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**Pandemic Risk
Exposure: Impacts of
COVID-19 Virus on Real
Estate Investments**

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**Pandemic risk exposure:
Impacts of Covid-19 virus on real estate investments.**

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Abstract:

The pandemic caused by the Covid-19 virus has severely impacted the real estate industry. The research investigates the relationship between the spread of the virus and REITs performances in Europe, considering the role played by localization and diversification of properties in the real estate portfolios. The results show that Covid-19 had heterogeneous impacts depending on property types. Moreover, risks associated to Covid-19 may be described by synthetic indexes that represent the degree of vulnerability of economic activities carried out in the real estates.

Keywords: Covid-19, commercial real estates, REITs, vulnerability, abnormal returns.

JEL Classification Numbers: G1, I10, D80, R10, R30.

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1. Introduction

The real estate sector has been one of the most affected by the Covid-19 pandemic and one of the last to recover (Wen and Arbogast 2021; Canton et al. 2021). The implementation of lockdowns and social distancing policies has undermined tenants' rental collection capacities (Akinsomi 2021) resulting in a reduction in cash flow for those real estate companies that derive most of their revenue from renting properties. High uncertainty about rental income and increased risk-aversion behaviour resulted in higher risk premia and declining property values (Duca et al. 2020). In the commercial real estate sector, the effects of confinement measure have been heterogeneous across property types (Balemi et al. 2021). For example, buildings hosting hotels have been directly hit by rental reduction due to the decrease both in international tourist arrivals and in business travels. Similarly, real estates with retail activities have suffered the restrictive policies because they needed to provide in person services. In many offices instead employees were able to offer the required services by teleworking from home. Therefore, also office buildings have remained vacant, and the effective experience of remote working have cast some doubts on the future of office space demand. On the other hand, manufacturing activities have continued their production with less problems, and storage and logistics spaces have been busy all over the pandemic period.

In the paper, we try to assess how much the shock of Covid-19 has been transmitted to the returns of real estate companies through their asset base considering that the intensity of the sanitary emergency has been heterogeneous across European territory - with the number of positive cases that have varied from region to region - and heterogeneous across sectors and real estate types - with some economic activities and professions more vulnerable than others. We test the significance of synthetic measures of firms' pandemic related risk by means of indices that measure the degree of sectoral vulnerability to the diffusion of the virus. For this, we followed Sanchez et al. (2020), Dingel and Neiman (2020) and Avdiou and Nayyar (2020) who suggested to divide jobs into three categories: those that are essential, those that can be done from home, and those that require face-to-face interactions to be performed. For each Ateco 2007 economic sector, the authors associate a percentage that indicate the share of workers that satisfy the criterium. By linking each property type to its most likely economic sector, it is possible to derive measures of essentiality, teleworkability and face-to-face interactivity for each property type. Stock returns of real estate company may also be influenced by the economic specialization of the surrounding region (Coulson et al. 2020, Bai and Zhu 2018). Among the others, Coulson et al. (2013) show that housing prices are significantly driven

by certain locally concentrated industries. The same may apply to commercial properties. Therefore, we rely on the concept of economic base* (Hoyt 1954; North 1955; Tiebout 1956) to understand whether the occupational composition of the regional economy in which REITs own properties, is important for the performance of real estate companies. Finally, we test whether environmental, social and governance (“ESG”) scores may have mitigated the COVID-19 shock (Broadstock et al. 2021, Demers et al. 2021, Engelhardt et al. 2021).

Since the beginning of the pandemic, many studies have tried to disentangle market reactions to the spread of coronavirus disease by looking at firm-level returns. For example, Ding et al. (2021) tried to determine the relationship between corporate characteristics and the performance of stock returns to Covid-19 cases; Ramelli and Wagner (2020) exploit the exogenous shock due to the pandemic outbreak to identify the drivers of firm value; He et al. (2022) analyse Chinese firms’ exposure to Covid-19 and they observe that a lower COVID exposure is associated with higher cash holding. Other studies instead focus on index-level returns: Gormsen and Kojen (2020) uses the S&P 500 for the United States, the EuroStoxx 50 for European Union, the Nikkei 225 for Japan, Doko Tchatoka et al. (2022) examine MSCI market index data while Szczygielski et al. 2022 analyse the reaction of industrial groupings. In the real estate sector, several studies evaluating the effects of Covid-19 concentrated on the housing market (Zhao 2020, Laysner et al. 2020, Gupta et al. 2021) even at the regional level (Del Giudice et al. 2020, Allen-Coghlan and McQuinn 2020, Duca et al. 2021, Zhang et al. 2022). D’Lima, Lopez and Pradhan (2020) were the first to document the effect of the disease spread on US residential properties transactions highlighting a significant decrease in sales and a modest decrease in prices in densely populated locations. Liu and Su (2021) found that the diffusion of teleworking has shift the US demand for houses away from dense neighbourhoods. Turning to commercial properties, most of the studies look at index-level returns (Gherghina et al. 2021 for Romania, Chong and Phillips 2022 with the estimation of the impact of Covid-19 on REITs index-returns in absence of fiscal and monetary policies). For example, Van Dijk, Thompson and Geltner (2020) analyse the performance of RCA Commercial Property Price

* According to the theory of the economic base (Hoyt, 1954; North, 1955; Tiebout, 1956), in a regional economic system it is possible to distinguish between: 1) “basic” activities, which are addressed to an external demand, and 2) “non-basic” activities, which are locally provided services that strictly depend on their growth on the level of basic activities. The first group identifies the sectoral specialization of the area and basic activities are also determinant for the occupational growth of the non-basic activities via sectoral interdependencies.

Indexes for eight major US metro markets; Gholipour et al. (2021) consider the effect of market participants' perceived uncertainty on both REITs and commercial property price index for the US. Among those looking at real estate sub-sectoral indexes, Akinsomi (2020) found that the top three REIT sector losers in the US are lodging/resort, retail and office; Hoesli and Malle (2021) for the European Union conclude that retail and hospitality properties (and to a lesser extent office buildings) have been affected the most by Covid-19, while the residential and industrial sectors have been less affected by the crisis. Ling et al. (2020) are the first to evaluate the effect of the pandemic on stock returns in the real estate market through firm's underlying assets. The authors relate US REITs abnormal returns to a weighted average of daily growth rates of Covid-19 cases in the counties in which the REITs own properties. By distinguishing between commercial real estate sectors, they show that hospitality and retail trade are those that have had the poorest performance. Similarly, Xie and Milcheva (2020) studied the Hong Kong case by considering the proximity of real estates to infections in the early stage of the pandemic. The results show that REITs with properties within two miles from a Covid-19 case have a 0.02% lower return the day after the disclosure of the case. Milcheva (2022) analysed the variation in the risk-return relationship before and after the outbreak of Covid-19 in the United States, Singapore, Hong Kong and Japan. She founded that the spread of the disease is associated with an increase in risk and a decrease in returns, which makes the risk-return relationship negative, especially in the United States. The most affected sectors are retail and accommodation in the US, offices in Asian countries. Cai and Xu (2022) distinguished the consequences of Covid-19 from that of recessions finding that the latter had negatively affected office and residential REITs returns while the former had a positive influence on industrial REITs returns. Finally, other studies have evaluated firm level exposure to pandemic even by relying on different measures. For example, Allan et al. (2021) evaluates the impact of the COVID-19 pandemic on commercial property rent dynamics in the Asia-Pacific region finding that rents had a decline of approximately 15% during the first six months of 2020. The most severe drops are associated to real estates located in areas with more Covid-19 cases.

To this literature, we made several original contributions. Firstly, while most of the studies look at the United States or Far East context, we focus on the European context for which evidence are scarce and confined to index-level returns. Secondly, we construct specific measures of real estate companies' vulnerability to evaluate the risk associated to Covid-19 diffusion. On this issue, Wang and Zhou (2021) limited their analysis to the impact of face-to-face interactions. Finally, we evaluate the importance of the regional economic base for real estate firms'

performance and the importance of ESG scores. The rest of the paper is structured as follows: Section 2 describes the empirical methodology followed and the data that have been used, Section 3 analyses the empirical results and Section 4 concludes.

2. Empirical methodology and data description

The empirical analysis evaluates the consequences of the diffusion of COVID-19 on the returns of the real estate sector. To achieve the aim, we consider the performance of 60 REITs which a) are among the constituents of the S&P Developed REIT Index and b) have their headquarters in one of the European countries[†], in the period between March 2020 and December 2021.

To evaluate the impact of COVID-19 exposure on firm-level stock returns, we adopt an event study methodology (Fama et al. 1969) according to which the effect of an event on stock prices is measured by the difference between the expected and the actual return, which is called abnormal return. Since expected returns are not observed, they need to be estimated. In the empirical analysis, the expected return model that is implemented is the market model according to which the return on stock i at time t ($R_{i,t}$) is determined by the return on the market at time t (M_t). The relationship is supposed to be linear, as in equation (1)

$$R_{i,t} = \alpha_i + \beta_i M_t + \varepsilon_{i,t} \quad (1)$$

which is estimated for a reference period, preceding the event to be evaluated, to obtain the estimated relationship for normal returns. In our case the reference period lasts from the 3rd of January 2019 to the 31st of December 2019 and the reference market is represented by the STOXX Europe 600 Index. Data on stock prices are obtained from the Bloomberg database and daily returns are calculated as log differences of day-to-day last prices. Subsequently, expected returns are computed for the period of interest by using the previously estimated parameters $\hat{\alpha}_i$ and $\hat{\beta}_i$, as in Equation (2)

$$ER_{i,t+k} = \hat{\alpha}_i + \hat{\beta}_i M_{t+k} \quad (2)$$

[†] Europe intended as the geographic region; therefore, REITs based in the UK are included in the analysis.

Finally, abnormal returns for the period $t + k$ are derived as the difference between actual stock returns ($R_{i,t+k}$) and normal returns that have been predicted in the previous step ($ER_{i,t+k}$), as in Equation (3)

$$AR_{i,t+k} = R_{i,t+k} - ER_{i,t+k} \quad (3)$$

Estimated daily abnormal returns are the dependent variable in the second step of the empirical analysis, where we test the significance of a set of explicative variables through linear regressions estimated using the OLS methodology. The period examined extends from the 2nd of March 2020 to the 31st of December 2021; therefore, our sample includes data for 60 equity REITs examined for 480 (working) days, for a total of 28,740 observations. We proceed starting from a baseline regression and gradually including more independent variables.

In the baseline regression we investigate the effect of regional COVID-19 daily growth rates on the REITs' returns of the day after. The growth rate of confirmed COVID-19 cases is computed at the NUTS 3 level[‡], by relying on the data collected by Naqvi (2021)[§] for the publicly accessible COVID-19 European regional tracker. To assign, for each point in time, unique values of REITs vulnerability to COVID 19, we compute a measure of REITs' exposure to COVID-19 which is a geographically weighted average of the growth rates obtained by multiplying the NUTS 3 growth rates of COVID-19 with the percentages of portfolio allocated in each NUTS 3 (*GeoCovid*). Figure 1 reports the evolution of geographically weighted growth rate of COVID-19 for the period March 2020 to December 2021. Data about companies' real estate portfolios are manually collected using information available in the annual reports. In particular, we compiled the list of real estate properties, reporting geographical location and type of property. The percentage of property portfolio located in each NUTS 3 is computed in terms of sizes (sqm) of real estate present in each NUTS 3 at the end of 2019. The total number

[‡] The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK. NUTS 3 regions correspond to the lower tier.

[§] Data on daily COVID-19 cases at the sub-national level for European countries are available at <https://github.com/asjadnaqvi/COVID19-European-Regional-Tracker>.

of properties belonging to the 60 REITs considered in the analysis is 5,252**. Figure 2 represents the geographic extent of the analysis. Data on the geographic localisation of the real estate properties are collected at the NUTS3 level. In the map, NUTS 3 regions with real estate belonging to the portfolios of the REITs considered in the analysis are coloured in grey. Most of the properties are in Western Europe. In particular, the countries involved in the analysis are Austria, Belgium, Czech Republic, Denmark, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden and UK. In the baseline regression we use *GeoCovid* reported on day $t - 1$ as a predictor for REITs' stock returns on day t , in order to test the hypothesis that news related to the diffusion of COVID-19 in the NUTS 3 in which REITs own properties has an effect on abnormal returns.

Subsequently, we investigate the role played by property types in determining the gap between actual and expected returns. The baseline regression is then enriched to account for diverse reactions across property types, that we derive from companies' annual reports. As discussed in the introduction, REITs focused on different property types experienced substantial variations in returns both before and after the onset of the pandemic. ++ Figure 3 reports the distribution of property types across companies' portfolios. Retail trade represents the most diffused type of property (30.7% of the total number of observations) followed by offices (22.6%). The least represented sectoral activities are those related to the arts, entertainment and recreation (0.4%), as well as the accommodation and food services (3.3%). Types of properties are classified in nine categories: manufacturing, transportation and warehousing, offices, student residences, housing, retail trade, healthcare and social assistance, accommodation and food services, arts entertainment and recreation. The significance of property type in explaining abnormal returns is tested in a second regression, where we include dummies for each category.

In the empirical analysis we also test the relevance of the economic structure of the region in which the REITs own real estate properties. In order to identify which economic sectors represent the economic base of the NUTS 2 region surrounding the NUTS 3 in which REITs own real estate properties, we use the criterion of the location quotient, according to which a sector is considered as "basic" activity if the number of jobs (relative to the total

** One REIT (LAND LN equity) does not report the full list of real estate belonging to its portfolio, in this case we considered only the top 10 real estate.

number of jobs in the region) in that sector is higher than the corresponding national average. For each possible “basic” sector considered in the analysis (industry, trade, transport and services), the location quotient (LQ_{sj}) is equal to

$$LQ_{sj} = \frac{(E_{sj}/E_j)}{(E_{sn}/E_n)} \quad (3)$$

where j , s and n define, respectively, the sector, the region (NUTS 2) and the nation under analysis, and E is the number of employees. If the ratio is greater than one, then there is a surplus of production and the sector represent an economic base for exports. For the economic activities identified as “basic”, the number of jobs exceeding the national average indicates the strength of the sector. In the empirical analysis we calculate the sectoral composition of the employment surplus of the regions (NUTS 2) in which REITs own real estate properties and then we compute for each REIT weighted averages based on the percentages of portfolio allocated in each NUTS 2. We test the significance of the economic base in explaining abnormal returns in the third version of the model.

Finally, to investigate property-type specific effect of GeoCovid, we augment the model with variables that result from the interaction between GeoCovid and the property type dummies. The resulting interaction variables allow to determine the different impacts of GeoCovid depending on the types of real estate properties in the REITs’ portfolios. For example, for the category *Accommodation and food services*, the estimated coefficient associated with the corresponding interaction variable express the difference in the impact of GeoCovid between the hospitality and the non-hospitality type of property.

We repeat the steps of the analysis using three indexes of COVID vulnerability in place of properties type. The indexes refer to the degree of essentiality of the jobs, the possibility of tele-working and the necessity of face-to-face interactions to perform the activity. The first measure, developed by Sanchez et al. (2020), indicates the percentages of jobs considered essential in each economic sector of the NACE 1 classification^{**} (Ess). For some categories, such as Public Administration, Human Health and Social Work Activities and Water Supply, 100% of the jobs are supposed to be essential; on the other hand, other sectors

^{**} Sanchez et al. (2020), table 2, page 2.

have been considered as non-essential at all. The latter comprise, for example, Arts, Entertainment and Recreation, Accommodation and Food Service Activities. We recompute Sanchez et al. (2020) percentages to sectoral activities associated to the property types considered in the empirical analysis. Once we determine the rate of essential jobs for each type of property, we compute for each REIT the proportion of essential jobs performed in the portfolio's real estate properties. The second measure of Covid-related risk exposure concerns the possibility of teleworking (*Tel*). Dingel and Neiman (2020) quantify the fraction of employees that are in tele-workable occupations for each economic sector in the NAICS 2-digit classification.^{§§} There is significant variation across occupations. For example, office workers are largely able to work from home while transport, construction, and production workers cannot. As before, we adapt the information to sectoral activities associated to the property types considered in the empirical analysis and we compute for each REIT the proportion of tele-workable jobs performed in the portfolio's real estate properties. The same procedure is adopted for the third measure, which is related to the necessity of face-to-face interactions with other workers or with customers to best perform the job. To determine an index of interactions intensity applied to the NAICS 2-digit economic sectors, Avdiou e Nayyar (2020)^{***} considered the necessity of: a) establishing and maintaining personal relations, b) assisting and caring for the others, c) working directly with the public, and d) selling or influencing purchases. Although the measure of interaction intensity (*FtoF*) may seem similar to that of tele-workability, for some sectors the two indicators differ. For example, many jobs in manufacturing require physical presence in the workplace but do not require much face-to-face interaction. On the contrary, teaching is likely to be carried out electronically, but it requires a strong component of interaction between teacher and student, and this may have influenced the performance of student residences.

As control variables, we use quarterly accounting data, obtained from the Bloomberg database. In particular, we consider determinants of daily stock returns reported in previous studies (e.g. Ling et al. 2020, Milcheva 2022). *Leverage* refers to financial leverage, and it is calculated as average total assets divided by average total common equity; *Tobin's Q* is the ratio of the market value of a firm to the replacement cost of the firm's assets. The

^{§§} Dingel and Neiman (2020), table 3, page 8.

^{***} Avdiou e Nayyar (2020), figure 1, appendix A.

numerator is the sum of market cap, total liabilities, preferred equity and minority interest, the denominator is total assets. *Assets* indicate the size of the REIT and are the total of all short and long-term assets as reported on the Balance Sheet; *Cash* is the sum of cash and cash equivalents divided by lagged total assets; *LagRet* are REITs returns in the last quarter of 2019. We also include two Herfindahl-Hirschman kind of indexes to account for firms' degree of concentration related either to the type of property (*SecHHI*) or to the geography (*NutsHHI*). Finally, we use as control variables three indicators of economic prosperity at the national level as industrial production (*IndProd*), unemployment (*Unempl*) and exports (*Exp*) and Bloomberg ESG (*Environmental - BESGENV, Governance - BESGGOV, Social - BESGSOC*) scores.

3. Empirical results

The results of the baseline regression are reported in the first column of Table 1, where we investigate the effect of regional COVID-19 daily growth rates (*GeoCovid*) on abnormal returns on the following day. The findings are in line with expectations: the estimated coefficient for *GeoCovid* is negative and highly significant: returns react negatively to the spread of the virus in regions where REITs own real estates. In the second column of Table 1 we investigate the reaction of REITs' returns to different property types in the period of COVID-19 diffusion. Three categories present a significantly negative sign, while another four have experienced positive returns in the pandemic period. The former group includes real estates dedicated to arts, entertainment and recreation activities, retail trade and offices; the latter comprises buildings with healthcare and social assistance functions, or real estates used for manufacturing, transportation and warehousing. Finally, housing has maintained positive returns, although poorly significant. Column (3) of Table 1 presents the estimation results of the regression in which we introduce the three indexes of COVID vulnerability, essentiality (*Ess*), teleworkability (*Tel*) and interaction intensity (*FtoF*) in place of properties type. The results indicate that, during the sanitary emergency, the ownership of real estates in which highly teleworkable activities were conducted has revealed to be harmful to stock returns. The same applies to those activities which need face-to-face interaction to be performed. While the former category may be associated to office work, the latter well represent retail trade. As noted with the previous estimates, offices and shops have suffered during the pandemic period. On the other hand, less teleworkable and in need of face-to-face interactions activities have performed better during COVID-19 spread. This is the case of manufacturing activities and warehousing.

Finally, real estate where essential jobs were performed experienced significantly positive returns. Healthcare and social assistance belong to this class of activities.

The influence of different local economic structures in determining REITs' performances, as well as the impact of their financial characteristics, is investigated in Table 2. The first column reports the estimation results when the property type dummies are included in the analysis, in the second column the binary variables are substituted with vulnerability indicators. In both cases, the coefficient of the main variable of interest, *GeoCovid*, is significant and maintain the expected negative sign. For what concerns the economic base, REITs surrounded by regions with commercial specialization, were favoured during the pandemic period. The reason behind this result may be that regions highly specialized in commerce tend to be more residential than regions with, for example, an industrial specialization, there the retail trade may have been replaced by the e-commerce, favouring warehouses. Control variables related to the economic dimension are industrial production, unemployment and exports. The former and the latter have significant coefficients, both positive. The other covariates, *Tobin's Q*, *Leverage*, *Asset*, *LagRet*, *Cash*, *NutsHHI*, *SecHHI*, are all not significant except for the sum of cash and cash equivalents divided by lagged total assets. In the second version of the analysis, when vulnerability indexes substitute property types, also the two Herfindahl-Hirschman indexes are slightly significant.

Subsequently, we determine property-type specific effect of *GeoCovid* by augmenting the previous models with interaction variables resulting from *GeoCovid* multiplied by property type dummies (Table 3, Column 1) or vulnerability indicators (Table 3, Column 2). The estimated coefficients indicate the difference in the impact of *GeoCovid* between the category of interest and the other categories. Reading Column 1 of Table 3, the specific impact of Covid-19 on retail trade is negative; while *GeoCovid* has been beneficial for the healthcare sector and the transportation and warehousing activities, maybe due to the significant increase in e-commerce experienced in the pandemic period. Looking at the second version of the model, with vulnerability indexes instead of property types, it turns out that the more teleworkable and highly interactive the activities are, the more they have been damaged by the spread of the virus.

Finally, we restrict our sample to those REITs with Bloomberg ESG (Environmental - BESGENV, Governance - BESGGOV, Social - BESGSOC) scores and we evaluate their impact in determining abnormal returns during the pandemic period. Table 4 presents the results. REITs with higher scores in social activities have been rewarded during the pandemic period.

4. Conclusions

The paper investigates the transmission of Covid-19 shock to the returns of real estate companies through their asset base. Results show that day-after returns are negatively related to the spread of the virus in regions where REITs own properties. The effect of Covid-19 shock has been heterogeneous across property types with some economic activities and professions more vulnerable than others: real estates dedicated to arts, entertainment and recreation activities, retail trade and offices have suffered the most in the pandemic period. On the other hand, properties comprising buildings with healthcare and social assistance functions, or real estates used for manufacturing, transportation and warehousing have reacted positively to the sanitary emergency. Moreover, lower stock returns are associated with the ownership of real estates in which highly teleworkable or interactive activities were conducted. The type of economic base of the region where REITs own properties contributed to determine variations in returns: regions highly specialized in commerce were favored during the pandemic. Finally, REITs with higher scores in social activities have been rewarded during the pandemic period.

Table 1. Column 1: Baseline results. Abnormal returns and geographically weighted COVID-19 growth. Column 2: Extended regression 1a. Abnormal returns and property types. Standard errors clustered at firm level. Column 3: Extended regression 1b. Abnormal returns and vulnerability.

VARIABLES	(1) Abnormal returns	(2) Abnormal returns	(3) Abnormal returns
GeoCovid	-1.831*** (0.337)	-1.838*** (0.339)	-1.837*** (0.338)
Accommodation and food services		-0.020 (0.019)	
Arts, entertainment and recreation activities		-0.042* (0.021)	
Healthcare and social assistance		0.024* (0.014)	
Retail trade		-0.033** (0.013)	
Manufacturing		0.069*** (0.020)	
Transportation and warehousing		0.078*** (0.017)	
Offices		-0.034** (0.015)	
Student residences		0.001 (0.0138)	
Housing		0.033* (0.019)	
Tel			-0.180*** (0.028)
Ess			0.053*** (0.015)
FtoF			-0.129*** (0.025)
Constant	-0.024** (0.009)	-0.019 (0.014)	0.084*** (0.024)
Observations	28,740	28,740	28,740
R-squared	0.042	0.043	0.043

Table 2. Abnormal returns and geographically weighted COVID-19 growth. Economic structure and financial controls included. Column 1: Dummies for property types included. Column 2: vulnerability indexes included. Standard errors clustered at firm level.

VARIABLES	(1) Abnormal returns	(2) Abnormal returns
GeoCovid	-1.309*** (0.382)	-1.293*** (0.379)
EB_industry	0.014 (0.043)	0.008 (0.035)
EB_trade	0.223** (0.108)	0.195** (0.086)
EB_transport	0.067 (0.059)	0.049 (0.049)
EB_services	0.007 (0.046)	0.008 (0.044)
IndProd	0.005*** (0.002)	0.005*** (0.002)
Unempl	-0.003 (0.004)	-0.001 (0.003)
Exp	0.002*** (0.001)	0.002*** (0.001)
Tobin's Q	-0.041 (0.063)	-0.098 (0.064)
Leverage	-0.014 (0.016)	-0.002 (0.014)
Asset	0.002 (0.001)	0.001 (0.001)
Cash	0.674** (0.274)	0.680*** (0.255)
NutsHHI	0.025 (0.039)	0.054* (0.028)
SecHHI	0.050 (0.040)	0.052* (0.027)
LagRet	0.001 (0.001)	0.001 (0.001)
Constant	-0.667*** (0.182)	-0.470*** (0.162)
Property types' dummies	YES	NO
Vulnerability indicators	NO	YES
Observations	28,740	28,740
R-squared	0.043	0.043

Table 3. Abnormal returns and geographically weighted COVID-19 growth. Interaction variables, economic structure and financial controls included. Col. 1: Dummies for property types included. Col. 2: vulnerability indexes included. Standard errors clustered at firm level.

VARIABLES	(1) Abnormal returns	(2) Abnormal returns
GeoCovid	-1.089* (0.592)	-0.714 (0.702)
Accomodation*GeoCovid	0.018 (0.016)	
Enterteinment*GeoCovid	-0.028 (0.019)	
Healthcare*GeoCovid	0.025*** (0.009)	
Retail*GeoCovid	-0.015* (0.008)	
Manufacturing*GeoCovid	0.010 (0.007)	
Transportation*GeoCovid	0.018*** (0.006)	
Offices*GeoCovid	-0.007 (0.007)	
Student*GeoCovid	-0.005 (0.010)	
Housing*GeoCovid	0.003 (0.006)	
Tel*GeoCovid		-0.033*** (0.011)
Ess*GeoCovid		0.037*** (0.009)
FtoF*GeoCovid		-0.0257*** (0.009)
Constant	-0.657*** (0.182)	-0.450*** (0.151)
Property types dummies	YES	NO
Vulnerability indicators	NO	YES
Control variables	YES	YES
Observations	28,740	28,740
R-squared	0.045	0.045

Table 4. Abnormal returns and geographically weighted COVID-19 growth. The role of ESG scores. Economic structure and financial controls included. Dummies for property types included.

VARIABLES	Abnormal returns
GeoCovid	-2.106** (0.769)
BESGENV	-0.003 (0.021)
BESGGOV	-0.011 (0.014)
BESGSOC	0.033*** (0.010)
Constant	-1.117*** (0.364)
Observations	13,412
R-squared	0.006

Figure 1. GeoCovid evolution March 2020-December 2021.

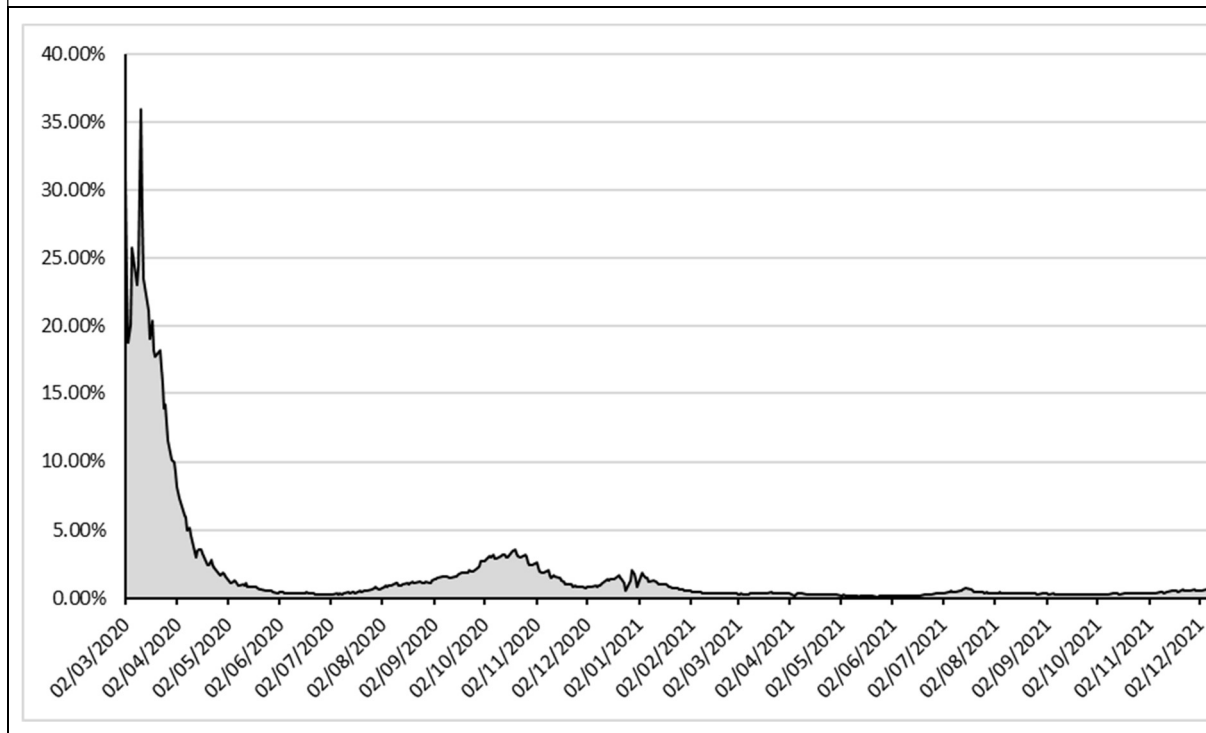


Figure 2. Geographical location of real estate properties.

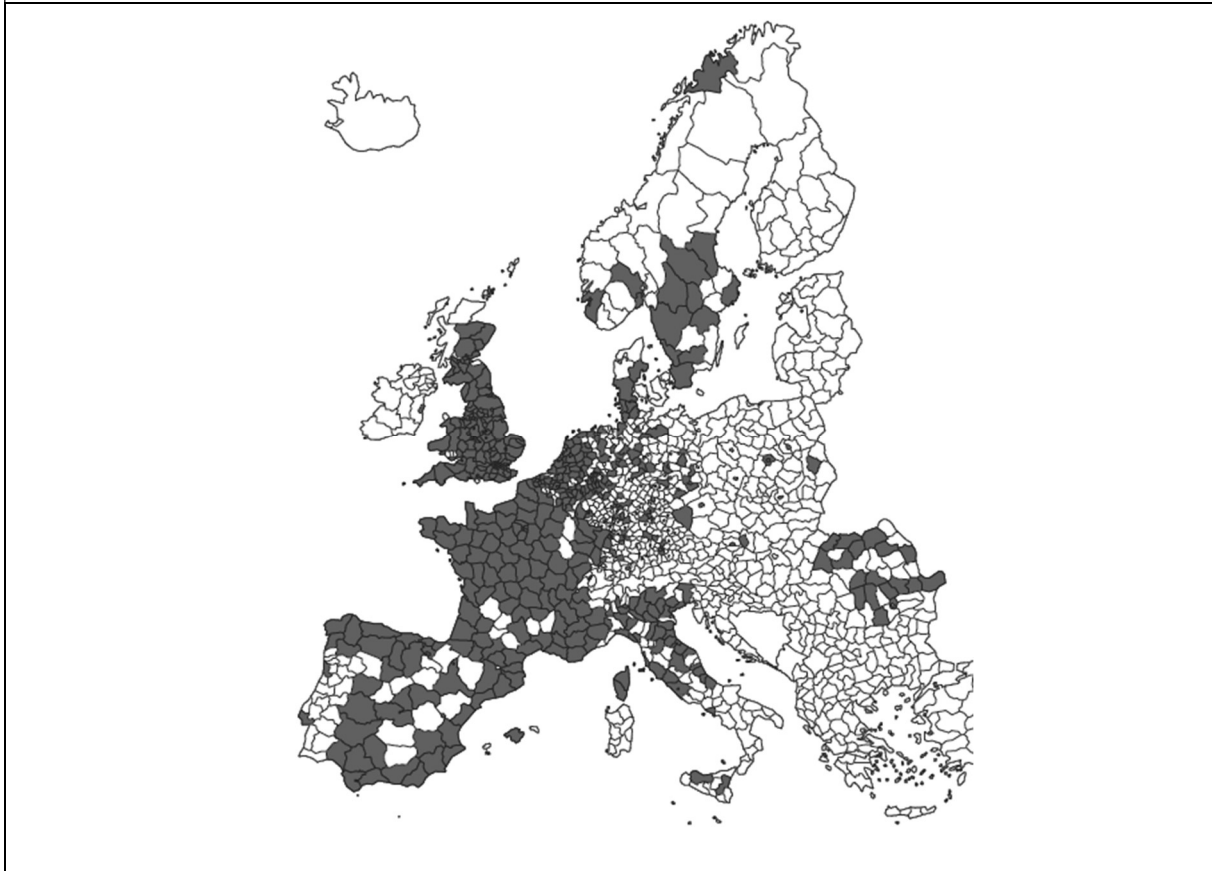
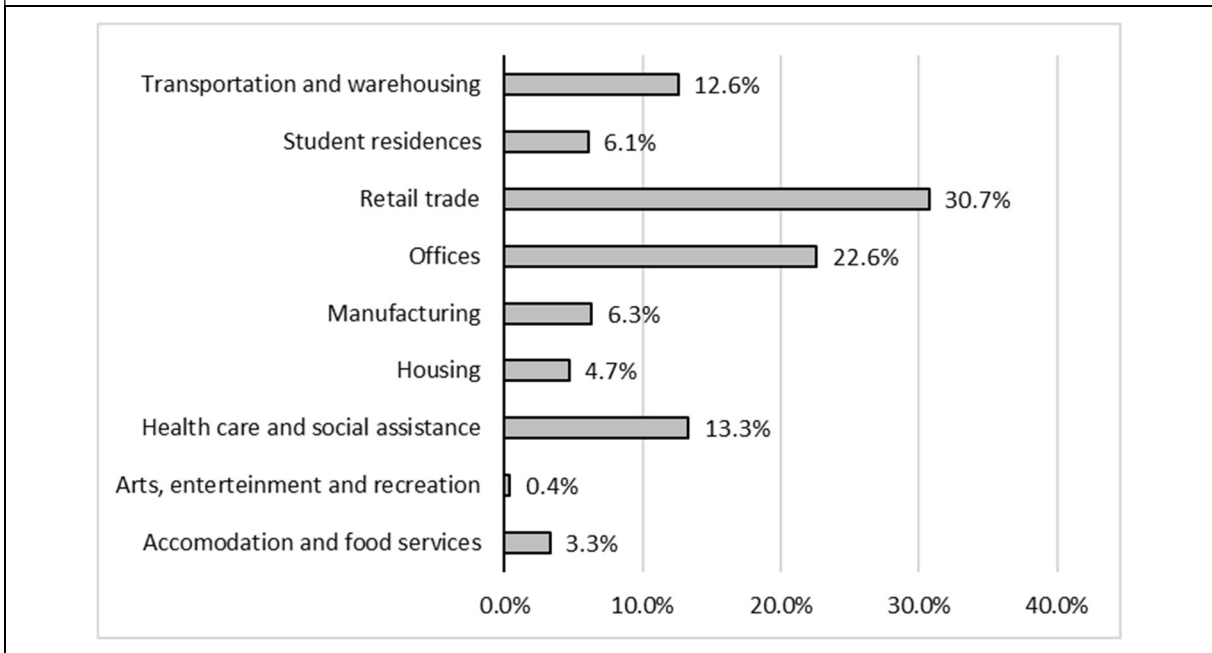


Figure 3. Composition of properties portfolios by type of activity.



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