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Work from Home and Commercial Real Estate

Evidence from Stock Markets

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EXECUTIVE SUMMARY

We explore investor expectations about the effects of work from home (WFH) for the commercial real estate sector. Driven by the Covid-19 outbreak, the accelerated and widespread adoption of communication platforms have enabled the fast transition to remote working. However, it remains to be seen whether WFH will become the new normal. Investors therefore are looking for clues on the likelihood of a firm to be affected by WFH. WFH for the commercial real estate industry can be associated with a long-term shift in the demand for rental space. In the early stages of the pandemic, share prices of REITs can capture early speculations of the effects of working from home in the absence of any other information. Where the link between a corporate tenant and its landlord is established, WFH announcements by tenants can signal investors long-term WFH intentions. The actual impact of WFH is unknown but stock market reactions to news about WFH show the extent to which investors expect that WFH will affect the demand for rental space.

We assess how differences in WFH exposure of REITs in the largest European economies – Germany, France and the UK – during the early stages of the Covid-19 pandemic affect their abnormal returns. We use the property portfolio and the associated major tenants to account for investor expectations about the effects of WFH exposure on REIT abnormal returns. First, we assume that REITs which have above median share of offices in their portfolio might have higher WFH exposure. The reason is that WFH should have a direct effect on office properties but a rather indirect effect on other sectors. We use exposure to retail as the placebo effect and find that indeed office exposure is a good proxy for WFH exposure. Second, we construct a variable called tenant WFH intensity using tenant WFH announcements between March and June 2020 to capture tenant's strong commitment to working from home in the future. We follow a series of steps to get to the announcements by the major tenants for each REIT and in each country overcoming challenges such as announcements being in different languages or not necessarily associated with actual intentions of working from home for the respective tenant.

We find that WFH exposure through their property portfolio or through their tenants leads to significantly negative abnormal returns for REITs independently of their domicile, sector specialization or CBD exposure. A REITs with above median portfolio exposure to office has 0.3% lower daily abnormal return. In addition, a 1% increase in tenant WFH intensity would lead to 1.76% lower abnormal returns. REITs which have above median CBD exposure would also be associated with significantly negative abnormal returns. Overall, our results suggest that investors perceive WFH to negatively affect returns controlling for a host of idiosyncratic and systematic risks. Equity investors can look at REIT portfolio composition and WFH announcements by tenants to assess the likelihood of WFH in the long term and the associated drop in office demand.

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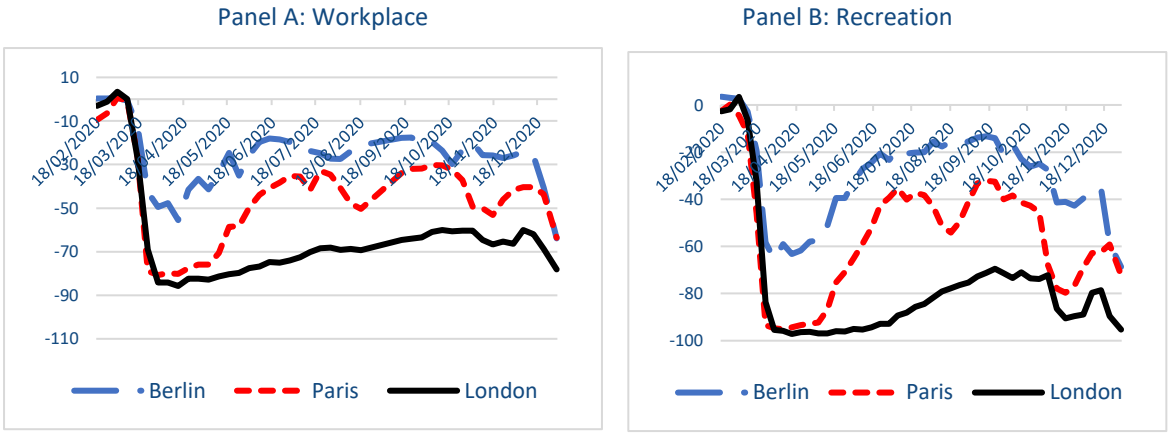
1. Introduction

On 11 March 2020, the World Health Organization (WHO) (2020) declared the novel coronavirus Covid-19 a pandemic. To stop the spread of the virus, a large number of white-collar workers around the world were asked to work from home (WFH) instead of going into the office. The series of lockdowns that followed have led to a large share of office workers adjusting their way of working to suit working from home. During the first few months of the pandemic, there was uncertainty about the extent to which WFH will become the new normal. The Covid-induced shift in working from home, similar to online shopping, can be seen either as temporary, with WFH gradually returning to pre-Covid levels, or as permanent. The latter is seen as a structural shift with long-term re-distributional effects on labour and real estate markets.

Google mobility data in Figure 1 shows that workplace mobility (Panel A) in the largest capital cities in Europe – Berlin, London and Paris – went down by more than 80% in March 2020 as compared to February 2020. Recreation mobility (Panel B), which involves retail and hospitality dropped by almost 100% in London and Paris. We also see large differences in the recovery of mobility in the first half of 2020 across the three cities. While London's mobility had hardly recovered as of the end of June 2020, Germany has quickly bounced back to only 20% lower mobility as compared to pre-Covid as of June 2020. Paris lies in between.

Figure 1. Percentage change in mobility from pre-Covid-19 levels



Note: Source: Google mobility, 2021

In addition to above mobility trends, surveys also capture the sentiment around continuing to work from home as the effects of the pandemic fade away. A poll by the London Chamber of Commerce and Industry (2021) with more than 500 business leaders reports that half of London's companies whose staff can work from home expect them to do so in some form after the pandemic. A large number of other surveys report that most employees would like to continue working from home even when the pandemic is over. A YouGov survey conducted with UK employees suggests that fewer than four in ten want to leave their house to commute to work (YouGov, 2020) . A survey by Anact[1] shows that around 88% of the respondents expressed their hope to continue working from home after the pandemic.

While the welfare implications associated with WFH and the impact on the companies adopting WFH policy are still unknown, we can use stock market data to measure investor sentiment related to the anticipated effects of WFH on the commercial real estate market. Analysing stock market performance of REITs in the early stages of the Covid-19 pandemic, can capture expectations about the likelihood that WFH will shift the demand for rental space. The direction of the effects is not straight forward, as more working from home can reduce the demand for some types of rental space, like office, retail, or hotel, on the one side, but increase the demand for other sectors, such as residential and industrial, on the other. Furthermore, WFH can affect the regional dynamics of urban and suburban areas. It can increase the demand for space in suburban regions, in which WFH employees

[1] Anact is a public administrative agency for improving working conditions in France. 97% of the respondents have WFH experience, but 80% had no WFH experience prior to the pandemic. https://www.anact.fr/teletravail-en-confinement-les-premiers-chiffres-cles

will spend more time and decrease the demand for properties in urban areas, especially in central business districts (CBDs).

Changing attitudes about WFH at large scale was induced by an unexpected global shock associated with the emergence of Covid-19. Therefore, the early period of the pandemic lends itself to a stock market study of investor expectations to identify the implications of working from home. However, during that period, a lot is going on with most office workers working from home as a result of the world-wide lockdowns. We isolate the market-wide effects associated with Covid-19 and the systematic risks for REITs, by only looking at abnormal returns. Abnormal returns are calculated using a market model for the very early Covid-19 period – January and February 2020.

In order to identify which firms are more strongly affected by WFH, we construct several WFH exposure metrics. First, we distinguish between REITs whose real estate portfolio is more heavily weighted in office buildings. The latter should be more strongly affected by an increase in WFH than other types of sectors. We split between REITs with above-median share[2] of office properties in their real estate portfolio. Secondly, not every office property might be equally affected by WFH, however, and this will depend of the likelihood of tenants to continue working from home. One way we try to account for that is to measure tenant WFH intensity, which is another measure of WFH exposure. Expectations about the role of WFH on future performance and REIT value can be affected by major tenants publicly announcing working from home. While a large number of companies have moved to working from home in the early stages of the pandemic as a result of national lockdowns, some of them decide to publicly announce this, i.e. on their company websites. Investors in REITs can interpret WFH information related to those tenants as a commitment from the tenants to remain working from home even after the pandemic. Therefore, such WFH announcements can be seen as tenant statements on post-Covid WFH policy and can affect expectations about the future performance of the REIT. A company facing a high number of its tenants announcing WFH, i.e. high tenant WFH intensity, may be associated with worse equity performance than a company with low tenant WFH intensity. Tenant WFH intensity is a measure of the share of tenants making WFH-related announcements and is constructed for each REIT.[3] The more tenants announce WFH, the higher the tenant WFH intensity for an individual company would be. Another metric of WFH exposure is CBD exposure of the property portfolio of a REIT, as CBDs might be most strongly affected by WFH. One of the main reasons behind choosing to work from home can be reduced commuting time to and back from the office. For employees working in CBDs, the commuting times might be longer, as CBDs are characterized by more expensive residential markets and less supply of residential properties than suburban areas. This might lead to REITs which have higher exposure to CBDs being more strongly negatively affected by working from home. In turn, the reverse also might be true. Commercial properties located in CBDs, most likely offices, are often considered core markets and attract a large amount of funds from institutional investors. CBD-located offices are in scarcer supply than other types of offices and therefore may keep their value better during structural shifts related to WFH. We are going to test empirically which channel prevails and differentiate across sectors and countries.

While CBD and office exposure can be more easily constructed using information about the property holdings of REITs, tenant WFH intensity is a metric relying on identifying WFH related news for each tenant in our sample. We account for WFH announcements by manually extracting relevant news using Google searches of keywords associated with 'work from home' together with the name of the respective corporate tenant.[4] We perform this search in the respective language – in English for the UK, in French for France and German for Germany – and use Google translate. While those three countries are the largest economies in Europe and have well established commercial real estate markets, their approach to working from home differ largely as depicted in Figure 1. UK is the country that was most strongly hit by WFH resulting in a drastic drop in workplace mobility for a much longer period that for example in Germany. This might imply that the UK REITs were more badly affected that German or French REITs.

[2] The median REIT in our sample has about 19% office properties in the portfolio as of 2020 according to SNL data. The median share is only based on the REITs in our sample and not all REITs. The selection of the companies in the sample is described in length in the Data section.
[3] The exact calculation of tenant WFH intensity can be found in the Data section. Note that we do not access to all tenants for each REIT but instead to a maximum of the top five largest tenants for each property owned by a REIT.
[4] We only consider the news relevant if that tenant is renting office space. For example, if Amazon announces work from home, we consider this news for a REIT that has Amazon as a tenant of office space, but not of industrial space.

A REITs with above median portfolio exposure to office has 0.3% lower daily abnormal return. In addition, a 1% increase in tenant WFH intensity would lead to 1.76% lower abnormal returns. REITs which have above median CBD exposure would also be associated with significantly negative abnormal returns. Overall, our results suggest that investors perceive WFH to negatively affect returns controlling for a host of idiosyncratic and systematic risks. Equity investors look at REIT portfolio composition and WFH announcements by tenants to assess the likelihood of WFH in the long term and the associated drop in office demand.

2. Literature review

2.1 WORK FROM HOME

WFH is defined as employees performing work tasks from home instead of going to the workplace (also called teleworking or telecommunicating). The presence of the Covid-19 has accelerated the trend of firms adopting WFH practices to add more flexibility when facing the disruptive changes brought by the pandemic. There has been small but growing literature on WFH in a Covid-19 context (Delventhal, Kwon and Parkhomenko, 2021) .

The advantages of WFH include a cut in commuting time and cost as well as a potential improvement in work-life balance. From employer's perspective, this could also save the rental cost on office properties. According to a 9-month WFH experiment conducted with employees in the Shanghai call center of Ctrip (one of the largest Chinese travel agency that is NASDAQ-listed), there has been a dramatic increase of 13% in homeworker's performance (Bloom et al., 2015). The researchers found that 70% of the increase was attributed to prolonged hours employees worked, and the remaining 30% was due to an increase in the output per minute (i.e., number of calls they take per minute). In the interviews, the employees attribute the increase in working hours to the greater convenience provided by the home-working environment (e.g., the ease of getting lunch and using the toilets) and attribute an increase in efficiency (i.e., work output per minute) to a more quiet environment at home. From this experiment, we could indeed observe a productivity increase brought by the home-working practices.

However, the nature of the job in above example does not require much teamwork or face-to-face interaction with colleagues and is quite suitable to be conducted at home. In reality, however, not every type of work is suitable for being conducted at home. Businesses that rely heavily on face-to-face communications and a close physical proximity to co-workers might be quite vulnerable to WFH practices. Koren and Peto (2020) construct an index to measure worker's reliance on fact-to-face communication and proximity to co-workers for each industry. If the characteristic of the work is not suitable for being conducted at home, the firm might experience a productivity loss compared to the times when its employees work in a conventional office setting. As a result, if there is a link between tenant and REIT performance, the associated landlord might also experience a performance shock. Likewise, Papanikolaou (2021) found that sectors in which a higher portion of workers are unable to work remotely would experience more significant drops in employment, expected revenue growth and have worse stock performance. In short, pandemic induced WFH practices have caused severe disruptions to the supply-side of the economy.

In addition to the nature of the work, the biggest concern with WFH is that "working from home" could possibly end up with employees "shrinking from home" due to a lack of sufficient supervision (Bloom et al., 2015; Dutche, 2012). The benefits brought by a home-working environment, i.e., the ease of satisfying personal needs and a quiet and comfortable environment, might however distract workers from their job in some cases. In the previous example, the senior management team was worried that employees might engage in entertaining activities that deteriorate the quality of work, e.g., taking calls while watching TV. As Dutche (2012) argued, there are more and better outside options at home that lead to distractions not presented in the office. Additionally, it is more difficult for managers to monitor homeworking employees. As a result, the presence of more attractive distractions and an extra freedom due to less supervision increase the possibility of shrinking for homeworking employees. Experimental evidence provided by Engel (2010) confirms that individuals work less when they were given a exogenous outside option. Moreover, phycological factor might also come to affect worker's motivation due to loneliness cause by being physically isolated from co-workers (Bloom et al., 2015). As a result, we believe that firms adopting WFH practices might experience a productivity loss.

With workers shifting to WFH, the decline in physical proximity and urban interactions reduces the risk of Covid-19 transmission. However, it also reduces the appeal of urban centres. City centres are relevant for agglomeration economies and can be associated with positive externalities stemming from spatial interactions among agents (Rosenthal, Strange and Urrego, 2021). During the pandemic when agents are more geographically dispersed, working from home with less urban interactions, the values of urban locations might therefore be revised downwards. As city centres might have a higher share of jobs that are compatible to tele-working, when WFH is implemented, the desirability of dense districts declines more severely (Liu and Su, 2021). Gupta et al.(2021) show that the prices and rents in city centers have been decreasing and they suggest that the presence of remote working makes workers re-optimise their location choices and reevaluate the urban real estate. Therefore, we add CBD exposure variables for REIT's portfolio in this study to examine its impact on REIT performance. In addition, WFH can be associated also with lower net asset values (NAV) of REITs, whose asset value is almost entirely derived from the value of their properties.

2.2 TENANT VERSUS LANDLORD PERFORMANCE

Real estate firms are only as successful as their assets. Since the asset consists of a bundle of lease contracts between tenants and landlords, asset quality essentially relies on tenant quality (Liu and Liu, 2013). As a result, real estate firms (i.e., landlords) are incentivized to screen potential tenants and create an optimal tenant mix.

With the nature of lease contracts, landlord's income is derived from tenant's rental payments. Therefore, there should be a positive correlation between tenant's and landlord's performance. Chen, Harrison and Khoshnoud (2020) used data from 96 publicly traded REITs and their principal tenants, and found that landlords with best performing tenants generate annualized abnormal return which is 6 percentage points higher than landlords with worst performing tenants. In other words, buying REITs whose tenants are high performers and selling REITs whose tenants had the worst returns yields 5-6% abnormal return a year. The authors referred to this predictability of tenant-landlord performance as a 'tenant momentum'. In addition, anchor tenants might spillover a performance shock on to other tenants and the landlords themselves. Office anchor tenants usually draw employees and other tenants to the neighborhood. If an anchor tenant adopts a WFH policy, other nearby tenants might suffer a productivity loss as well. For example, high street businesses were negatively affected as a result of the decline in passing trade from workers during Covid-19. The head of the Confederation of British Industry (CBI) warned that WFH might turn towns into "ghost towns" if office tenants continue working from home (BBC, 2020). Hence, landlords with properties near a WFH anchor office tenant might suffer loss as well.

3. Methodology

We employ a panel regression analysis to estimate the impact of a firm's WFH exposure on a landlord's abnormal stock performance. A listed firm's stock performance can only be considered as 'abnormal' when comparing to a particular benchmark, and we use the country-specific stock market index as a benchmark. For the UK we use the UK FTSE 100, for France we use CAC 40 and for Germany we use DAX. In the first step, we need to calculate the abnormal return which will be the dependent variable in the second step. The reason for that is to control for market drivers and any non-market performance associated with the early stages of Covid-19. For that, we firstly estimate the sensitivity of each firm to a country benchmark market index using a classic market model specified as:

$$R_{i,t} = \alpha_i + \beta_i \times R_{m,t,c} \quad (1)$$

where $R_{i,t}$ denotes the observed return on company i at time t, $R_{m,t,c}$ denotes the return on the benchmark market index in country c, α_i is the non-market return associated with management skill and β_i is the company beta, or the sensitivity of company i to the market.

To account for the changes in the parameters – alpha and beta – we estimate the model only during the Covid-19 period but before the tenants start announcing working from home policies. Therefore, the market model is estimated from January until February 2020[5].

In the second step, we use the estimated coefficients from the first step to calculate abnormal returns for each REIT on each day. Abnormal returns and are estimated as:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i \times R_{m,t,c}) \quad (2)$$

Equation (2) is estimated for a sample period starting with the first announcement of a WFH policy by a tenant in our sample. This happens in early March for all three countries. The estimation period ends in June 2020. We decide to limit our estimation period to the first few months of the pandemic as they are characterised by country-wide lockdowns, little economic activity and the dominance of news about Covid-19 infection rates. In those early stages little was known about the implications of WFH on commercial real estate and little was known on how long the pandemic will last. There were also different forecasts on how long the pandemic will last, with some predicting a V-shared and others an L-shaped recovery.

We then pool all firm-day abnormal returns from the individual country models into a single panel regression controlling for day and country variations. The model is given as:

$$AR_{it} = \delta_0 + \delta_1 WFH_{i,t} + Firm\ Controls_i + Time\ FE + Country\ FE + \varepsilon_{it} \quad (3)$$

WFH stays for WFH exposure measured in various ways. First, we measure it using a static measure for REIT-level WFH exposure by examining the portion of office properties in a REIT's current portfolio. The portfolio measure of WFH exposure is calculated as

$$Office\ Share_i = \frac{Number\ of\ office\ properties\ owned\ by\ company\ i}{Total\ number\ of\ properties\ owned\ by\ company\ i} \quad (4)$$

In addition, the ratio for retail property has also been calculated using the same equation, replacing office property with the retail property. We then create an Office (Retail[6]) PF (i.e., portfolio) variable which equals one for firms that have above-median share of office (retail and hotel) properties among other in-sample firms. The median office share in the sample is 19%. We believe that firms with a higher holdings of office properties are more likely to have a tenant that adopts WFH practices. As a result, we expect a negative relationship between Office PF and the performance measure for our in-sample REITs. We also include Retail PF to account for the placebo effect of WFH as we do not expect a direct effect on retail properties from WFH. We also use CBD exposure and a CBD PF dummy constructed in a similar way to the Office PF. Those WFH exposure measures are static capturing the firm's portfolio holdings as of 2020. Tenant WFH intensity instead is a dynamic measure which changes daily depending on whether a new tenant in the portfolio of properties makes an announcement about WFH. All measure of WFH are explained in more detail in the Data section.

In the panel regression model shown in Equation (3), the coefficient of interest δ_1 captures the impact of WFH on the same-day abnormal return. $Firm\ Controls_i$ are firm balance sheet variables taken for the financial year 2019 as the abnormal returns and the market model are all estimated using data from 2020 but not the entirety of 2020. We include country fixed effects and time fixed effects. Standard errors are clustered on REIT sectors.

In one robustness specification, we add to Equation (3) interaction terms of Office PF and CBD PF, and Retail PF and CBD PF for comparison. In another robustness specification, we expand the model in Equation (3) to include interaction terms between country dummies and key explanatory variables to explore how the relationships we

[5] The beta estimation period excludes non-trading days.
[6] Hotels are included into the retail property calculation.

discovered might be intensified or mitigated in different countries. Specifically, we add the interaction term of Office (Retail) PF and a UK dummy.

In the models where WFH exposure is measured by tenant WFH intensity, in addition to the baseline model specified in Equation (3), we interact Retail PF and Tenant WFH intensity to examine whether the presence of high retail portfolio exposure will mitigate or intensify the relationship between WFH exposure and abnormal return. To examine cross-country differences, we use the UK as the baseline and examine the coefficients on the interaction terms. We also account for delays in incorporating WFH information in prices by lagging WFH variables by 1 day, 2 days or 3 days. The results are robust across the specifications and discussed in more detail in the Results section.

4. Data

We focus on three European countries for which we have the best access to data – the UK, France and Germany. First, we collect information about the REITs including equity prices, property holdings and performance metrics. Second, we establish their property portfolio and are then able to get access to the names of their major tenants. The tenants in our sample include international public and private organisations. Third, we collect information on WFH policies for the most important tenants to each company and build a company-level variable called 'tenant WFH intensity'. The variable aims to measure the intensity of WFH announcements by tenants of the respective REITs. However, a large number of tenants do not publicly announce working from home in the early stages of the pandemic and therefore a large number of REITs will have zero tenant WFH exposure as a result. The REIT information, as well as property and tenant information come from S&P Global Market Intelligence (GMI) SNL dataset, or SNL for short thereafter.

4.1 REAL ESTATE DATA

We collect information on real estate investment trusts (REITs), domiciled in the UK, France and Germany. While we start off with all available REITs for each country, we narrow down the sample of countries based on availability of tenant information. While the SNL dataset collects information on the major tenants for some REITs, the majority of the firms do not have systematic reporting of their major tenants. We therefore obtain tenant information indirectly, using the property dataset. Using the property dataset assures that we can have a good idea of the major tenants for a large part of the REIT in our sample. For instance, from the company-level dataset, AEW UK REIT plc has no tenant records at the time of this study. Nevertheless, from the property dataset, we can see that some properties are owned by AEW UK REIT plc.

For each property, the SNL dataset contains information on tenants as well as the name of the company owner. Prior to that, given that the residential sector is a smaller part in overall property portfolios in European companies, we exclude residential properties. CBD exposure and tenant WFH intensity are constructed based on total number of non-residential properties (or the tenants associated with them) for a given REIT. The property dataset provides information for up to the first top 5 tenants. We sort the data by tenant.

We remove properties with no tenant record from the sample. We also remove properties with no information on latitude and longitude coordinates as we are unable to identify the property location. This information is important to define CBD exposure. Amadeus contains public and private company information across Europe. We exclude the tenants for which Amadeus has no information. These are usually small businesses with no financial information, or non-company entities.

We then link those two datasets to provide a more complete record of property holdings and tenants for each company. We match tenants to companies using the property's ownership information. Since every tenant is associated with a property which belongs to one of our REITs, the data is structured in the format REIT-property-tenant, as depicted in Figure 2.

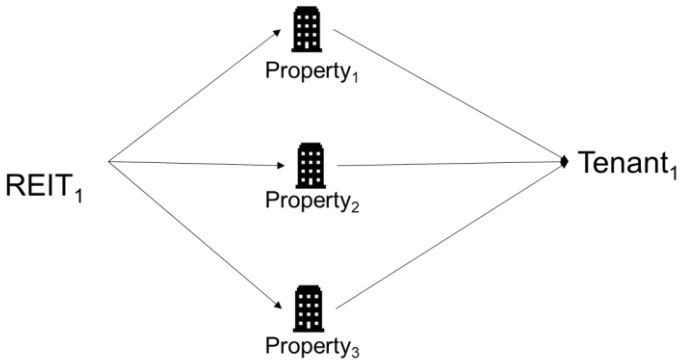
Figure 2. Data structure in our sample

		Tenant 1	Tenant 2	Tenant 3	…
$REIT_1$	$Property_1$	xxxxxxx	xxxxxxxx	xxxxxxxx	…

…	…	…
$REIT_1$	$Property_1$	$Tenant_1$
$REIT_1$	$Property_1$	$Tenant_2$
$REIT_1$	$Property_1$	$Tenant_3$

One problem that arises is that one REIT can let several different properties to the same tenant. As depicted in Figure 3, if we account for unique REIT-tenant pairs, then there is only 1 observation ($REIT_1$-$Tenant_1$), but if we account for repeated tenants in different properties, then there are 3 observations. In this study, as our focus is the link between a tenant and a REIT, we only account once for the repeated occurrence of a tenant if it is associated with only one REIT via multiple properties.

Figure 3. The relationship between a REIT, a property and a tenant



As we are examining the stock market performance, we only focus on listed REITs. The final sample covers 39 UK-listed REITs matched to 1,257 unique tenants, based on the property information available in SNL in May 2021[7]; 9 French REITs and 290 unique tenants (based on information from 200 properties); and 3 German REITs and 120 tenants (based on 140 properties). The reason why the number of REIT-property-tenant observations is much higher than any of these three elements individually is because the same property can be owned by more than one REIT, and the same tenant firm could rent several different properties owned by different REITs.

Our analysis is done using daily stock market data from the date of the first WFH event[8] we identified for each country respectively until the end of June 2020. This period is the early stage of pandemic when the IT infrastructure for WFH has not been sufficiently developed and office workers might face disruptions. In this stage, investors are likely to respond more strongly to WFH intensity as it's disrupting the status quo and characterises markets in flux. Table A2 in the appendix lists the REITs in our sample.

4.2 TENANT WFH INTENSITY

We now turn to constructing company-level WFH exposure. We assess to what extent a REIT has been affected by working from home. We account for WFH exposure by looking at the underlying tenants and information related to whether a tenant has announced working from home. Hence, the company-level WFH exposure is represented by the WFH intensity of its tenants (tenant WFH intensity, hereafter). We extract information on tenant's policy with regards to WFH using several approaches, we perform an extensive in-depth investigation

[7] In an intermediate step we have 90, 35 and 56 REITs for the UK, France and Germany respectively. But that number is reduced due to missing company data. For the UK, we find information for 1,775 unique properties let to 1,523 unique tenants by 90 unique REITs, which gives us a total of 3,146 unique REIT-property-tenant observations. For France we have 2,023 unique entries of REIT-property-tenant pairs consisting of 989 unique properties let to 935 unique tenants by 35 unique REITs. For Germany, there are 1,253 unique entries of REIT-property-tenant pairs consisting of 654 unique properties let to 647 unique tenants by 56 unique REITs.

[8] The first WFH event date is 6th March 2020 for the UK, 4th March 2020 for France and 10th March 2020 for Germany.

of the tenant's press release, announcement and the media coverage on announcements related to WFH for the tenants in question. We set several key words that are relevant to WFH 'events' or news, such as "*work from home*" and "*remote working*". The search was performed in Google using either word in addition to a host of other keywords.

First, we add the keyword "*Covid-19*" to ensure that we capture Covid-19 statements of a firm in response to the pandemic[9]. Second, as WFH might be associated with a shutdown of the workplace, we also include "*closure*" as a key word in case we miss WFH announcements expressed as a shutdown of the office building. Third, the name of the tenant company is added to the keyword search. Once we have inserted the relevant keywords, we sort the search results by relevance and the top 50 most relevant results were examined one-by-one by reading the text in each link. We use this approach to identify if those announcements qualify as *news* associated with WFH for the tenant in question. This is repeated for all more than 1,500 tenants in our sample that fit the criteria. Most tenants in our sample have publicly accessible official websites and receive sufficient media attention.

To perform the Google search, instead of using manual search, we apply big data techniques to speed up the process. This process will structure all searches (firm name plus key words) within one document and automatically perform the repetitive actions of clicking and opening the result pages, so that the only manual effort we need to contribute is to read and understand relevant pages. The identification of a WFH event, i.e., reading and understanding the message within a WFH-related announcement is done manually because a machine-based identification might not be accurate in our case. This is because text mining using machine learning techniques normally captures and extracts all relevant text or calculates the relevance of the text for a given word/topic. Some form of discussion features in a lot of news entries related to WFH and WFH has become a popular phrase since the outbreak of Covid-19. Therefore, even firms that do not have WFH policies mention the phrase 'work from home' on official websites or appear in searches. For example, the company itself has not announced or adopted working from home, but it provides advisory to clients looking to transition to work from home. This will then be stated in the firm's official website or would have received media attention. In such a case, a tenant WFH intensity metric constructed using machine learning techniques will pick up wrongly and could potentially recognize that company itself as a WFH company.[10] Given that our sample of tenants lends itself to a manual selection of events and we consider this the most robust way of sorting relevant news from irrelevant information, we decided to identify a WFH event manually to achieve higher accuracy despite the highly time-consuming nature of this exercise.

A WFH event is usually associated with an announcement date and an implementation date, and we count the announcement date as the date that the tenant starts to contribute to the WFH intensity of a REIT as this is the date WFH policies for a specific firm become publicly known, which in turn can have effects on the landlord. This might be reflected in the overall performance of the landlord, i.e., their stock returns, if the landlord has large exposure to the WFH tenants. We use the WFH announcements for which a release date could be identified due to the panel nature of our data and the fact that we have daily abnormal returns for each REIT. Therefore, we monitor daily variation on WFH intensity in addition to cross-sectional variation across REITs.

After we identify the relevant events, we construct a WFH dummy equal to one for a tenant who makes a WFH announcement for the day of the announcement and thereafter. Those variables are aggregated at the firm level and then a share of tenants on each day is calculated as below to obtain a company-level tenant WFH intensity on daily basis

$$Tenant\ WFH\ intensity_{i,t} = \frac{Number\ of\ tenants\ renting\ from\ REIT_i\ who\ have\ annouced\ WFH\ as\ of\ day_t}{Total\ number\ of\ in{-}sample\ tenants\ to\ REIT_i} \quad (5)$$

The tenant WFH intensity is unique for each company and is calculated at the firm level rather than the tenant or building level.

[9] We translate the keywords in the respective language – German and French – for Germany and France respectively.

[10] While the company's business will be impacted from WFH as more requests for advisory on WFH can come in, hence increase business activity for such an advisory firm, we want to identify the economic effect of specific news about tenants related to working more from home on REITs. Those most likely will be negative effects for the REITs. There might be positive effects for other types of firms and the aggregate effect on a region is also not the scope of this study.

4.3 WFH EVENTS

The identification of the WFH event for each tenant is crucial for the tenant WFH intensity. Firstly, we have to differentiate WFH from Covid-induced lockdowns and closures which also happen during the same period, and which also represent a shutdown of the workplace and might affect rental revenue for REITs. A tenant could make a closure announcement, either a temporary or a permanent closure, to the public.[11] We therefore exclude closure announcements (both temporary and permanent) as these are normally associated with tenants in non-office properties or bankruptcies of tenants. In this way we only identify the effect of a WFH event, which is not due to a business shutdown.

An important consideration is also the sector, in which the tenant is renting a building. Since a tenant can simultaneously rent retail, office and industrial properties from different REITs, we need to account for the sector with which the WFH event is associated. WFH announcements are usually made at the tenant level and are related to office workers going less into the office but other parts of the business, for example retail or industrial activities, might not be affected in terms of demand for space. Therefore, a WFH announcement should only affect demand for office space in the short run[12]. Therefore, we assume that WFH announcements will only affect REITs which have let office space to WFH tenants but would not affect REITs with non-office properties to the same WFH tenants.

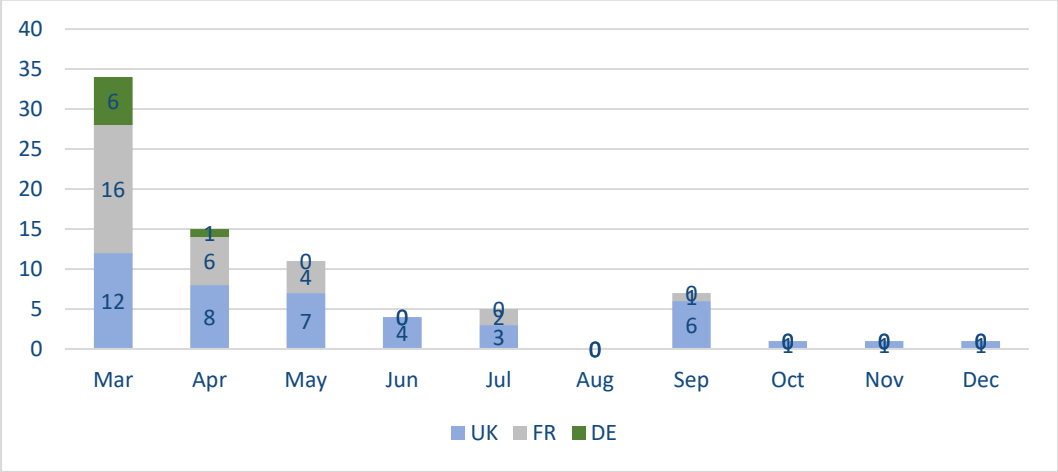
Table 1. Criteria for WFH event identification

Announcement Type	Property Type	Counted as WFH?
Closure	Retail	N
Closure	Office	N
WFH	Retail	N
WFH	Office	Y

We end up with 79 WFH events for all tenants in our sample[13] - 43 for the UK, 29 for France and 7 for Germany. Figure 4 shows the distribution of WFH events across 2020. We conduct the WFH tenant announcement search in the summer of 2021 without putting any time limit on the search results. As depicted in Figure 4, the majority of the 'events' occur between March and June 2020. To be precise, 34 announcements occur in March, 15 in April, and 11 in May. In September some more WFH announcements by tenants followed perhaps as a result of re-assessing the implications of the pandemic and realizing that a change in WFH policy is rather a long-term strategy and not a temporary response to the pandemic. After September 2020, the intensity of news drastically drops as compared to the early stages of the pandemic, with one announcement each month. It looks like tenants swiftly made WFH decisions early in the Covid-19 pandemic despite not knowing at that stage that Covid-19 lockdowns will become a frequent recurrence in the majority of the countries during 2020 and 2021. Looking at each country individually, we see that the distribution is smoother for the UK with more and more companies announcing working from home throughout each month. For France, the main events happen from March until May while for Germany, mostly only during March. This is also because we have more tenants and more companies overall. Only in the UK there is a reassessment of WFH in September, which the other countries seem to have moved on from introducing WFH. This is also in line with what we see in the Google mobility data in Figure 1 with the UK having a large number of companies still working from home throughout 2020 which Germany has quickly returned to in-person working.

[11] The temporary closure can be associated with tenants of a retail property to stop the spread of Covid -19 virus during the early stages of the pandemic. The permanent closure is usually associated with bankruptcies as a result of the pandemic.
[12] However, WFH might affect demand for retail space in the long run, because there is usually a greater propensity for public amenities (parks and schools) and private amenities (retail shopping) to locate in proximity to greater concentration of potential users and consumers (Delventhal, Kwon and Parkhomenko, 2021). Locations with higher WFH exposure represents a lower concentration of potential customers (office workers) for retail shops. As a result, in the long run, the retail properties in locations with high WFH exposure would be negatively affected. In this paper, we do not test this effect however.
[13] There are more WFH events, but they were excluded from the sample due to missing values for some key variables in our empirical model.

Figure 4: WFH event distribution across the months of 2020 for the UK, France and Germany



Note: Y-axis: number of tenants, who rent office space from the REITs, announcing WFH. The events are identified as explained in the main text.

4.4 CBD EXPOSURE

CBDs have been some of the most affected areas during the pandemic as a result of working from home due to lockdowns, Covid contagion fears in general, and firm-specific policies. We therefore construct a measure of the exposure of REITs to CBDs. For each REIT, we calculate the share of its properties that is located within a CBD. Before identifying which properties fall within CBDs, we need to know the boundaries of the CBDs. We use information from CBD maps[14] identified by CBRE that has been shared with us for this research. CBRE provided us with a complete list of CBDs in the UK, Germany, and France as well as the boundaries of the CBD areas. We then plot the in-sample properties on the CBD maps along with the identifiers of the REIT that owns the property for the calculation of the firm-level CBD exposure in the next step. Figure A1 in the Appendix shows the CBD boundaries together with properties that fall within (and close to[15]) the CBDs in our sample. We then link each property to its owner and calculate a company-level exposure to CBDs as follows.

$$CBD\ exposure_i = \frac{Number\ of\ properties\ owned\ by\ REIT\ i\ located\ within\ CBDs}{Total\ number\ of\ in{-}sample\ properties\ owned\ by\ REIT\ i} \quad (6)$$

4.5 SUMMARY STATSTICS

Table 2 presents the firm-level averages for the REITs in our sample. Table A3 in the Appendix reports the standard deviations. We have 51 REITs in total, and we tabulate their names and information in Table A2 in the Appendix. The first column shows the full sample statistics for the mean values. We first average the abnormal return (AR) across time for each REIT after which we average across firms. The daily average AR is -0.2%, which means REITs had negative performance from March until June 2020. The next two columns split the sample into firms with above-median share of office properties (Office PF) and firms with a below median office share (non-Office PF). As expected, the average AR for 'office' REITs is 0.2% lower than the AR for non-Office PF REITs. This indicates differences in the performance of REITs based on their office exposure. Similarly, if the sample is split into firms with positive tenant WFH intensity versus those with zero intensity, the ARs are 0.2% larger for the former.

[14] For example, maps of some German cities with submarkets and CBDs specified could be found via: https://www.cbre.de/en/research.
[15] Properties which are close to CBD boundaries were just drawn for a graphical demonstration purpose and were not taken into the calculation of CBD exposure.

The mean ARs for a split by office PF or tenant WFH intensity are the same suggesting that those two FH metrics might be comparable. However, on average the tenant WFH intensity is only 2%, meaning that a REIT has 2% of its tenants announcing WFH. There is however more than half of the REITs who do not have tenants who announce WFH. For the REITs with positive WFH intensity, the average is 4.3%. The tenant WFH intensity is higher for firms with high exposure to office buildings in their portfolio, and this is in line with our expectations as these two variables are both the measure of WFH exposure. In fact, the correlation between both variables is about 42%. If we compare the value of Office PF split by tenant WFH intensity instead, we see that for REITs with positive tenant WFH intensity, about 87.5% of the REITs will have above median office exposure[16]. For REITs with zero tenant WFH intensity, only 18.5% will have above median office exposure. This is not the case for Retail PF where there is no substantial difference in the retail exposure across zero and non-zero tenant WFH intensity.

In the final three columns we split the companies into their countries of domicile. We see some country-level variations in tenant WFH intensity and CBD exposure. French REITs have the highest tenant WFH intensity of 3.7% on average, as compared to 1.7% for the UK and 1.4% for Germany. French corporate tenants seem to be more transparent as to sharing information about working from home as compared to the other two countries. It also may be the case that French tenants more quickly decide on whether to adopt WFH or not. Similarly, French REITs seem to have higher average office exposure of 77.8% as compared to only 44% in the UK. For Germany we report 100% office exposure, indicating that all three German REITs have above-median share of offices in their portfolios. The UK instead seems to have higher retail exposure with 57% of the REITs having above average retail and hotel exposure. In France this figure is only 22%. Overall, the higher tenants WFH exposure in France is coupled with higher office exposure as compared to the UK.

As for CBD exposure, there is a notable difference in the mean values (26.6%) of CBD exposure for firms with higher office exposure, compared to the only 9.1% of CBD exposure for non-Office PF firms. Similarly, for positive tenant WFH intensity REITs, we observe that on average 23% of their properties are located in the CBDs as compared to 13.6% for zero-tenant WFH intensity REITs. As expected, France has the highest average CBD exposure of 23.7% followed by the UK with 17.8% and Germany with only 3.8%. So, it seems that while Germany has a lot of office REITs. Instead, the high CBD exposure goes hand in hand with high WFH exposure metrics which might be related to the fact that office properties are more likely to be located in CBDs than any other property type.

The average REIT has a leverage ratio of 32.8% in 2019. There are no differences in the leverage ratio across the splits by WFH exposure. UK REITs seem to have the lowest leverage of 30% on average which French and German REITs have a ratio of 40%.

French REITs are the largest in our sample by total assets. Year-on-year NAV growth for 2020 does not considerably differ across WFH metrics although it is marginally higher for higher WFH exposure. It also does not vary across UK and French REITs. Only German REITs seem to have a closer to zero NAV of -0.5% as compared to -9% for the other two countries.

In terms of the beta coefficient from the market models, we see that on average the REIT beta is 0.5 which is substantially below one indicating that REITs have lower volatility than the market for 2019. There is also little variation across WFH exposure groups and across countries. Only Germany is the outlier again, with a lower beta of 0.378. The average R-square of the market models is about 27%.

[16] The median for the ratio of office property holding among sample firms is 19.35%.

Table 2. Summary statistics – averages across firms

Mean	Full sample	Office PF	Non-Office PF	WFH Intensity>0	WFH Intensity=0	UK	FR	DE
Abnormal Return	-0.002	-0.003	-0.001	-0.003	-0.001	-0.002	-0.002	-0.003
Office PF	0.51	1	0	0.875	0.185	0.41	0.778	1
Retail PF	0.51	0.5	0.52	0.542	0.481	0.564	0.222	0.667
Tenant WFH Intensity	0.02	0.037	0.003	0.043	0	0.017	0.037	0.014
CBD PF	0.490	0.769	0.200	0.667	0.333	0.513	0.444	0.333
CBD Exposure	0.18	0.266	0.091	0.231	0.136	0.178	0.237	0.038
Firm Leverage	0.328	0.328	0.328	0.337	0.319	0.304	0.406	0.403
Total Assets (€Mn)	5,039	5,076	5,000	813	2,284	2,741	15,900	2,204
NAV Return (2020)	-0.091	-0.097	-0.086	-0.103	-0.083	-0.097	-0.094	-0.005
Beta (market model)	0.532	0.512	0.553	0.554	0.514	0.537	0.563	0.378

Note: The table provides the mean values of the variables for firms in the sample. Accounting figures are from the year 2019. The name of the columns specifies sub-samples of firms. Abnormal Return is estimated using REIT returns and stock market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany) for January-February 2020. Beta is the sensitivity of a REIT to the market index of those models. Tenant WFH Intensity is a ratio calculated as the number of tenants that have announced WFH to the total number of in-sample tenants for REIT and varies daily. Office (Retail) PF is a dummy variable which takes the value 1 for a REIT which has an above-median property portfolio composition of office (retail) properties. CBD Exposure is the ratio of properties that locate within CBDs to the total number of in-sample properties held by a REIT. CBD PF is a dummy variable that equals 1 for firms with an above-median share of CBD exposure. Firm leverage is the ratio of total debt to total assets in year 2019. High Leverage Dummy equals 1 for firms having above median leverage among in-sample firms. Firm Size is the natural logarithm of [total asset +1] for a REIT. NAV return is calculated as the NAV growth for 2020 as compared to 2019. UK, FR, DE denote UK, France, Germany respectively.

5. Results

We firstly estimate the impact of WFH using the Office portfolio measure. Office portfolio is equal one if a REIT has above median office exposure. We report results for same-day stock returns in Table 3. We include a host of control variables such as REIT size for 2019. We also construct a dummy variable which is equal to one if the REIT has above median leverage. This way we want to account for financing constraints that some REITs may face which has not been captured by the alpha and beta from the market model and remains unexplained. As the regressions are in panel format, including REITs from various counties over time, we include country and time fixed effects. We cluster the standard errors by REIT sector to account for any correlation in standard errors across SNL-identified REIT sectors. Model (1) in Table 3 shows the baseline result. The coefficient of interest is Office PF and is significantly negative. This means that a REIT which has an office-focused portfolio of properties will have 0.3% lower daily abnormal returns. The abnormal return already accounts for market sensitivity (beta), market risks and non-market returns (alpha). It is the unexplained by the factor model return. This means that although an alpha and beta can account for differences in the pricing and risk across REITs, part of the return remains unexplained by those and is driven by WFH proxies among other variables. The overall R-square of the baseline Model (1) is 22% which for a panel model of abnormal returns is considered good explanatory power. The model also controls for company accounting variables from the year prior to the estimation, 2019. Those however are not significant. This is not surprising, as this information should already be captured in the market model in Equation (1) and is a sign of an efficient market for REIT stocks.

Another way to account for WFH for each REIT is to differentiate between two groups of REITs, those which have above median CBD exposure and those with below median CBD exposure. This means that we first find out what is the median share of properties located in CBDs across all REITs in our sample. We then compare each REIT CBD share with the median and that share is higher, a value of one gets assigned. The CBD exposure is measured using maps for CBD areas in the main cities in the three countries of interest. The exact approach is described in the Data section. The CBD PF variable then is a dummy variable for above median CBD portfolio exposure of the REIT. The results are reported in Model (2) in Table 3. The CBD PF coefficient is significantly negative, similar to the Office PF. It is also similar in value, 0.23% as compared to 0.3% for Office PF. This is not surprising as most of the properties for which being in CBD locations matters, are offices. The differences in abnormal returns in major European REITs during the early stages of the pandemic are partially explained by their property portfolio exposure to office buildings or CBD areas. If we include CBD PF and Office PF dummies in the same model – in Model (3) – the results remain robust. Both measures are still significant, meaning that both types of WFH exposure separately matter and capture different dynamics of the WFH exposure. The interaction term of Office PF and CBD PF captures the incremental effect of a REIT having high exposure to offices and simultaneously high exposure to CBD areas. While the individual exposures are associated with negative effects, the interaction term is significantly positive. The significance is lower, only at 10% but the positive sign indicated that for REITs that have high exposure to office, it might be better to have those offices in CBD areas than outside those areas. As we discussed in the Introduction, the effect of CBD is not straight forward. While having above average CBD exposure is associated with lower abnormal returns, the sector also matters. For office REITs, the reverse relationship is observed most likely due to the more stable demand from large institutional investors for offices in CBDs. Offices in CBDs are considered prime real estate and are a target for pension funds and insurance companies.

The observation that the sector and location of property portfolio plays such differential role in explaining residual return differences suggest that equity investors pay large attention to this kind of information during volatile periods (Milcheva, 2021). Given the Google workplace mobility differences across the UK, France and Germany, we also want to test whether UK REITs in particular are associated with worse abnormal performance as compared to French and German REITs. We therefore expand Model (1) to include a dummy if the REIT is UK based and report the results in Model (4). The Office PF variable remains significant albeit the coefficient is slightly lower than in the baseline regression. However, the UK interaction with Office PF is not significantly different from zero. This means that we cannot see significant differences between the WFH effects across countries. Investors seem to not differentiate so much across countries for office related WFH exposure, but they do across CBD and non-CBD and across sectors when anticipating the outcomes of WFH. To assess the effects of WFH which might be associated with higher portfolio exposure to retail and hospitality sectors, we also construct in a similar way a Retail PF dummy. The variable takes the value one if the REIT has above median share of retail (all types) and hotel properties in their portfolio as of 2020. The baseline results are reported in Model 5. The coefficient is not significant and is very close to zero. Adding CBD PF into the model and an interaction term between Retail PF and CBD PF in Model (6) also does not lead to significance of the Retail PF dummy. This means that having high retail and hospitality exposure is not associated with significantly different abnormal returns. This result shows that the 'placebo' of checking if any badly hit property sector by the pandemic might show significance is not the case. This can be seen as an endorsement of our WFH proxy of using Office PF. One observation from Model (6) which is significantly negative is the interaction of Retail PF and CBD PF. This means that if a REIT has above median exposure to retail and hospitality sectors in 2020 and at the same time has high exposure to CBDs, then they would have worse abnormal performance. This is the opposite from what we see for office REITs. It is not surprising as while office REITs with high CBD exposure are seen as having exposure to Core markets during WFH shocks, the retail that might be most negatively affected is the one in the CBD areas as a result of reduced footfall. Those two results taken together, may suggest that investors do not think demand for office space in CBDs will significantly be reduced as a result of WFH despite working from home. However, less people on average come to the office – and have the same space to work from – footfall is shopping malls and hospitality may still drop. The results for retail however are not strongly significant and should be taken with a pinch of salt.

Table 3. The role of WFH on REIT abnormal returns using property portfolio measures

	Abnormal Return					
	(1)	(2)	(3)	(4)	(5)	(6)
Office PF	-0.0030***		-0.0031***	-0.0024***		
	(0.0004)		(0.0008)	(0.0003)		
CBD PF		-0.0023***	-0.0015*			-0.0010
		(0.0009)	(0.0009)			(0.0012)
Office PF* CBD PF			0.0014*			
			(0.0008)			
UK				-0.0005		
				(0.0010)		
Office PF * UK				-0.0006		
				(0.0008)		
Retail PF					0.0001	0.0015
					(0.0008)	(0.0010)
Retail PF* CBD PF						-0.0026*
						(0.0015)
Retail PF*UK						
FR	0.0010	-0.0005	0.0008		-0.0003	-0.0009
	(0.0011)	(0.0014)	(0.0015)		(0.0014)	(0.0015)
DE	0.0011	-0.0011	0.0009***		-0.0009	-0.0020*
	(0.0008)	(0.0009)	(0.0003)		(0.0012)	(0.0012)
High Leverage Dummy	-0.0009	-0.0007	-0.0008	-0.0008	-0.0001	-0.0006
	(0.0009)	(0.0009)	(0.0010)	(0.0010)	(0.0011)	(0.0008)
Firm Size	0.0000	0.0001	0.0000	0.0000	0.0000	0.0002
	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)
Intercept	-0.0017	-0.0036	-0.0019	-0.0014	-0.0032	-0.0046
	(0.0053)	(0.0060)	(0.0048)	(0.0055)	(0.0061)	(0.0055)
N	3906	3906	3906	3906	3906	3906
Country FE	Yes	Yes	Yes		Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.2244	0.2244	0.2244	0.2244	0.2244	0.2244
Overall R2	0.2246	0.2241	0.2247	0.2246	0.2230	0.2244
Between R2	0.2559	0.1789	0.2814	0.2573	0.0072	0.2324

Note: This table presents the result of panel regressions using the portfolio measure of WFH exposure (i.e., a higher portion of office property holdings in the portfolio) as the independent variable and the abnormal returns as the dependent variable. Day fixed effects and country

fixed effects are included in all models. Accounting figures are from the year 2019. Abnormal Return is estimated using REIT returns and stock market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany) for January-February 2020. Office (Retail) PF is a dummy variable which takes the value 1 for a REIT which has an above-median property portfolio composition of office (retail) properties. CBD PF is a dummy variable that equals 1 for firms with an above-median share of CBD exposure. High Leverage Dummy equals 1 for firms having above median leverage among in-sample firms. Firm Size is the natural logarithm of [total asset +1] for a REIT. Standard errors are clustered on REIT sectors and are shown in parentheses. p-values are denoted as * for p<0.1, ** for p<0.05 and *** for p<0.01.

Above results use proxies for WFH exposure based on the sector and location of the properties of each REIT. Those are not perfect measure of the extent of WFH and therefore, we construct tenant WFH intensity. The measure is based on the tenants instead on the properties. We are able to see the top five tenants for a large part of the property portfolio of the REITs in our sample and then link tenants to REITs. One thing to note is that those tenants are corporations which rent space from our REITs and are relatively large in size. We do not have information on every possible tenant of the REIT. Once we know the tenants, we then sort tenants into those that publicly announce they will begin working from home publicly versus those that do not. There might be tenants that work from home, but we would not be able to find this out easily on the web. If we think that investors care about WFH and have not access to insider information, they will use publicly available information online to figure out which major tenants might in the future adopt a more relaxed approach to WFH. Therefore, our tenant WFH intensity metric can be seen as a way to measure the likelihood of a tenant continuing to work from home after the pandemic. The tenant WFH intensity and Office PF are correlated to 42% which is a good sign that Office PF is a good measure of WFH exposure. We report the results in Table 4. All models use the same model specification as in the baseline in Table 3. Model (1) is the baseline only including tenant WFH intensity and firm, time and country controls. The coefficient is significantly negative and takes the value -0.0176. This means that a one percent increase in tenant WFH intensity would lead to a 1.76 percentage points decrease in daily abnormal returns. The models have similar explanatory power with overall R-square being around 22%. We also want to see how related this WFH measure is to CBD exposure. This time, CBD exposure is not a dummy but is the share of the properties which fall within the CBD areas of major real estate markets. The higher the share the higher the CBD exposure would be. So, both, tenant WFH exposure and CBD exposure are continuous variables. However, it is important to note that more than half of the REITs in our sample would have zero WFH intensity as we would not identify any WFH announcements associated with their tenants.

Adding CBD exposure to the tenant WFH intensity metric in Model (2) shows that the latter remains significant while the former is not. This means that the effect is not stemming from the CBD exposure of those tenants and even accounting for that, we still see lower performance for REITs which have higher tenant WFH intensity.

Model (3) controls for the effect of REIT portfolio exposure to retail properties on WFH intensity. We use the Retail PF dummy used in Table 3 to control for REITs which have high exposure to retail and hotels versus REITs which are more heavily invested in other property sectors. We see that including the Retail PF does not change the significance of tenant WFH intensity. It even increases the negative impact for REITs which are characterized by high WFH intensity and high retail exposure. The interaction coefficient of WFH and Retail is high at 0.017 but only significant at 10%. This means that the effect for REITs with high retail exposure is worsened through their exposure to WFH announcing tenants. However, those WFH tenants are not retail tenants, this means that the effect is not direct but rather indirect. REITs which happen to have high Retail exposure alone are not having significantly lower abnormal returns but they are having such if they happen to have office tenants that announce they will work from home. Such REITs might suffer a double whammy of having to restructure their office portfolio and their retail portfolio at the same time as a result of WFH.

A final model specification is to look whether there are any country differences with the tenant WFH intensity metric. We report the results in Model (4). We use the UK as the baseline for comparing country coefficients. The tenant WFH intensity remains significant. We do not see any significant differences for French REITs as compared to UK ones. We see small difference between Germany and the UK but the coefficient is only significant at 10% and also we only include 3 German REITs. While keeping this in mind, we see that German REITs respond significantly negatively as compared to UK REITs if they are associated with positive tenant WFH intensity. While less tenants are working from home in Germany, it might be the case that German REITs are more sensitive overall to working from home being adopted by their tenants.

We also account for delays in investors' response to WFH announcements using the 1, 2, and 3 days lagged tenant WFH intensity. The results remain robust and are presented in Table A4 in the Appendix.

Table 4. The role of tenant WFH intensity for REIT abnormal returns

	Abnormal Return			
	(1)	(2)	(3)	(4)
Tenant WFH Intensity	-0.0176***	-0.0169***	-0.0155***	-0.0171**
	(0.0065)	(0.0057)	(0.0059)	(0.0077)
Retail PF			0.0002	
			(0.0009)	
Retail PF * Tenant WFH Intensity			-0.0118*	
			(0.0068)	
FR* Tenant WFH Intensity				-0.0017
				(0.0260)
DE*Tenant WFH Intensity				-0.0772*
				(0.0453)
CBD Exposure		-0.0010		
		(0.0008)		
FR			-0.0001	-0.0001
			(0.0011)	(0.0018)
DE			-0.0009	0.0002
			(0.0011)	(0.0007)
High Leverage Dummy	-0.0003	-0.0005	-0.0003	-0.0002
	(0.0010)	(0.0009)	(0.0010)	(0.0009)
Firm Size	0.0001	0.0001	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Intercept	-0.0036	-0.0036	-0.0054	-0.0041
	(0.0079)	(0.0081)	(0.0064)	(0.0068)
N	3906	3906	3906	3906
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Within R2	0.2243	0.2243	0.2244	0.2243
Overall R2	0.2234	0.2234	0.2234	0.2234
Between R2	0.0840	0.0939	0.0736	0.0924

Note: This table presents the result of panel regressions using tenant WFH intensity as the independent variable and the abnormal returns as the dependent variable. Day fixed effects and country fixed effects are included in all models. Accounting figures are from the year 2019. Abnormal Return is estimated using REIT returns and stock market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany) for January-February 2020. Tenant WFH Intensity is a ratio calculated as the number of tenants that have announced WFH to the total number of in-sample tenants for REIT and varies daily. Retail PF is a dummy variable which takes the value 1 for a REIT which has an above-median property portfolio composition of retail properties. CBD Exposure is the ratio of properties that locate within CBDs to the total number of in-sample properties held by a REIT. High Leverage Dummy equals 1 for firms having above median leverage among in-sample firms. Firm Size is the natural logarithm of [total asset +1] for a REIT. Standard errors are clustered on REIT sectors and are shown in parentheses. p-values are denoted as * for p<0.1, ** for p<0.05 and *** for p<0.01.

Finally, we look at how WFH affects the change in net asset value per share from 2019 to 2020. It might be the case that, while abnormal returns respond to WFH exposure, the valuations of the properties as such, have not adjusted yet. We measure NAV return on the year 2020 as:

$$\Delta NAV_{2020} = \frac{NAV_{2020} - NAV_{2019}}{NAV_{2019}} \quad (7)$$

where NAV is the net asset value per share obtained from SNL dataset. Due to the missing information on NAV for some firms, we exclude those REITs from the current sample. The model is estimated for a total of 45 REITs using a cross-sectional OLS regression. Given the low number of observations, we try to save degrees of freedom by only estimating baseline models with as little variables as possible but making sure we control for country and firm differences.

The results are reported in Table 5. We find that using the Office PF metric does not yield significant results and the predictability of Model (1) is low, with an adjusted R-square of close to zero. Using Retail PF instead is associated with a higher adjusted R2 of 27%, which, given the small sample size, is considered a good fit. There is a significantly negative relationship between REITs with above median exposure to retail and hotel and NAV growth. Such a REIT would have almost 12 percentage points lower NAV growth. All other measures of WFH exposure are not significant, pointing towards a slow adjustment in valuations for properties. However, the results are based on very few observations and a more rigorous analysis is required to provide further evidence.

Table 5. WFH exposure and NAV growth

	ΔNAV			
	(1)	(2)	(3)	(4)
Office PPF	-0.0456			
	(0.0544)			
Retail PF		-0.1187**		
		(0.0388)		
Average Tenant WFH Intensity			-0.0596	
			(0.5869)	
CBD Exposure				-0.0600
				(0.1114)
High Leverage Dummy	-0.0717**	-0.0717**	-0.0603*	-0.0688
	(0.0286)	(0.0199)	(0.0309)	(0.0509)
Firm Size	-0.0068	-0.0139	-0.0075	-0.0057
	(0.0180)	(0.0156)	(0.0182)	(0.0135)
FR	0.0404	0.0086	0.0272	0.0390
	(0.0692)	(0.0438)	(0.0711)	(0.0889)
DE	0.1377***	0.1230**	0.1076**	0.1017**
	(0.0157)	(0.0394)	(0.0420)	(0.0380)
Intercept	0.0463	0.1944	0.0345	0.0220
	(0.2147)	(0.2059)	(0.2283)	(0.1842)
N	45	45	45	45

R2	0.1094	0.2778	0.0847	0.1013
Adj-R2	-0.0048	0.1852	-0.0326	-0.0139

Note: This table presents the result of OLS regressions using the portfolio measure of WFH exposure (i.e., a higher portion of office property holdings in the portfolio) as the independent variable and the return on NAV (net asset value) per share as the dependent variable. NAV Return is calculated as [(NAV per share at 2020- NAV per share at 2019)/ NAV per share at 2019]. Country fixed effects are included in all models. Accounting figures are from the year 2019. Abnormal Return is estimated using REIT returns and stock market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany) for January-February 2020. Average tenant WFH Intensity is the average ratio over time, which is calculated as the number of tenants that have announced WFH to the total number of in-sample tenants for REIT and varies daily. Office (Retail) PF is a dummy variable which takes the value 1 for a REIT which has an above-median property portfolio composition of office (retail) properties. CBD Exposure is the ratio of properties that locate within CBDs to the total number of in-sample properties held by a REIT. CBD PF is a dummy variable that equals 1 for firms with an above-median share of CBD exposure. Firm leverage is the ratio of total debt to total assets in year 2019. High Leverage Dummy equals 1 for firms having above median leverage among in-sample firms. Firm Size is the natural logarithm of [total asset +1] for a REIT. Standard errors are clustered on REIT sectors and are shown in parentheses. p-values are denoted as * for p<0.1, ** for p<0.05 and *** for p<0.01.

6. Conclusion

We explore investor expectations about the effects of work from home (WFH) for the commercial real estate sector. Driven by the Covid-19 outbreak, the accelerated and widespread adoption of communication platforms have enabled the fast transition to remote working. However, it remains to be seen whether WFH will become the new normal. Investors therefore are looking for clues on the likelihood of a firm to be affected by WFH. WFH for the commercial real estate industry can be associated with a long-term shift in the demand for rental space. In the early stages of the pandemic, share prices of REITs can capture early speculations of the effects of working from home in the absence of any other information. Where the link between a corporate tenant and its landlord is established, WFH announcements by tenants can signal investors long-term WFH intentions. The actual impact of WFH is unknown but stock market reactions to news about WFH show the extent to which investors expect that WFH will affect the demand for rental space.

We assess how differences in WFH exposure of REITs in the largest European economies – Germany, France and the UK – during the early stages of the Covid-19 pandemic affect their abnormal returns. We use the property portfolio and the associated major tenants to account for investor expectations about the effects of WFH exposure on REIT abnormal returns. First, we assume that REITs which have above median share of offices in their portfolio might have higher WFH exposure. The reason is that WFH should have a direct effect on office properties but a rather indirect effect on other sectors. We use exposure to retail as the placebo effect and find that indeed office exposure is a good proxy for WFH exposure. Second, we construct a variable called tenant WFH intensity using tenant WFH announcements between March and June 2020 to capture tenant's strong commitment to working from home in the future. We follow a series of steps to get to the announcements by the major tenants for each REIT and in each country overcoming challenges such as announcements being in different languages or not necessarily associated with actual intentions of working from home for the respective tenant.

We find that WFH exposure through their property portfolio or through their tenants leads to significantly negative abnormal returns for REITs independently of their domicile, sector specialization or CBD exposure. A REITs with above median portfolio exposure to office has 0.3% lower daily abnormal return. In addition, a 1% increase in tenant WFH intensity would lead to 1.76% lower abnormal returns. REITs which have above median CBD exposure would also be associated with significantly negative abnormal returns. Overall, our results suggest that investors perceive WFH to negatively affect returns controlling for a host of idiosyncratic and systematic risks. Equity investors can look at REIT portfolio composition and WFH announcements by tenants to assess the likelihood of WFH in the long term and the associated drop in office demand.

References

BBC, 2020. *Coronavirus: Working from home damaging economy, Raab warns*. [online] Available at: <https://www.bbc.com/news/business-54047347>.

Bloom, N., Liang, J., Roberts, J. and Ying, Z.J., 2015. Does working from home work? Evidence from a chinese experiment. *Quarterly Journal of Economics*, 130(1), pp.165–218.

Chen, H., Harrison, D.M. and Khoshnoud, M., 2020. Investors' Limited Attention: Evidence from REITs. *Journal of Real Estate Finance and Economics*, 61, pp.408–442.

Delventhal, M.J., Kwon, E. and Parkhomenko, A., 2021. JUE Insight: How do cities change when we work from home? *Journal of Urban Economics*, 103331.

Dutche, E.G., 2012. The effects of telecommuting on productivity: An experimental examination. The role of dull and creative tasks. *Journal of Economic Behavior and Organization*, 84(1), pp.355–363.

Engel, R., 2010. Why Work When You Can Shirk?: Worker Productivity in an Experimental Setting. *The Journal of Applied Business and Economics*, 11(2), pp.104–119.

Gupta, A., Mittal, V., Peeters, J. and Nieuwerburgh, S. Van, 2021. Flattening the curve: Pandemic-Induced revaluation of urban real estate. *Journal of Financial Economics*.

Koren, M. and Peto, R., 2020. Business disruptions from social distancing. *PLoS ONE*, [online] 15(9), e0239113. Available at: <https://doi.org/10.1371/journal.pone.0239113>.

Liu, C. and Liu, P., 2013. Is what's bad for the goose (tenant), bad for the gander (landlord)? A retail real estate perspective. *Journal of Real Estate Research*, 35(3), pp.249–282.

Liu, S. and Su, Y., 2021. The impact of the COVID-19 pandemic on the demand for density: Evidence from the U.S. housing market. *Economics Letters*, 207, 110010.

London Chamber of Commerce and Industry, 2021. *Polling shows half of London businesses will support some remote workdays during post-pandemic week*. [online] Available at: <https://www.londonchamber.co.uk/news/press-releases/polling-shows-half-of-london-businesses-will-suppo/>.

Milcheva, S., 2021. Volatility and the Cross-Section of Real Estate Equity Returns during Covid-19. *Journal of Real Estate Finance and Economics*.

Papanikolaou, D., 2021. Working Remotely and the Supply-side Impact of Covid-19. *The Review of Asset Pricing Studies*.

Rosenthal, S.S., Strange, W.C. and Urrego, J.A., 2021. JUE insight: Are city centers losing their appeal? Commercial real estate, urban spatial structure, and COVID-19. *Journal of Urban Economics*, 103381.

World Health Organization, 2020. *Rolling updates on coronavirus disease (COVID-19)*. [online] Available at: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>.

YouGov, 2020. *Most workers want to work from home after COVID-19*. [online] Available at: <https://yougov.co.uk/topics/economy/articles-reports/2020/09/22/most-workers-want-work-home-after-covid-19>.

Appendix

Table A1. Variable definitions

Name	Definition
Abnormal Returns	Estimated using raw returns and market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany). The estimation model and process are described in detail in the methodology section.
Office PF	A dummy variable which takes the value of one for a REIT which has a property portfolio which has above median share of office properties (above 20% office properties in its portfolio).
Retail PF	A dummy variable which takes the value of one for a REIT which has a property portfolio which has above median share of retail properties (above 13% retail properties in its portfolio).
Tenant WFH Intensity	A ratio calculated as: the number of tenants that have announced WFH to the total number of in-sample tenants for REIT i on day t.
CBD Exposure	A ratio calculated as: the number of properties that fall within CBDs to the total number of in-sample properties held by a REIT.
CBD PF	A dummy variable that equals 1 for firms with an above-median value (among all in-sample firms) in CBD exposure.
Firm leverage	The ratio of total debt to total assets in year 2019.
High Leverage Dummy	A dummy variable that equals 1 for firms having above median leverage among in-sample firms.
Firm Size	The natural logarithm of [total asset +1] for a REIT, and the total asset of the year 2019 is used
NAV Return	Calculated as [(NAV per share at 2020- NAV per share at 2019)/ NAV per share at 2019]
UK/FR/DE	A dummy variable that equals 1 If the REIT is a UK/ France/ Germany REIT

Table A2. Name, headquarter location and sector of firms

Name	HQ Location	REIT Type
UK		
AEW UK REIT plc	London	Diversified REIT
Alternative Income REIT Plc	London	Diversified REIT
Assura Plc	Warrington	Healthcare REIT
Big Yellow Group Plc	Bagshot	Self-Storage REIT
BMO Commercial Property Trust Limited	Saint Peter Port	Diversified REIT
BMO Real Estate Investments Limited	Saint Peter Port	Diversified REIT
British Land Company Plc	London	Diversified REIT
Capital & Counties Properties PLC	London	Retail REIT
Capital & Regional Plc	London	Retail REIT
Custodian REIT Plc	Leicester	Diversified REIT
Derwent London Plc	London	Office REIT
Empiric Student Property Plc	London	Residential REIT
GCP Student Living Plc	Exeter	Residential REIT
Great Portland Estates Plc	London	Office REIT
Hammerson Plc	London	Retail REIT
Highcroft Investments Plc	Kidlington	Diversified REIT
Land Securities Group Plc	London	Diversified REIT
LondonMetric Property Plc	London	Diversified REIT
LXI REIT plc	Diversified REIT	London
McKay Securities Plc	Reading	Office REIT
NewRiver REIT plc	London	Retail REIT
Picton Property Income Limited	Saint Peter Port	Diversified REIT
Primary Health Properties Plc	London	Healthcare REIT
Real Estate Investors Plc	Birmingham	Diversified REIT
Regional REIT Limited	Guernsey	Office REIT
Safestore Holdings Plc	Borehamwood	Self-Storage REIT
Schroder Real Estate Investment Trust Limited	Saint Peter Port	Diversified REIT
Secure Income REIT Plc	London	Diversified REIT
SEGRO Plc	London	Industrial REIT
Shaftesbury PLC	London	Retail REIT
Standard Life Investments Property Income Trust Limited	Saint Peter Port	Diversified REIT
Supermarket Income REIT plc	London	Retail REIT
Target Healthcare REIT plc	Saint Helier	Healthcare REIT
Town Centre Securities Plc	Leeds	Diversified REIT

Tritax Big Box REIT Plc	London	Industrial REIT
UK Commercial Property REIT Limited	Saint Peter Port	Diversified REIT
Urban Logistics REIT plc	London	Industrial REIT
Warehouse REIT plc	Chester	Industrial REIT
Workspace Group Plc	London	Office REIT
France		
Covivio	Paris	Office REIT
Gecina	Paris	Diversified REIT
Icade	Issy-les-Moulineaux Cedex	Diversified REIT
Société de la Tour Eiffel	Paris	Office REIT
Société Foncière Lyonnaise	Paris	Office REIT
Unibail-Rodamco-Westfield	Paris	Retail REIT
CeGeREAL	Paris	Office REIT
Acanthe Développement	Paris	Office REIT
Altarea SCA	Paris	Residential REIT
Germany		
alstria office REIT-AG	Hamburg	Office REIT
Fair Value REIT-AG	Munich	Diversified REIT
Hamborner REIT AG	Duisburg	Retail REIT

Table A3. REIT-level Standard Deviations on Key Variables

Standard Deviation	Full sample	Office PF	Non-Office PF	WFH Intensity>0	WFH Intensity=0	UK	FR	DE
Abnormal Return	0.003	0.002	0.003	0.002	0.003	0.003	0.002	0.002
Office PF	0.505	0	0	0.338	0.396	0.498	0.441	0
Retail PF	0.505	0.51	0.51	0.509	0.509	0.502	0.441	0.577
Tenant WFH Intensity	0.036	0.043	0.011	0.042	0	0.038	0.023	0.015
CBD PF	0.505	0.43	0.408	0.482	0.48	0.506	0.527	0.577
CBD Exposure	0.302	0.307	0.275	0.284	0.316	0.3	0.362	0.054
Firm Leverage	0.109	0.128	0.089	0.132	0.087	0.094	0.126	0.142
Total Assets (€Mn)	10200	6959	12900	14000	3001	3833	20400	2486
NAV Return (2020)	0.133	0.081	0.167	0.079	0.16	0.139	0.098	0.037
Beta from market model	0.253	0.25	0.258	0.222	0.279	0.251	0.26	0.301
R2 from market model	0.156	0.156	0.158	0.145	0.166	0.145	0.168	0.288

Note: The table provides the standard deviation of the variables for firms in the sample. Accounting figures are from the year 2019 and accounting variables. The name of the columns specified the categories of firms that these values are calculated for. Abnormal Returns is estimated using raw returns and market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany). The estimation model and process are described in detail in the methodology section. Tenant WFH Intensity is a ratio calculated as: the number of tenants that have announced WFH to the total number of in-sample tenants for a REIT daily. Office PF is a dummy variable which takes the value of one for a REIT which has a property portfolio which has above median share of office properties (above 19% office properties in its portfolio). Retail PF is a dummy variable which takes the value of one for a REIT which has a property portfolio which has above median share of retail properties (above 13% retail properties in its portfolio) CBD Exposure is a ratio calculated as: the number of properties that fall within CBDs to the total number of in-sample properties held by a REIT. CBD PF is a dummy variable that equals 1 for firms with an above-median value (among all in-sample firms) in CBD exposure. Firm leverage is the ratio of total debt to total assets in year 2019. High Leverage Dummy equals 1 for firms having above median leverage among in-sample firms. Firm Size is the natural logarithm of [total asset +1] for a REIT, and the total asset of the year 2019 is used. NAV return is calculated as [(NAV per share at 2020- NAV per share at 2019)/ NAV per share at 2019]. UK/FR/DE equals 1 If the REIT is a UK/ France/ Germany REIT. Beta is estimated using firm's stock return and market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany), R2 is from the market model. The estimation model and process are described in detail in the methodology section.

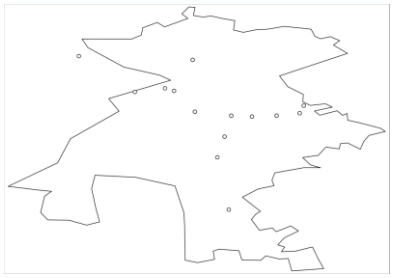
Table A4. Models with lagged WFH exposure

	Abnormal Return		
	(1)	(2)	(3)
L1_Tenant WFH Intensity	-0.0181***		
	(0.0069)		
L2_Tenant WFH Intensity		-0.0177**	
		(0.0072)	
L3_Tenant WFH Intensity			-0.0183**
			(0.0081)
High Leverage Dummy	-0.0003	-0.0003	-0.0003
	(0.0010)	(0.0010)	(0.0010)
Firm Size	0.0001	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)
Intercept	-0.0036	-0.0035	-0.0036
	(0.0079)	(0.0080)	(0.0081)
N	3906	3906	3906
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Within R2	0.2243	0.2243	0.2243
Overall R2	0.2234	0.2233	0.2234
Between R2	0.0841	0.0841	0.0845

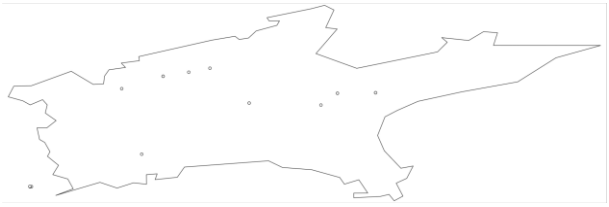
Note: This table presents the result of panel regressions using lagged tenant WFH intensity as the independent variable and the abnormal returns as the dependent variable. Abnormal Returns is estimated using raw returns and market indexes (FTSE100 Index for UK firms, CAC for France, and DAX for Germany). The estimation model and process are described in detail in the methodology section. Tenant WFH Intensity is a ratio calculated as: the number of tenants that have announced WFH to the total number of in-sample tenants for REIT i on day t. L1, L2 and L3 indicates 1 day, 2 day and 3 day lag respectively. High Leverage Dummy equals 1 for firms having above median leverage among in-sample firms (leverage is the ratio of total debt to total assets in year 2019). Firm Size is the natural logarithm of [total asset +1] for a REIT, and the total asset of the year 2019 is used. Day fixed effects and country fixed effects are included in all models. Standard errors are clustered on REIT sectors and are shown in parentheses. p-values are denoted as * for p<0.1, ** for p<0.05 and *** for p<0.01.

Figure A1. In-sample property locations within and close to CBDs

a. Central Birmingham



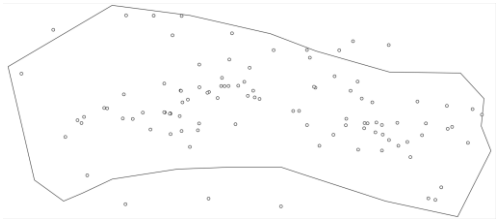
b. Central Manchester



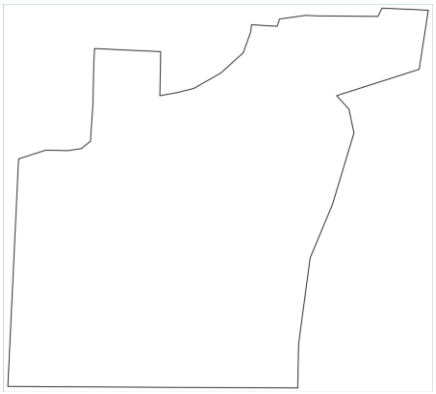
c. Central Edinburgh

d. London West End

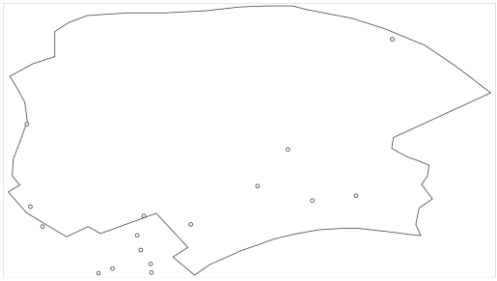
e. London City



f. Paris CBD

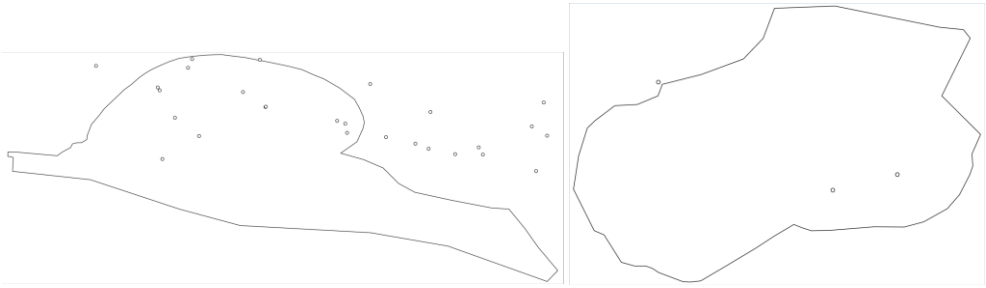


g. Dusseldorf CBD[17]



h. Frankfurt (City, Banking District, and Westend)

[17] The Dusseldorf CBD has been identified as a very small area located in the Dusseldorf City, a few in-sample properties are very close to the CBD boundaries but not within it.



i. Hamburg (City, Hafen City, and Harbour)

j. Munich City Centre

k. Berlin (Central, City West)

Note: Boundaries for CBD areas from CBRE research 2021.

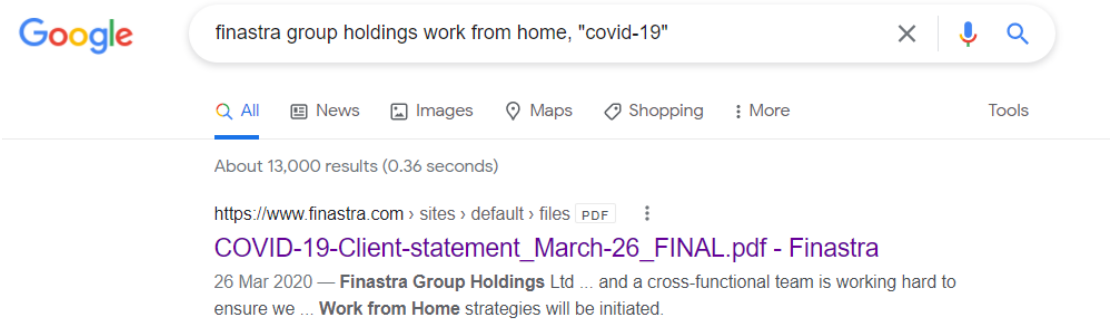



Figure A2. Screenshot example of a tenant's WFH announcement