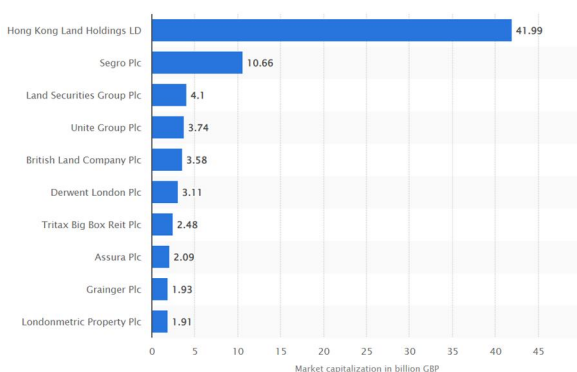


**Figure 2:** Biggest real estate companies in the UK by market cap

### Source:

<https://www.statista.com/statistics/895256/real-estate-companies-on-lse-market-capitalization/>

### The companies' financial position

As mentioned previously, all of the companies are based in the UK, and they operate in the real estate sector. Segro plc showed resilience despite the hard times of the covid-19 in 2020. From the annual report of Segro plc in 2020, they had profit after tax of £1,429.1m, and if we compare to 2019 which was £860.6m, we can see that Segro plc was in a strong financial position as they performed better than the previous year. As for Land securities group plc, from their annual report of 2020, we find that they made a loss of £837m which was much higher loss compared to 2019 which was a loss of £123m. In terms of The Unite Group plc, we can see from their annual report of 2020 that they made a loss of £122.2m which also was higher compared to 2019 which was a loss of £87.6m. British Land company also did not perform well in 2020, from the annual report we find that they made a loss of £1,114m in 2020, and a loss of £320m in 2019. Derwent London plc was also one of the companies who made a loss in 2020, from the income statement of Derwent London plc we find that they made a loss

of £81.4m. However, unlike the other 3 companies who made losses, Derwent London plc made a profit of £278.1m in 2019. From the income statements of the companies, we can see that most of the companies did not perform financially well during the covid-19 outbreak.

Now that we have decided on the sample of the companies that will be used for the event study, we will need to collect data regarding those companies. The data that will be needed in order to conduct an event study are the historical share prices of those companies. The daily historical share prices will be obtained from Yahoo Finance, and they will be from the date of 17/06/2019 until 08/04/2020, which covers the whole period from -150 to +57 and the event date as well.

### **Estimation Model**

All of the equations below are based on a study done by (Singh et al., 2020) which used the event study as the methodology. The first step in calculating the event study is calculating the daily returns from the share prices using the following formula:

$$R_{i,t} = \frac{P_{i,t}}{P_{i,t-1}} - 1$$

Where  $R_{i,t}$  is the daily return of company  $i$  in day  $t$ , and  $P_{i,t}$  is the share price of the company  $i$  at time  $t$ . and  $P_{i,t-1}$  is the share price of the company  $i$  at day  $t-1$  (the

previous day). Using this formula, we will get the daily returns from the period -150 to +57.

After getting the daily returns, the next step would be to calculate the expected mean return, in which we will use the market model, meaning that we will use the focal firm's individual CAPM, which is obtained through multiplying the market return with the firm's individual  $\beta$ .

$$R_{it} = \alpha_i + \beta_i \cdot R_{mt} + \varepsilon_{it}$$

In terms of the reference market, we will be using FTSE 100 index, as this index is based in the UK.

Once we have obtained both of the expected mean returns from the period (-150 to -1), and the daily returns in the period (-150 to +57) then we can calculate the abnormal returns as shown in the following equation:

$$AR_{i,t} = R_{i,t} - \bar{R}_t$$

Where  $AR_{i,t}$  are the abnormal returns for company  $i$  at day  $t$ .

The next step in the calculation would be calculating cumulative abnormal returns (CAR) for the company  $i$  over the window from  $t_0$  to  $t_1$  using the following equation:

$$CAR_i(t_0, t_1) = \sum_{t=t_0}^{t_1} AR_{i,t}$$

Next is calculating average abnormal returns (AAR), which is the arithmetic

average of ARs for the 5 companies over the period (-150 to +57)

$$AAR_t = \frac{1}{N} \sum_{i=1}^N AR_{i,t}$$

Where N is the number of companies, which in this case is 5.

Then based on this  $AAR_t$ , we can calculate cumulative average abnormal returns (CAARs), which is the aggregate of daily AARs for the event window  $(t_0, t_1)$ , which is calculated using the following equation:

$$CAAR(t_0, t_1) = \sum_{t=t_0}^{t_1} AAR_t$$

The standard deviation is calculated using the AARs in the period (-150 to -1), as shown in the following equation:

$$\sigma(AAR_t) = \sqrt{\sum_{-150}^{-1} (\overline{AR} - \overline{\overline{AR}})^2 / 150}$$

In terms of the significance of the coefficient of AAR on event day t and CAAR for a particular event window, we will use t-statistics as shown in the following 2 equations:

$$t \text{ Test}_{AAR} = AAR / \sigma(AAR_t)$$

$$t \text{ Test}_{CAAR} = \sqrt{\frac{CAAR(t_2 - t_1 + 1)}{\sigma(AAR_t)}}$$

## Data Analysis

### Mean returns of the companies

In regard to the data of the 5 companies of our sample, Table 1 shows the companies' mean returns as well as the standard deviation both in percentage. In part A, it shows the companies' returns mean and standard deviation prior to the event period, i.e. (-150, -1), while in part B, it shows during the event period, i.e. (0, 57).

From the table we can see that all the 5 companies yield a positive average return before the event period, ranging from 0.08% to 0.20%, while the standard deviation ranges from 1.14% to 1.66% across the 5 companies. After the covid-19 outbreak, we can see that the mean returns of the companies became negative ranging from -0.13% to 0.71%, and the standard deviation almost increased threefold, and the range increased to (from 3.12%, to 4.38%). These results suggest that the pandemic had a negative impact on the stock prices of the 5 companies and led to higher stock volatility.

**Table 1**

Part A: Pre-event period from 18/06/2019 to 17/01/2020. (-150, -1)

|                            | SEGRO | Land.L | UTG.L | BLND.L | DLN.L |
|----------------------------|-------|--------|-------|--------|-------|
| No. of trading days        | 150   | 150    | 150   | 150    | 150   |
| Company Returns' mean      | 0.15% | 0.11%  | 0.20% | 0.08%  | 0.19% |
| Company Returns' Std. Dev. | 1.14% | 1.59%  | 1.16% | 1.66%  | 1.36% |

Part B: During the event period from 20/10/2020 to 08/04/2020, (0, 57)

|                            | SEGRO  | Land.L | UTG.L  | BLND.L | DLN.L  |
|----------------------------|--------|--------|--------|--------|--------|
| No. of trading days        | 58     | 58     | 58     | 58     | 58     |
| Company Returns' mean      | -0.13% | -0.71% | -0.64% | -0.66% | -0.31% |
| Company Returns' Std. Dev. | 3.12%  | 3.19%  | 4.38%  | 3.62%  | 3.27%  |

Source: The author.

### Abnormal returns of the companies

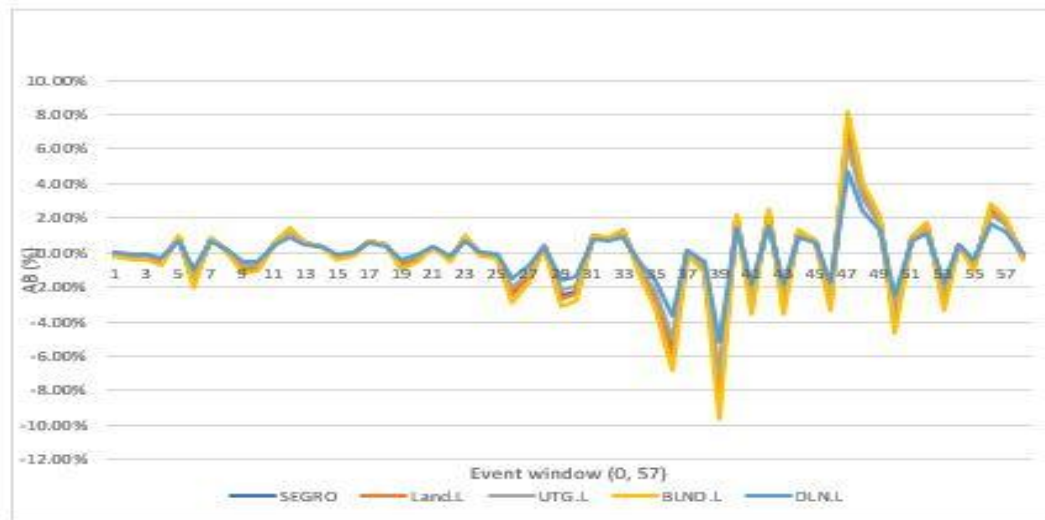
In order to see the impact of the covid-19 outbreak in the event day, Table 2 provides information about the abnormal returns on  $t_0$  (the event day), and  $t_1$  (the day after the event day). We can see that on  $t_0$  4 out of the 5 companies reported negative abnormal returns, showing that the covid-19 had a negative impact on the performance of the real estate companies as the news regarding the covid-19 started spreading in the media. On the day after the event day  $t_1$ , all the 5 companies reported negative abnormal. Although we can see that the covid-19 had a negative impact in the short-term, it is not by any means a significant impact if we make a comparison between the abnormal returns on these 2 days with the average abnormal returns of the period (-150, -1). The  $t_0$  abnormal

returns ranged from 0.03% to -0.22% and for  $t_1$  ranging from -0.09% to -0.43%, while we can see that the average abnormal returns of the period (-150, -1) ranged from 0.08% to 0.20%. Although the  $t_0$  and  $t_1$  abnormal returns are negative, while the average ABs of (-150, -1) are positive, there is not a big difference between them as they are all close to 0. We can even see that in the case of the British Land Company Plc (BLND.L), the abnormal returns of  $t_0$  (0.03%) were positive, meaning that the impact of the covid-19 on  $t_0$  and  $t_1$  were very insignificant.

**Table 2:** Abnormal returns on  $t_0$  and  $t_1$ 

| Abnormal Returns (%) |        |        |                           |
|----------------------|--------|--------|---------------------------|
|                      | $t_0$  | $t_1$  | Average ARs in (-150, -1) |
| SEGRO                | -0.09% | -0.26% | 0.15%                     |
| Landi.L              | -0.15% | -0.33% | 0.11%                     |
| UTG.L                | -0.02% | -0.18% | 0.20%                     |
| BLND.L               | -0.22% | -0.43% | 0.08%                     |
| DLN.L                | 0.03%  | -0.09% | 0.19%                     |

Source: The author

Notes:  $t_0$  = abnormal returns on event day (Day 0);  $t_1$  = abnormal returns day after the event Day (Day 1)**Figure 3:** Abnormal returns of the companies in the event window (0, 57)

Now that we have looked at the abnormal returns in  $t_0$  and  $t_1$ , we can also look at the abnormal returns in the rest of the event window (0, 57). Figure 3 illustrates the abnormal returns of the companies over the event window (0, 57). We can see from figure 3 that at the beginning of the event window, the volatility of the abnormal returns was small across the 5 real estate companies, indicating that in the short term, the covid-19 outbreak did not have a major impact yet, as the abnormal returns were generally within the window of [-2%,

+2%] from day 0 to day 27. At day 28, the first abnormal return under -5% was recorded in the event window in UTG.L plc, which stood at -5.63%, whereas for the other companies they remained within [-2%, +2%] window until day 26, where the volatility started to slightly increase as the abnormal returns of the companies went beyond the [-2%, +2%] window. From day 35 onwards, we can see that the volatility increases across the 5 companies, with DLND.L plc showing the highest volatility which reached a record low of -9.65%

abnormal returns in day 39, and peaked after that in day 47 with abnormal returns of 8.12%. This illustrates the covid-19 outbreak impact on the performance of the 5 real estate company, by increasing the volatility and the uncertainty in the market, and we also note that the impact was not clearly seen at the beginning until 33 trading days passed where the impact started showing signs in the stock market.

### **Cumulative Abnormal Returns (CARs) of the companies**

In the following sections we will discuss the cumulative abnormal returns (CARs) in the 6 phases of the event window as mentioned previously: (0-9), (10-20), (21-30), (31-40), (41-50), (51-57). In the series of tables 3-8, they provide information about the CARs in the event window which, as discussed previously, will be the aggregate abnormal returns in that event window. Then we have the standard deviation for the window, which is the standard deviation of the abnormal returns of the company but adjusted for the event window using the formula of:  $\text{Stdev} * \text{SQRT}(\text{Number of days in the event window})$ . For example, the event window (0-9) has 10 trading days, so we adjust the standard deviation using the following formula:  $\text{Stdev} * \text{SQRT}(10)$ .

We use the standard deviation of the window in order to calculate the t-test, and the results are shown in the tables. We use the t-test in order to test for the significance of the CARs, and to do that we need to use the t-statistics table, and by using the degrees of freedom, we can compare the value in the table to the CARs t-test value. If the CARs t-test absolute value is bigger than that of the t-statistics table in the relevant degrees of freedom, we can conclude that it is significant.

Cumulative Abnormal Returns in the event window (0-9)

In the previous section, we analysed the abnormal returns throughout the full event window and seen how the covid-19 outbreak had a minor impact at the beginning and bigger impact halfway through the event window. We can see those varied impacts in greater details on each phase of the event window. Starting with the first phase (0-9), we can see from Table 3 that all the 5 companies had negative CARs due to the breaking news that was brought by the media regarding the covid-19. The level of the impact varied from one company to another, with DLN.L plc showing the smallest negative impact among the 5 companies, with a CAR of -0.79%, and BLND.L plc showing the highest negative impact with CAR of -

4.10%. In addition, one thing that should be noted in this period is that all the 5 companies' CARs were not significant at

10% or lower except for BLND.L which was significant at 10%.

Table 3: CAR in the event window (0-9)

| Company | CAR (0-9) | Stddev for the window | t-test |
|---------|-----------|-----------------------|--------|
| SEGRO   | -2.50%    | 1.76%                 | -1.418 |
| Land.L  | -3.11%    | 1.85%                 | -1.678 |
| UTG.L   | -1.65%    | 1.58%                 | -1.045 |
| BLND.L  | -4.10%*   | 2.12%                 | -1.933 |
| DLN.L   | -0.79%    | 1.18%                 | -0.672 |

Source: The author.

Notes: CAR is significant at: \*p < 0.10; \*\* p < 0.05; \*\*\*p < 0.01.

#### Cumulative Abnormal Returns in the event window (10-20)

In the second phase (10-20) of the full event window (0-57), we can see from Table 4 that the second phase had the opposite effect of the first phase. All the 5 companies had a recovery in terms of the CARs, with all of them reporting positive

CARs ranging from 2.34% to 3.29%. In addition, we also note that in this period, DLN.L plc CAR (10-20) was significant at 5% which had the value of 2.93%, while UTG.L plc CAR (10-20) was significant at 10%, reporting a value of 3.29%.

Table 4: CAR in the event window (10-20)

| Company | CAR (10-20) | Stddev for the window | t-test |
|---------|-------------|-----------------------|--------|
| SEGRO   | 2.94%       | 1.85%                 | 1.593  |
| Land.L  | 2.57%       | 1.94%                 | 1.319  |
| UTG.L   | 3.29%*      | 1.66%                 | 1.983  |
| BLND.L  | 2.34%       | 2.22%                 | 1.053  |
| DLN.L   | 2.93%**     | 1.23%                 | 2.375  |

Source: The author.

Notes: CAR is significant at: \*p < 0.10; \*\* p < 0.05; \*\*\*p < 0.01.

#### Cumulative Abnormal Returns in the event window (21-30)

Table 5 shows the CARs of the 5 companies in the third phase (21-30). All of the 5 companies reported negative CARs, and compared to the first phase which also had negative CARs, this phase the impact

is even bigger, as the range of the CARs in phase 3 is from -3.62% to -9.20%, as compared to the one from the first phase which was from -0.71% to -6.48%, which means that this phase is the one where the

covid-19 impact shows strong impact. Also, in this phase, the CARs of all the companies are significant at different levels. With the CARs of DLN.L plc being significant at p-value of 5%, and

reporting the lowest negative impact, with a CAR of -3.62%. While the other companies' CARs were significant at p-value of 1%.

**Table 5: CAR in the event window (21-30)**

| Company | CAR (21-30) | Stddev for the window | t-test |
|---------|-------------|-----------------------|--------|
| SEGRO   | -6.74%***   | 1.76%                 | -3.824 |
| Land.L  | -7.57%***   | 1.85%                 | -4.085 |
| UTG.L   | -5.45%***   | 1.58%                 | -3.452 |
| BLND.L  | -9.20%***   | 2.12%                 | -4.340 |
| DLN.L   | -3.62%**    | 1.18%                 | -3.078 |

Source: The author.

Notes: CAR is significant at: \*p < 0.10; \*\* p < 0.05; \*\*\*p < 0.01.

Cumulative Abnormal Returns in the event window (31-40)

Table 6 shows the CARS for the 5 companies in the event window of (31-40), we can see that all of the 5 companies reported negative CARs that were all significant at 0.1%. In addition, if we compare the CARs of this phase (31-40), to the CARs of the previous phase (21-30),

we can see that the CARs(31-40) are even more negative ranging from -10.35% to -21.32% as compared to CAR(21-30) which ranged from -3.62% to -9.20%. This indicated that the covid-19 pandemic impact extends to this window with even stronger negative impact, and it is also where the negative impact peaks.

Table 6: CAR in the event window (31-40)

| Company | CAR (31-40) | Stddev for the window | t-test  |
|---------|-------------|-----------------------|---------|
| SEGRO   | -16.81%**** | 1.76%                 | -9.543  |
| Land.L  | -18.18%**** | 1.85%                 | -9.804  |
| UTG.L   | -14.49%**** | 1.58%                 | -9.170  |
| BLND.L  | -21.32%**** | 2.12%                 | -10.058 |
| DLN.L   | -10.35%**** | 1.18%                 | -8.797  |

Source: The author.

Notes: CAR is significant at: \*p &lt; 0.10; \*\* p &lt; 0.05; \*\*\*p &lt; 0.01; \*\*\*\*p &lt; 0.001.

Cumulative Abnormal Returns in the event window (41-50)

Cumulative Abnormal Returns in the event window (41-50)

Table 7 shows the CARs for the 5 companies in the event window (41-50). In this phase, all of the 5 companies report positive CARs that are all significant at 1%, except for DLN.L plc which was significant at 0.1%. This means that all of the 5 companies made a recovery after the

big negative impact that was seen in the previous phase. Furthermore, according to (Singh et al., 2020) in this period the governments and other international bodies intervened in this period to offset the negative impact of the covid-19 pandemic. Therefore, this could explain the sudden recovery of these firms and obtaining positive CARs.

Table 7: CAR in the event window (41-50)

| Company | CAR (41-50) | Stddev for the window | t-test |
|---------|-------------|-----------------------|--------|
| SEGRO   | 7.66%***    | 1.76%                 | 4.348  |
| Land.L  | 7.58%***    | 1.85%                 | 4.087  |
| UTG.L   | 7.46%***    | 1.58%                 | 4.720  |
| BLND.L  | 8.12%***    | 2.12%                 | 3.833  |
| DLN.L   | 5.99%****   | 1.18%                 | 5.094  |

Source: The author.

Notes: CAR is significant at: \*p &lt; 0.10; \*\* p &lt; 0.05; \*\*\*p &lt; 0.01.

Cumulative Abnormal Returns in the event window (51-57)

Table 8 shows the CARs of the 5 firms in the event window (51-57). In this phase, all the 5 companies reported positive CARs, and only DLN.L and UTG.L had CARs that were significant at 10%. We can see

that the CARs decreased as compared to the previous period but remained positive. This suggests that the situation started to stabilize thanks to the intervention that was done in the previous period.

**Table 8:** CAR in the event window (51-57)

| Company | CAR (51-57) | Stdev for the window | t-test |
|---------|-------------|----------------------|--------|
| SEGRO   | 2.55%       | 1.47%                | 1.728  |
| Land.L  | 2.34%       | 1.55%                | 1.510  |
| UTG.L   | 2.70%*      | 1.32%                | 2.040  |
| BLND.L  | 2.30%       | 1.77%                | 1.297  |
| DLN.L   | 2.32%*      | 0.98%                | 2.352  |

**Source:** The author.

**Notes:** CAR is significant at: \* $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ .

Cumulative Abnormal Returns in the event window (0-57)

Figure 4 shows the CARs throughout the whole event window from day 0 to day 57.

From this graph we can see that the CARs of all the companies had very similar trend.

A small short-term negative impact on the CARs followed by a recovery from day 10 to day 24. After that a decrease of the CARs across the 5 companies until day 44 where it starts recovering again.

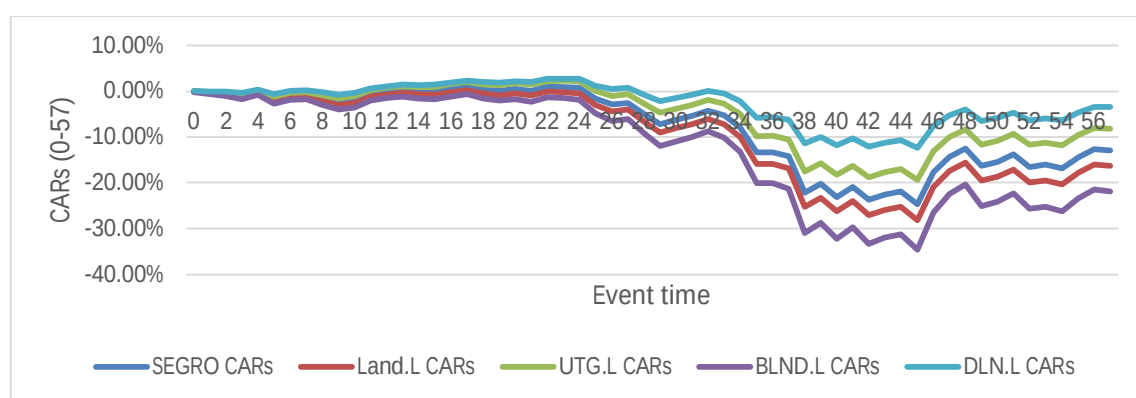


**Figure 4:** CARs of the companies in the event window (0-57)

### Cumulative Average Abnormal Returns (CAARs)

In this section we will analysis the CAARs in the event period, which is similar to the average CARs of the 5 companies (ACAR). Table 9 presents the CAARs in the 6 phases of the event window. What the table shows is a summary of our previous findings from the CARs in the event windows. We note a small short-term negative impact in CAAR (0-9) of -2.43%,

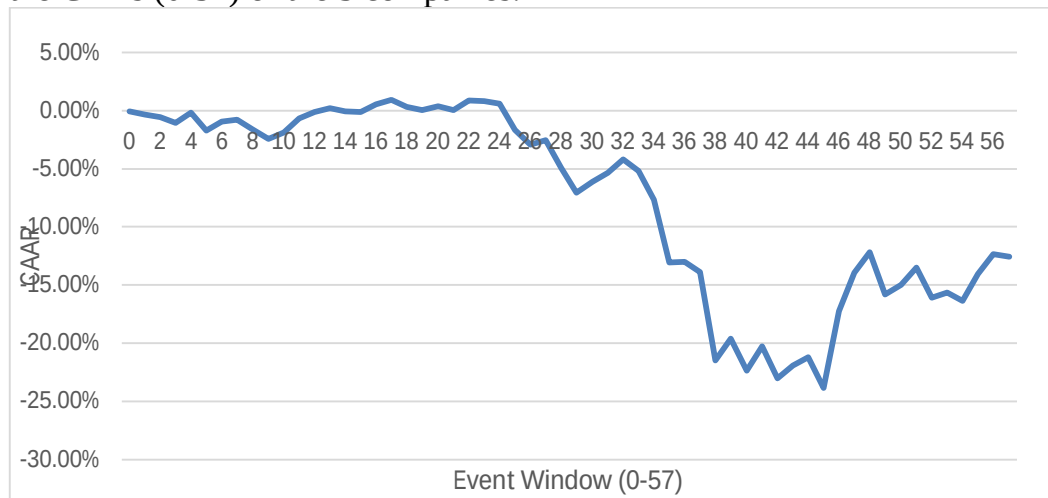
followed by a recovery in the (10-20) window with CAAR of 2.81%. CAAR (21-30) and CAAR (31-40) both show negative results of -6.52% and -16.23% respectively, and both of them are significant at 0.1%. CAAR (41-50) shows a recovery after a strong negative impact, and it is significant at 0.1%, while CAAR (51-57) was also positive and significant at 10%.

**Table 9:** CAARs in the event window (0-57)

|              | CAARs       | Stdev for the window | T-test (CAAR) |
|--------------|-------------|----------------------|---------------|
| CAAR (0-9)   | -2.43%      | 1.70%                | -1.4305       |
| CAAR (10-20) | 2.81%       | 1.78%                | 1.5794        |
| CAAR (21-30) | -6.52%****  | 1.70%                | -3.8373       |
| CAAR (31-40) | -16.23%**** | 1.70%                | -9.5557       |
| CAAR (41-50) | 7.36%****   | 1.70%                | 4.3352        |
| CAAR (51-57) | 2.44%*      | 1.42%                | 1.7174        |

**Notes:** CAAR is significant at: \* $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ ; \*\*\*\* $p < 0.001$ .

Figure 4 show the CAARs in the event window (0-57), and it shows a very similar trend to the CARs (0-57) of the 5 companies.

**Figure 4:** CAARs in the event window (0-57)

### Second methodology

In order to assess the hypothesis H1, which states that there is a positive relationship between average aggregate house prices and the real estate share prices, we will run multiple OLS regressions with the aggregate house prices being the independent variable, and the stock prices of the 5 companies used in the previous methodology as the dependant variable.

### Variables and data collection

In terms of the aggregate house prices, we collected data from HM land registry open data, which provide us with the price paid for properties in the UK from 1995 up to

this date. The data collected contains over a million of rows for each year, and each row represents one transaction of sale of a property, therefore, data cleaning is necessary to use this database. We use excel to average the prices of properties in a monthly manner from January 2010 till October 2021, which includes a sample size of 142. The properties are divided into 5 different types of houses, which are as following; detached, semi-detached, flats, terraced, other. These 5 types of properties will be the independent variable for the regressions. In terms of the dependant

variable, we will use the monthly stock prices of the 5 companies in the same

period. The results of the regressions are reported in table 10.

Table 10: Results of the OLS regressions.

| Variable                         | Coefficient   | t-statistics | Prob   | R-squared       |
|----------------------------------|---------------|--------------|--------|-----------------|
| <b>Segro plc</b>                 |               |              |        | <b>0.888512</b> |
| Detached                         | 0.004185****  | 7.668521     | 0.0000 |                 |
| Semi-detached                    | 0.006874****  | 3.674445     | 0.0003 |                 |
| Flats                            | 3.56E-05      | 0.073293     | 0.9417 |                 |
| Terraced                         | -0.005902**** | 0.001666     | 0.0005 |                 |
| Other                            | 4.56E-06      | 0.563158     | 0.5743 |                 |
| <b>Land Securities Group plc</b> |               |              |        | <b>0.389527</b> |
| Detached                         | 0.000522      | 0.658405     | 0.5114 |                 |
| Semi-detached                    | -0.006796**   | -2.502639    | 0.0135 |                 |
| Flats                            | 0.004598****  | 6.516124     | 0.0000 |                 |
| Terraced                         | 0.003745      | 1.549038     | 0.1237 |                 |
| Other                            | 2.28E-05*     | 1.942453     | 0.0541 |                 |
| <b>The Unite Group</b>           |               |              |        | <b>0.858321</b> |
| Detached                         | 0.002177***   | 3.169426     | 0.0019 |                 |
| Semi-detached                    | 0.011806****  | 5.013376     | 0.0000 |                 |
| Flats                            | 0.003006****  | 4.912185     | 0.0000 |                 |
| Terraced                         | -0.010174**** | -4.853049    | 0.0000 |                 |
| Other                            | 9.34E-06      | 0.915923     | 0.3613 |                 |
| <b>British Land Company</b>      |               |              |        | <b>0.385242</b> |
| Detached                         | 0.000410      | 0.886604     | 0.3769 |                 |
| Semi-detached                    | -0.002229     | -1.404461    | 0.1625 |                 |
| Flats                            | 0.002225****  | 5.395948     | 0.0000 |                 |
| Terraced                         | 0.001151      | 0.814501     | 0.4168 |                 |
| Other                            | 1.20E-05*     | 1.748190     | 0.0827 |                 |
| <b>Derwent London plc</b>        |               |              |        | <b>0.683073</b> |
| Detached                         | 0.006335***   | 2.668727     | 0.0085 |                 |
| Semi-detached                    | -0.000645     | -0.079213    | 0.9370 |                 |
| Flats                            | 0.011740****  | 5.551733     | 0.0000 |                 |
| Terraced                         | -0.001586     | -0.218909    | 0.8270 |                 |
| Other                            | 6.73E-05*     | 1.907811     | 0.0585 |                 |

Notes: The variables are significant at: \* $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\* $p < 0.01$ ; \*\*\*\* $p < 0.001$ .

From table 10, we can see that 12 of the 25 variables are significant, and among these 12 significant variables, 9 of them show a positive relationship between the aggregate average house prices of the relevant property type and the stock prices of the companies. In addition, in terms of goodness of fit  $R^2$ , Segro plc and The Unite Group plc both had high R-squared with values of 88.85% and 85.83% respectively,

meaning that more than 85% of the variance of the stock prices is explained by the house prices. On the other hand, Land Securities Group plc and British Land Company both had low R-squared values which were, 38.95% and 38.52% respectively, implying low goodness of fit for the model. Based on these results, we cannot reject the hypothesis that there is a positive relationship between average

aggregate house prices and the real estate stock prices. Since we have obtained mixed results, we can conclude that there is, to some extent, a positive relationship between the average aggregate house prices and the stock prices of the real estate companies. However, this will depend on the company and the type of property. For example, from table 10 we can see that The Unite Group plc has 4 significant variables in which 3 of them are positive, meaning that the expected stock price of The Unite Group plc is positively influenced by the increase of the prices of detached, semi-detached, and flats type of properties. On the other hand, British Land Company plc has only 2 significant variables, flats and other, which are significant at 0.1% and 10% respectively, while other variables are insignificant at any level. This means that the expected stock price of British Land Company plc is positively influenced by the increase of the prices of flats and other types of properties.

One of the limitations of the data is that if it is used on daily or weekly basis instead of monthly basis, the property prices will be highly volatile, therefore if used in a regression we will not obtain any meaningful results. This means that after running a series of OLS regressions using the stock prices as the dependant variables,

and covid-19 cumulative cases as independent variable, and the house prices as the mediator, we were not able to obtain meaningful results due to the limitations of the data.

### Findings

To summarize the findings that were obtained from the research in regard to the impact of the covid-19 outbreak. From the event study, we found that following the covid-19 outbreak, the immediate response from in the real estate market show small negative day 0 abnormal returns across 4 out of 5 companies ranging from 0.03% to -0.22% in day 0, and from -0.09 to -0.43% in day 1 after the event day. Furthermore, we found that in the event window (0-9) the CAAR was negative with value of -2.43%, followed by positive CAAR of 2.81% in the window (10-20). Event windows (21-30) and (31-40) both reported significant negative CAARs with values of -6.52% and -16.23% respectively. Then in event windows (41-50) and (51-57), significant positive CAARs were reported with values of 7.36%, and 2.44% respectively. Therefore, based on these results we cannot reject our hypothesis H2 which states that the real estate stock market will induce negative abnormal returns following the outbreak of Covid 19. In addition, from figure 4 we can see that

the overall trend of the CAARs in the event window (0-57) was negative, which supports the hypothesis H2. In terms of the house prices, we obtained mixed results in which half of the variables were significant, and one-fourth of those significant variables showed negative relationship between the aggregate average house prices and the real estate companies stock prices. While the other 3/4 of the significant variables showed positive relationship between the aggregate average house prices and the real estate companies stock prices. Also, Segro plc and The Unite Group plc had high R-squared with the values above 85%, as compared to Land Securities Group plc and British Land Company plc who had low R-squared with values lower than 40%, then we had Derwent London plc which had R-squared of 68.30%. This means that depending on the company, the aggregate average house prices had different influence depending on the type of the property, and which company we are looking at. Due to the limitations brought by the nature of the data, we were not able to establish whether the covid-19 had any effect on the house prices or not.

## **Conclusion**

The real estate industry, as many other industries suffered a short-term negative

impact following the covid-19 outbreak and faced many challenges during this period as shown in the event study. We also found that the stock prices of the real estate companies are highly influenced by the house prices, and this can be due to the fact that the real estate companies are dependant to some extent on house sales as well as the rent from the properties. Having said that, the residential real estate sector is not the only sector the real estate industry operates in. As we have mentioned before, there are industrial real estate, commercial real estate, residential real estate. The performance of the real estate companies depends on these factors as well and not only the residential sector. Those sectors were also impacted by the covid-19, for example in the commercial sector, demand for offices dropped in the short term as employees started working from home (Godley and Glowacz, 2020). Moreover, retail stores were in constant risk of shutting down impacting the rents on the real estate companies, while on the other hand, food deliveries and online shopping were in a good position during the pandemic because of the changes brought by the Covid-19 (Godley and Glowacz, 2020). Finally, there is the industrial and logistics, which was highly dependent on the supply chains, and those supply chains

were disrupted by the pandemic, and new trends started to emerge such as; “the use of automation and robots, increase demand for logistics space (Godley and Glowacz, 2020).

Although this paper established some findings regarding the impact of the covid-19 on the real estate industry, we need to keep in mind some of limitations of this study. Firstly, the sample contains only five companies from the real estate industry, they could be a good representation for how the industry performed, but they are not exhaustive to how every company performed. In addition, in terms of the aggregate average prices data, although we separated the noise of the property prices on 5 types, it could still be volatile due to other factors that are not considered. For example, the data does not include information about the size of the property or the location of the property to make an actual representation of the house prices. Therefore, one pitfall is that the aggregate average price will depend on what was more sold in that month making it more volatile. However, this is compensated by the fact that we use very large sample size, which is as mentioned previously, more than a million transaction per year.

All in all, the covid-19 had a short-term negative impact on the real estate industry

and many other industries. However, it also had a long-term effect as it changed the norms of our daily life. For example, working remotely has become a lasting characteristic in how the companies operate as they explored the benefits from it (Godley and Glowacz, 2020). Then there is the feature of online shopping that has been more used during and after the pandemic, which changes how the retailers operate, and increases the demand for warehouses (Godley and Glowacz, 2020).

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