How Do Institutional Investors React to Local Shocks During a Crisis? A Test Using the COVID-19 Pandemic

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Abstract

We examine how institutional investors reacted to geographically dispersed local shocks during the early stages of the COVID-19 pandemic. A sample of Real Estate Investment Trusts (REITs) enables us to link two layers of geography, the locations of assets in which the REITs were invested and the locations of institutional investors who owned REIT shares. We find that the institutional ownership of firms with an economic interest in the investors' home markets declined more if those markets were heavily affected by the pandemic. In addition, the ownership responses to the COVID-19 shock were larger in those markets in which REITs had larger portfolio allocations and in markets that were home to the investors. Importantly, we find that non-passive and short-term investors may have overreacted to the local shocks because their REIT portfolios underperformed relative to passive and long-term investors. Our study highlights the importance of geography in the formation of investors' expectations during market crises.

Keywords: Institutional investors, Information salience, COVID-19, Commercial real estate, Asset location, Crisis

JEL classification: D82, G11, G14, G23, R30

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1. Introduction

A considerable literature is devoted to better understanding the role of institutional investors during market crashes (e.g., Gabaix et al., 2006; Coval and Stafford, 2007; Greenwood and Thesmar, 2011; Anand et al., 2013; Cella et al., 2013; Ben-David et al., 2021). Gabaix et al. (2006) suggest that the trades of large investors in illiquid markets destabilize stock prices. Stein (2009) concludes that professional investors exacerbate stock market crashes and drive prices away from fundamental values.[1] Despite these well-documented effects on stock prices, less is known about the factors that influence institutional trading decisions during market crises. We focus on one potential factor: the geography of firms' assets and investors.

The onset of the COVID-19 health pandemic left few populations untouched and sent stock markets plunging, with the S&P 500 index losing about a third of its value during February and March of 2020. Because the pandemic originated out of public health concerns, rather than changes in financial or economic conditions, numerous recent papers use the pandemic as a natural experiment to study various financial outcomes (e.g., Fahlenbrach et al., 2020; Rameli and Wagner, 2020).[2] However, the severity of the public health crisis varied widely across geographies in its early stages.[3] The exogenous nature of the health shock to financial markets and the geographic variation in its severity provides an opportunity to examine the extent to which the locations of a firm's assets *and* its investors influence institutional ownership decisions, which have important ramifications for asset prices and market stability.

[1] Stein (2009) suggests that it could happen when investors do not know in real time how many other investors are taking the same position and when some of the investors are forced to liquidate their commonly held stocks.
[2] Fahlenbrach et al. (2020) and Rameli and Wagner (2020) argue that COVID-19 is close to a truly exogenous shock. Examples that use COVID as an exogenous shock to the financial market include studies of corporate cash holdings (Acharya and Steffen, 2020), environmental and social policies (Albuquerque et al., 2020), bank lending (Li et al., 2020), firms' access to capital markets (Halling et al., 2020), corporate governance (Eldar and Wittry, 2020), and the closed-end fund (CEF) discount (Ma, 2021).
[3] For example, the average daily growth in the number of reported cases in 2020 from January 21 (the first reported case) to April 15 (before the first local reopening) in our sample MSAs ranged from 0% to 10.6%. As of April 15, the number of reported cases scaled by population in our sample MSAs ranged from 0.1% to 0.43%.

Examination of the extent to which geography affected the responses of institutional investors to the COVID-19 pandemic requires accurate information about (1) the locations of investors and (2) the locations and importance of the firm's economic interests (i.e., its geographic "footprint"). Information on the locations of institutional investors is available for all listed firms.[4] However, the location and importance of conventional firms' economic interests are typically proxied for by the firm's headquarters location (e.g., Davis and Henderson, 2008; Pirinsky and Wang, 2006; Hong et al., 2008; Korniotis and Kumar, 2013; Dougal et al., 2015) or by employing a text-based approach to tabulate the number of times a U.S. state's name appears in the firm's 10-K filings (e.g., Garcia and Norli, 2012; Bernile et al., 2015). Both proxies suffer from potentially serious limitations.[5]

We improve on the measurement of a firm's geographic footprint, and therefore the exposure of its assets to the COVID-19 pandemic, by focusing our analysis on listed equity real estate investment trusts (REITs). REITs of all types collectively own more than $3.5 trillion in gross assets across the U.S., with stock-exchange listed REITs owning over $2.5 trillion in assets.[6] However, some of the institutional investors (e.g., pension funds) we study also invest directly in the "parallel" private commercial real estate (CRE) market, which contains properties collectively valued in excess of $10 trillion.[7] Although less liquid than the public market, we expect similar patterns of information-driven and sentiment-driven trading behavior among institutional investors in the larger private market.

Our dataset links the geographic exposure of equity REITs to 386 metropolitan statistical areas (MSAs) and to the locations of institutional investors who owned

[4] Many previous studies identify the locations of institutional investors by scraping SEC documents, investors' web sites, or Nelson's Directory of Investment Managers (e.g., Pool et al., 2012; Bernile et al., 2015).
[5] State counts (citations) implicitly assume states with different sizes and economic relevance are identical. The use of states as the unit of measure for geography also masks the potential variation across metropolitan areas within a state in economic activity, labor markets, and information availability. Moreover, the number of times a state's name appears in a firm's 10-K report may not directly identify the state's economic significance to the firm.
[6] reit.com/nareit (last access: September 14, 2021).
[7] https://www.reit.com/news/blog/market-commentary/total-size-of-us-commercial-real-estate-estimated-between-14-and-17-trillion

REIT shares. This dataset is well suited for this analysis for several reasons. First, the location of the assets in a REIT's CRE portfolio is fundamental to its stock price and can be precisely measured. This coupled with information on the date and cost of purchase of each property allows us to accurately determine the percentage of each REIT's overall portfolio invested in each MSA. In contrast, the location and value of the properties, factories, equipment, and intangible assets owned by many non-real estate firms are unobservable and often secondary to other determinants of firm value.[8]

Second, given the unexpected nature of the pandemic and its negative impact on liquidity in local CRE markets, REITs were unable to alter their portfolio holdings in a material way during the first few months of the health crisis;[9] in addition, institutional investors were not able to relocate within such a short period of time, especially under social distancing and lockdown orders.[10] Unlike prior studies of local investors' expectations and biases that must contend with potentially endogenous firm and asset location decisions (e.g., Pool et al., 2012), the geographically dispersed shocks associated with the onset of the pandemic provide a relatively clean identification strategy.

We conduct several exercises to examine how institutional investors react to COVID-induced local shocks using a difference-in-differences (DID) approach. Our identification relies on the unexpected nature of the *timing* of the pandemic, the assumed immobility of institutional investors during the early stages of the pandemic, and the rigidity of REIT portfolio holdings over our event window. In the first

[8] Even if it is possible to observe the value or cash flow generated by an asset, such as the sales revenue produced by a plant, it is typically the joint outcome of both the labor and land inputs employed during the production of final goods. For REITs, the primary input in the production process is the real estate, allowing us to distinguish the productivity of land and structure relative to labor.

[9] During the early stage of the pandemic, the number of real estate transactions declined significantly as investors were unable to perform onsite inspections and negotiate deals. This disruption affected both the CRE and housing markets.

[10] Note that our locations and property holdings are measured at the end of 2019Q1. Nevertheless, we checked the changes in property holdings by REITs during the first three quarters of 2021. According to the S&P Global Real Estate Properties database, the REITs in our sample sold 457 properties in 2019Q4. In contrast, just 47 properties were sold in 2020Q2 and 82 in 2020Q3.

exercise, we examine whether the geography of a firm's assets affected changes in firm-level institutional ownership after the onset of the pandemic. We construct two proxies for firm-level exposure to the COVID-19 shock during the pandemic's early stages. The first is the average daily growth of reported COVID-19 cases weighted by the percentage of each REIT's portfolio allocated to each MSA at the end of 2019. Our second proxy is the geographically weighted cumulative number of reported cases in each MSA, scaled by MSA's population.

We regress firm-level institutional ownership percentages against a post-COVID-19 dummy variable set equal to one if an observation falls in the first three quarters of 2020. This variable is interacted with our proxies for firm-level COVID-19 exposure, controlling for other predictors of institutional ownership as well as firm fixed effects and year-quarter fixed effects. We find a significant reduction in institutional ownership among REITs with greater portfolio exposure to the pandemic. That is, investors seem to respond to the cross-sectional differences in REITs' geographic footprints, regardless of the location of the investor.

Our second DID exercise disaggregates firm-level ownership into local ownership at the firm-MSA level by focusing on the locations of the institutional investors. We define "local" ownership as the ownership of firms with an economic interest in the investor's home MSA. A REIT has an economic interest in the investor's home MSA if it is headquartered there or owns property in the MSA. The magnitude of the REIT's economic interest varies with the percentage of a REIT's property portfolio allocated to the MSA. After controlling for time-varying, firm-level characteristics (through firm-by-year-quarter fixed effects), and factors related to firms' location-specific risk exposure (through firm-by-MSA fixed effects), we find that investors located in a particular MSA significantly reduced their ownership during the first three quarters of 2020 if their home MSA experienced a more severe COVID shock during the early stages of the pandemic. Furthermore, we find that the reduction in ownership among local investors is greater for REITs headquartered in

the same MSA as the investor, as well as for REITs with larger portfolio allocations in the investor's home MSA.

In our third exercise, we further dissect local institutional holdings at the firm-MSA level into the holdings of *individual* institutional investors headquartered in those MSAs (creating firm-MSA-investor pairs). This setup allows us to explore the impact of the heterogeneity of a firm's investor base (e.g., hedge funds *versus* indexers) on changes in institutional ownership. Our analyses based on this more granular sample reveal similar trends in COVID-induced ownership patterns as those at the firm-MSA level. In addition, the negative impact of the COVID-19 shock on institutional ownership is more pronounced among short-term and non-passive investors. These findings are consistent with the stabilizing influence of certain types of passive funds (Sushko and Turner, 2018; Glossner et al., 2020). It is also consistent with prior findings that non-passive investors, investors with short trading horizons, and those that trade frequently tend to engage in more extensive selling, leading to larger price declines during market turmoil (Cella et al, 2013; Dawkins et al, 2007).

Our fourth exercise includes all MSAs in which a REIT owns any properties – even if no institutional investor is located in the MSA. This allows us to test whether information salience is stronger in investors' home markets. Our findings suggest that investors responded to a REIT's COVID risk exposure in the investors' home MSAs: the reductions in local ownership in response to local shocks were more pronounced in investors' home MSAs.

Taken together, the above evidence on institutional ownership decisions, using different levels of granularity, suggests that the geographic dispersion of the intensity of local shocks plays an important role in shaping institutional investment decisions. However, an important question remains: what drives the portfolio reallocation decisions of investors? A reduction in the ownership of REITs with a presence in investors' home markets in response to locally severe shock may suggest that investors incorporate local, economically relevant information in their investment

decisions because they possess superior knowledge about their home markets (Coval and Moskowitz, 2001; Bernile et al., 2015). Such "*information-driven*" reactions to negative shocks would predict that investors decreased their holdings of REITs with a local presence more than their holdings of REITs with no economic interests in the investor's home market.

However, due to various financial and economic motivations, such as institutions' risk management, reputation concerns, herding, momentum trading, and bubble riding, institutional investors may react to changes in non-fundamentals-based sentiment in their local markets (e.g., DeVault et al., 2019; Korniotis and Kumar, 2013; Shiller, 2015).[11] In addition, investors might overreact to information about their home market due to salience (familiarity) bias; that is, a tendency to focus on events that are more noticeable or easier to recall (Tversky and Kahneman, 1973; Klibanoff et al., 1998; Bordalo et al., 2012).[12] Although reported COVID-19 cases are public information, investors might overweight local news and hence overestimate the pandemic risk. This misestimation could be further intensified by local news media, social networks, and the influence of their peers. Together, these "*sentiment-driven*" reactions also predict that overly risk-averse responses to the COVID-induced negative shock could be more pronounced in investors' local markets.

Although "*information-driven*" and "*sentiment-driven*" explanations of investors' trading behavior are not mutually exclusive, we investigate the relative importance of the two. We conduct a test that compares the ownership decisions of investors with respect to REITs that have a local presence. The idea is that, if the reduction in the ownership of REIT stocks that have economic interests in the investor's home MSA was driven by superior information, we would expect to find that the REIT portfolios of investors who were "heavy sellers" of REITs with a local presence (during the first quarter of 2020; that is, the *Feverish* period defined by

[11] Baker et al. (2012) suggest that the local component of investor sentiment affects the cross-section of returns considerably more than the global component. Soo (2018) finds that local sentiment predicts future houses prices.
[12] For example, Alok et al. (2020) find that mutual funds headquartered within a major disaster region overreact to climate disaster risks and underweight disaster zone stocks.

Ramelli and Wagner, 2020, and Gormsen and Koijen, 2020) performed better than non-heavy sellers when the market ceased its decline and began to rebound. We find instead that investors who heavily sold REITs with economic interests in the investor's home markets experienced lower risk-adjusted returns on their REIT portfolios. Moreover, heavy sellers located in low severity MSAs reduced their local holdings as much as sellers located in high severity MSAs and subsequently experienced the worst performance. In contrast, there is no performance difference between heavy sellers and their counterparts if we define heavy sellers based on their REIT holdings—regardless of asset location. These portfolio results suggest that, although we can not rule out the information channel, the sentiment channel appears to be more pronounced among some investors who overacted to the pandemic risk due to proximity-driven local sentiment or salience bias.

Although numerous studies have investigated the role of institutional investors during market crashes, to the best of our knowledge, our study is the first to investigate the role of geography in shaping institutional investors' decisions and their return performance during crisis periods. Leveraging granular data, we partition investors based on their geography and their manifest heterogeneous behavior. The first source of investor heterogeneity relates to the location choice of investors as well as that of the firms they own (e.g., Parsons et al., 2020; García and Norli, 2012; Bernile et al., 2015; Jannati, 2020; Smajlbegovic, 2019; Ling et al., 2021; Wang and Zhou, 2020). Ling et al. (2020) provide evidence that, in the early stage of the pandemic, the geographic exposure of a firm's asset base to the spread of the virus is negatively associated with stock returns. Although this heterogenous price response to the COVID-19 shock across locations helps explain stock price declines during the pandemic, its mechanism(s) is not well understood and might be associated with investors' preference for local investments.

The second source of investor heterogeneity arises from observed monitoring and trading behavior. Investors who assume a more active monitoring role might enjoy superior portfolio performance during normal times (Agarwal et al., 2013;

Bushee, 1998, 2001; Fich et al., 2015; Hardin et al., 2017). However, these "non-passive" investors may underperform during crisis periods and their active trading may exacerbate market crashes and destabilize prices. Their more passive peers, on the contrary, might be a stabilizing influence (Cella et al., 2013; Dawkins et al., 2007; Sushko and Turner, 2018; Glossner et al., 2020). Our study shows that some investors trade when they detect signs of COVID-induced market distress that might materialize in their location while others simply overreact to updates on the local COVID situation. In contrast to prior studies that examine how institutional ownership responds to universal shocks such as the global financial crisis and SEC regulation changes (e.g., Agarwal et al., 2013; Devos et al., 2013), our findings unveil the types of investors (i.e., non-passive and short-term) who may have overreacted during the crisis, leveraging the pandemic shock that unevenly impacts locations across the U.S.

Our results on "information-driven" and "sentiment-driven" explanations of trading behavior are related to studies debating whether a home or local bias is value-enhancing or value-destroying. A value-enhancing story would be consistent with an information-driven explanation when local investors are more informed about nearby assets and firms than their nonlocal peers (e.g., Coval and Moskowitz 1999, 2001, Hau, 2001, Garmaise and Moskowitz, 2004, Ivkovic and Weisbenner, 2005, Ivkovic et al. 2008, Teo, 2009). On the other hand, when investors do not possess a true information advantage, geographically biased investments may result in reduced portfolio performance (Huberman, 2001, Pool et al., 2012, Ben-David et al. 2017). The literature finds that local investors tend to be more bullish about their home markets than about distant markets (Strong and Xu, 2003, Cao et al., 2011, Solnik and Zuo, 2017). Sentiment-driven local overweighting might sharply reverse when certain types of investors overact to local shocks. Our sentiment-driven results contribute to this literature by documenting the opposite: investors holding more local assets tended to be heavy-sellers during the early stages of the pandemic and experienced worse investment outcomes after the initial onset of the pandemic.

2. Data

We start with a sample of 254 unique equity REITs obtained from the CRSP Ziman REIT database from 2017Q1 through 2020Q3.[13] These data are merged with investors' headquarters locations by searching the SEC EDGAR documents for all institutional investors that held equity REIT shares during the sample period.[14] We delete observations with missing financial information after merging with CRSP-Compustat as well as observations with incomplete information from Compustat Snapshot on historical REIT headquarter locations. These steps reduce the number of unique equity REITs to 187. Next, we merge our firm-level information with institutional ownership data from Thomson Reuters, which further reduces our sample to 181 REITs and 3,517 firm quarters. After the deletion of observations with missing data, our final sample contains 151 equity REITs and 3,009 firm quarters.

Our property-level data are obtained from the S&P Global Real Estate Properties database. For each property held by each REIT at the beginning of each year, we collect information on the property owner (institution name), property type, MSA location, acquisition date, sold date (if any), book value, initial cost, and historic cost.[15] We combine these data on historical property holdings from S&P Global with our merged REIT sample.

We measure COVID-19 severity during the early stage of the pandemic when the information was most salient (Hong et al., 2020; Ramelli and Wagner, 2020; Gormsen and Koijen, 2020). The first reported case in the U.S. occurred on January 21, 2020; however, the stock market did not experience a sharp decline until March, with a partial recovery in late April. March 5, 2020, is the date when the first local

[13] Since we have a relatively short post-pandemic window, we follow the previous literature (e.g., Albuquerque et al., 2020; Wang and Zhou, 2021) and start our sample period at the beginning of 2017. Results are qualitative similar when we start our sample period in 2015, 2016 or 2018.

[14] Equity REITs own income-producing real estate and obtain most of their revenues from rents. Mortgage REITs invest in mortgages or mortgage-backed securities.

[15] Initial cost (S&P Global KeyField: 221778) equals the original cost basis assigned to the property by the acquirer. Historical cost (S&P Global KeyField: 221782) equals the initial cost of the property plus capitalized expenditures and land improvements, net of write-downs.

non-pharmaceutical interventions (NPIs), such as shelter-in-place orders, went into effect in our sample. By April 15, roughly 67% percent of the value of an average firm's portfolio in our sample had been exposed to NPIs. On April 20, South Carolina adopted the first reopening policy. We therefore measure a firm's exposure to the COVID-19 shock from January 21 to April 15, 2020.[16]

We construct measures of the intensity of the COVID-19 shock at both the firm level and the MSA level. For our firm-level analysis, we first construct *COVID Growth*, which is the average of the geographically weighted daily growth of reported COVID-19 cases to which the REIT was exposed (Ling et al., 2020). Specifically, we first calculate the percentage of each REIT's property portfolio, based on depreciated book values, invested in each MSA at the end of 2019.[17] We then match these portfolio allocations with the daily growth rates of MSA-level COVID-19 confirmed cases, which are obtained from the Coronavirus COVID-19 Global Cases database at Johns Hopkins University.[18] These MSA-level growth rates are value-weighted by the percentage of the REIT's portfolio invested in each MSA. This produces an estimated daily COVID-19 exposure for each firm. We then calculate the average of these daily growth rates from January 21 to April 15, 2020.

Our second firm-level *COVID* measure, *COVID Severity*, is the log of the cumulative number of reported cases in a MSA from January 21 to April 15, 2020, scaled by the MSA's population, and then weighted by the percentage of each REIT's portfolio located in the MSA at the end of 2019.[19] Our two measures of a firm's geographically weighted exposure to the COVID-19 shock complement each other because the first captures the growth in COVID cases during the early stages of the pandemic while the second serves as a static snapshot of severity. For our analyses

[16] We also use alternative dates, including March 5, March 30 (i.e., the end of Q1), and April 20. Our results are qualitative similar using these alternative dates.

[17] The use of book values in place of unobservable true market values may understate (overstate) the value-weighted percentage of a CRE portfolio invested in regions that have recently experienced a relatively high (low) rate of price appreciation.

[18] https://github.com/CSSEGISandData/COVID-19

[19] This variable is shown as a percentage in Table 1 for presentation purposes and in a log form in regressions.

at the firm-MSA and firm-investor-MSA levels, we measure $COVID\ Growth$ and $COVID\ Severity$ directly at the MSA level.

3. Results

3.1 Firm-level Analysis

We first estimate the following difference-in-differences (DID) model:

$$IO_{i,t} = \alpha + \beta Post_t \cdot COVID_i + X_{i,t-1} + \gamma_i + \delta_t + \varepsilon_{i,t}, \quad (1)$$

where $IO_{i,t}$ is the fraction of REIT *i*'s shares held by institutional investors in quarter *t*.[20] The ownership data from Thomson Reuters are recorded at the end of each quarter. Investors started responding to the unfolding COVID crisis in the first quarter of 2020;[21] therefore, we construct a time dummy, $Post_t$, that equals one for quarters 2020Q1 to 2020Q3, and zero before.

$X_{i,t-1}$ includes a set of lagged firm-quarter control variables, following the related finance and real estate literature (e.g., Chung and Zhang, 2011; Bernile et al., 2015; Hartzell et al., 2014; Devos et al., 2013; Ling et al., 2021). *MKTCAP* is the natural logarithm of the product of the stock price and the number of common shares outstanding. *IVOL* is the standard deviation of residuals from monthly Fama-French-Carhart 4-factor-model regressions of daily stock returns. *ILLIQUID* captures the stock's illiquidity during the quarter following Amihud (2002). *LOGPRC* is the natural logarithm of the stock price and *LAG3MREIT* is the stock's total return over the prior three months. *MB* is the market value of the firm's assets divided by total book value and *ROA* is the ratio of net income to total assets. *LEVERAGE* is the sum of current liabilities and long-term debt, divided by total assets.

[20] We follow the literature (e.g., Chung and Zhang, 2011; Ling et al., 2021) and use $IO_{i,t}$ instead of $IO_{i,t+1}$. Our results are qualitatively the same using $IO_{i,t+1}$.

[21] Ramelli and Wagner (2020) point out that the first conference call by U.S. firms using any COVID-19 related keywords took place on January 22, 2020. The World Health Organization characterized COVID-19 as a pandemic on March 11.

We add several geographic controls frequently used in the literature (e.g., Hartzell et al., 2014; Wang and Zhou, 2020; Feng et al., 2021; Ling et al., 2021). *HOMECON* is the percentage of the total book value of a REIT's portfolio allocated to its headquarters MSA in quarter t-1. *GEOHHI* and *PropHHI* are Herfindahl indices that capture the degree to which the firm concentrates its property portfolio by county or by property type. The data used to calculate these control variables are obtained from the CRSP-Compustat merged database and S&P Global. Daily and monthly share price and the number of shares outstanding are obtained from CRSP-Ziman. Table A1 contains variable definitions and corresponding data sources. γ_i and δ_t in equation (1) represent firm fixed effects and year-by-quarter fixed effects, respectively. Standard errors are clustered at the firm level.

In our model, *COVID* acts as a continuous treatment variable. Our identification assumption is that, in the absence of the COVID-19 pandemic, institutional ownership would have changed in parallel fashion in both the treatment and pre-COVID-19 control group, controlling for firm fixed effects, year-quarter fixed effects, and other firm-level, time-varying, observables. This is a plausible assumption because the onset of the pandemic was an unexpected shock to investors (e.g., Albuquerque et al., 2020; Acharya and Steffen, 2020) and to REITs who were unable to materially adjust their geographic property allocations during the early stages of the pandemic.

One potential concern is that the local shock may be correlated with the expected changes in asset allocations and, therefore, institutional ownership. For example, Fisher et al. (2020) provide evidence that properties in population-dense areas generally performed better than properties in less dense locations. If REITs were therefore shifting allocations toward more dense areas prior to the pandemic to capture this expected outperformance, then movements in share prices and institutional ownership may have been driven, at least in part, by expectations formed prior to its onset. However, if expected property performance and population

density are both positively correlated with institutional ownership, this would work *against* finding a negative coefficient on *COVID* growth or severity.

To test the parallel trend assumption, we construct time dummies for each quarter in our sample and interact each with proxies for COVID severity. This allows us to examine changes in institutional ownership before and after the COVID outbreak., i.e., 2020Q1 (the omitted category). The estimated quarterly coefficients plotted in Figure 1 do not exhibit a trend prior to the COVID outbreak. However, a significant and persistent negative trend is observable after the outbreak. We also conduct DID analyses at the firm-MSA and firm-investor levels with more rigorous controls and fixed effects. These results are reported in sections 3.2 and 3.3.

Table 1 shows the summary statistics for our firm-level variables. During our sample period, the average (median) institutional ownership (IO) is 77.2% (85.0%), which highlights the important role of REIT institutional ownership.[22] Firm-level, geographically weighted, COVID growth (severity) from January 21, 2020 to April 15, 2020 averaged 6.9% (0.053%) with a standard deviation of 1.4% (0.074%). On average, 15.0% of a REIT's portfolio is located in its home MSA. The average Herfindfahl index for geographic focus is 0.187, which is consistent with Feng et al. (2020) and Wang and Zhou (2020). In contrast, the average property type Herfindfahl index is 0.879, which indicates that a typical REIT is highly focused by property type (Capozza and Seguin, 1990; Hartzell et al., 2014). An average REIT in our sample has a market cap of $5.1 billion, idiosyncratic volatility of 1.4%, an average Amihud (2002) illiquidity of 1.33, a market-to-book ratio of 2.6, a quarterly return on asset of 1.3%, a leverage ratio of 49.1%, and a previous three-month stock return of 1.0%.

The results from estimating equation (1) are presented in Table 2. This firm-level specification, which does not capture institutional ownership at the MSA level, is estimated with 3,009 firm-quarter observations. The estimated coefficients on both

[22] In fact, there has been an increasing interest from institutional investors since REITs' initial appearance into the S&P 500 index in 2001. See Pavlov et al. (2018).

Post-COVID × COVID Growth$_i$ and *Post-COVID × COVID Severity*$_i$ are negative and significant at the 1% level, indicating that institutional investors reduced their holdings of REITs with greater portfolio exposures to the pandemic. A one-standard-deviation increase in *COVID Growth*$_i$ reduced firm-level institutional ownership by 2.29 percentage points (=-1.633×0.014×100%). This magnitude is economically significant given that the average quarterly change in IO prior to the COVID outbreak was about -1 percentage point. Similarly, a one-standard-deviation increase in *COVID Severity*$_i$ is associated with a 1.79 percentage point decrease (=-0.026×0.69×100%) in institutional ownership.[23] The estimated coefficients of our control variables are consistent with prior studies (e.g., Badrinath et al., 1996; Falkenstein, 1996; Chung and Zhang, 2011; Ling et al., 2021). The high R-squared (over 0.80) suggests that our fixed effects model explains a substantial amount of variation in institutional ownership.

3.2 Firm-MSA level Analysis

We now examine how local investors reacted to the COVID-induced local shock in their home MSAs by estimating the following DID model using firm-MSA pairs:

$$LIO_{i,h,t} = \alpha + \beta_1 Post_t \cdot COVID_h + \gamma_{i,t} + \delta_{i,h} + \varepsilon_{i,h,t}. \quad (2)$$

Local institutional ownership, $LIO_{i,h,t}$, is defined as the percentage of firm *i*'s shares owned by institutional investors headquartered in MSA *h* in quarter *t*. The disaggregation of $IO_{i,t}$ from equation (1) by MSA increases the number of observations from 3,009 to 31,721. The firm-by-year-by-quarter fixed effects, $\gamma_{i,t}$, absorb time-varying firm-level characteristics (i.e., the control variables in equation (1)). Since most REITs tend to focus on a specific property type, the firm-by-year-by-quarter fixed effects also saturate the heterogeneous performance of property types over time. The firm-by-MSA fixed effects, $\delta_{i,h}$, capture factors related to the firms' location-specific risk exposure that are constant over time. Table 1, Panel B shows the

[23] In our regression estimations, we log transform the raw severity measure for ease of interpretation of its coefficient. For presentation purposes, however, we show the severity measure as a percentage in Table 1.

summary statistics of our firm-MSA-level variables. Local (MSA-level) institutional ownership has a mean of 2.86% and a standard deviation of 7.25%. The average MSA-level COVID growth (severity) is 9.4% (0.17%).

The results from estimating equation (2) are reported in columns (1) and (2) of Table 3. We cluster standard errors at the firm-quarter level to account for serial correlation within the same firm across MSA and time.[24] The coefficient estimates on our control variables vary little from those presented in Table 2 and are suppressed for brevity. The estimated coefficients on $Post\text{-}COVID \times COVID\ Growth_h$ and $Post\text{-}COVID \times COVID\ Severity_h$ are negative and significant, consistent with our previous firm-level analysis. Since our sample is constructed at the firm-MSA level, the average quarterly change in local ownership is only 0.086 percentage points. However, the economic significance of the DID coefficients is substantial: a one-standard-deviation increase in $COVID\ Growth_h$ $(COVID\ Severity_h)$ reduces local ownership by 0.056 (0.101) percentage points, representing 65% (117%) of the sample mean. This suggests that the extent to which investors headquartered in MSA h reduced their holdings of REIT i in quarter t is related to the severity of the COVID shock experienced by MSA h in the early stage of the pandemic. This MSA-level finding compliments our firm-level results which use an aggregate geographically weighted measure of COVID severity. Importantly, the results reported in the first two columns of Table 3 provide evidence of IO effects at the MSA level, even after controlling for time-varying firm performance, time-varying property sector performance, and firm-specific preferences over locations. The R-squared values are larger than those from our firm-level analysis because the regression models are more saturated with the inclusion of firm-by-year-by-quarter fixed effects.

We next examine whether the effects of the COVID shock on institutional ownership are more pronounced in MSA h if the MSA is also REIT i*'s* headquarters.

[24] We cluster at firm-quarter level which is the same as our fixed effects (Bertrand et al. 2004). Results clustered at the firm level are highly similar.

Specifically, expand equation (2) by estimating the following difference-in-difference-differences (DDD) model:

$$LIO_{i,h,t} = \alpha + \beta_1 Post_t \cdot COVID_h \cdot REIT\ HQ_{i,h,t} + \beta_2 \cdot Post_t \cdot COVID_h + \gamma_{i,t} + \delta_{i,h} + \varepsilon_{i,h,t}. \quad (3)$$

$REIT\ HQ_{i,h,t}$ is equal to one if REIT i is headquartered in MSA h in quarter t, and 0 otherwise. A negative estimate of β_1 would indicate that local ownership of REIT i's stock among investors headquartered in MSA h is further reduced if REIT i is headquartered in MSA h.

Columns (3) and (4) of Table 3 display the results. Prior research finds that investors recognize the potential operating efficiency REITs have in their local markets (Capozza and Seguin, 1999). Therefore, any adverse local shocks might be magnified in the REITs' home markets. Consistent with this expectation, we find that the DDD (triple interaction) coefficient estimates are negative and significant, indicating the COVID-induced reduction in local ownership is more pronounced when the REIT is headquartered in the investor's home MSA. This reduction in ownership is economically significant (= -0.433 percentage points). Similarly, the results reported in column (4) suggest that a one-standard-deviation increase in *COVID Severity*$_h$ is associated with a post-COVID decline in *LIO* of 0.062 percentage points. This reduction is further magnified by 0.284 percentage points if the REIT is headquartered in the investor's home MSA.

We also investigate whether the effect of the COVID shock on institutional ownership is more pronounced if REIT i holds more properties in MSA h using the following DDD model:

$$LIO_{i,h,t} = \alpha + \beta_1 Post_t \cdot COVID_h \cdot PropSHR_{i,h,t-4} + \beta_2 \cdot Post_t \cdot COVID_h + \gamma_{i,t} + \delta_{i,h} + \varepsilon_{i,h,t} \quad . \quad (4)$$

$PropSHR_{i,h,t-1}$ is the percentage of REIT i's portfolio invested in MSA h at the end of 2019. On average, REITs hold 4.24% of their properties in MSAs in which their investors are headquartered. (Table 1). A negative estimate of β_1 would indicate that

local ownership of REIT *i*'s stock among investors headquartered in MSA *h* is reduced if REIT *i* invests a large proportion of its portfolio in MSA *h*.

The results from estimating equations (4) are reported in columns (5) and (6) of Table 3. The estimated coefficients on the triple interaction variables are negative and statistically significant at the 5% level or higher, suggesting that reductions in local ownership are related to how concentrated the REIT's portfolio is in the investors' home market. The incremental effect of a one-standard-deviation increase in *PropSHR* on *LIO*, holding $COVID\ Growth_h$ ($COVID\ Severity_h$) at its mean, is an economically significant -0.572 (-0.113) percentage points.

In sum, the results reported in Table 3 reveal that COVID-19-induced local shocks influenced institutional investors' ownership decisions; moreover, the effects were more pronounced among REITs headquartered in the investor's home MSA and in markets in which the REIT owns more properties.

3.3 Firm-Investor (MSA) level Analysis

Our dependent variable in equations (2)-(4) is constructed by aggregating across the REIT holdings of all institutional investors located in a particular MSA (e.g., Boston). While this setup has merit (being concise), it precludes us from exploring the heterogeneity of a REIT's investor base beyond the dimension of geography. For example, in contrast to a passive Boston-based investor, a non-passive local peer might be more (less) sensitive to the salient COVID shock and therefore reduce her positions more (less).

To examine potential investor heterogeneity within a MSA, we disaggregate our dependent variable in equation (2) by including the holdings of *individual* investors headquartered in the same MSA and estimate the following DID equation:

$$LIO_{i,j,h,t} = \alpha + \beta_1 Post_t \cdot COVID_h + \gamma_{i,t} + \delta_{i,j,h} + \varepsilon_{i,j,h,t}, \qquad (2b)$$

Our dependent variable is $LIO_{i,j,h,t}$, defined as the local ownership of firm *i,* held by investor *j*, headquartered in MSA *h*, in quarter *t*. The disaggregation of local institutional ownership by investors increases our sample size to 166,600. The average MSA in our sample is home to about five investors. We also add firm-investor pair fixed effects, $\delta_{i,j,h}$, to control for the preference of individual investors for specific firms. This model specification allows us to investigate the behavior of different investor types in response to the COVID shock: in particular, short-term *versus* long-term investors and passive *versus* non-passive investors.

Using $LIO_{i,j,h,t}$ as the dependent variable, we also estimate the following DDD models:

$$LIO_{i,j,h,t} = \alpha + \beta_1 Post_t \cdot COVID_h \cdot REIT\ HQ_i + \beta_2 \cdot Post_t \cdot COVID_h + \gamma_{i,t} + \delta_{i,j,h} + \varepsilon_{i,j,h,t}, \quad (3b)$$

$$LIO_{i,j,h,t} = \alpha + \beta_1 Post_t \cdot COVID_h \cdot PropSHR_{i,h,t-1} + \beta_2 \cdot Post_t \cdot COVID_{h,t} + \gamma_{i,t} + \delta_{i,j,h} + \varepsilon_{i,j,h,t} \quad (4b)$$

The summary statistics of our firm-investor (MSA)-level variables are displayed in Table 1. Because the dependent variable now measures the ownership of individual investors, the mean of our local ownership measure, $LIO_{i,j,h,t}$, is smaller than the mean firm-MSA-level $LIO_{i,h,t}$. However, the means of our two COVID measures, *REIT HQ*, and *PropSHR* are larger than those in Panel B because the investors in our sample tend to cluster in MSAs more negatively affected during the early stages of the pandemic (e.g., New York).

Table 4 presents the results from estimating equations (2b) through (4b). The results in columns (1) and (2) are highly consistent with the corresponding results in Table 3. Even when controlling for investors' preferences for certain REITs (through the use of firm-by-investor fixed effects), we still find that the ownership of REITs with a local economic presence is reduced more in markets that were hit harder by the pandemic (columns (1) and (2)). However, the change in ownership among

investors located in MSA h is no longer associated with the REIT being headquartered in MSA h (columns (3) and (4)).

Importantly, the results displayed in columns (5) and (6) reveal that it is the magnitude of a REIT's allocation to MSA h that explains the reduction of ownership in MSA h. To further gauge economic significance, we tabulate the distribution of the quarterly change in $LIO_{i,j,h,t}$ within the same firm and the same MSA prior to COVID. Since our sample is constructed at the firm-investor (MSA)-level, the mean and median are close to zero, and the 25 (75) percentile is about -0.08 (0.08). Holding $COVID\ Growth_h$ ($COVID\ Severity_h$) at its mean, the effects of a one-standard-deviation increase in $PropSHR$ on $LIO_{i,j,h,t}$ is -0.148 (-0.113) percentage points. Hence, the effects of $PropSHR$ on $LIO_{i,j,h,t}$ in the early stages of the pandemic are quite large.

The literature often partitions institutional investors into groups based on their manifest behavior and typically finds that investors that trade frequently tend to exacerbate stock crash risk and destabilize prices. In contrast, certain types of passive investors have been found to be a stabilizing influence (Cella et al, 2013; Dawkins et al, 2007; Sushko and Turner, 2018; Glossner et al., 2020). We therefore expect short-term and nonpassive investors to be more sensitive to negative COVID-induced local shocks.

To investigate this issue, we divide $LIO_{i,j,h,t}$ into "short-term" and "long-term" investors based on the frequency of their stock trading (Cella et al, 2013). Using quarterly 13f filing for each institutional investor, we calculate the "churn ratio" for each investor-quarter.[25] An investor is classified as a short-term (long-term) investor if the churn ratio is below (above) the median during the prior quarter. We also follow

[25] The churn ratio is calculated as follows:

$$Churn\ Ratio_{j,q} = \frac{\sum_{i \in I} \left| N_{i,j,q} P_{i,q} - N_{i,j,q-1} P_{i,q-1} - N_{i,j,q-1} \Delta P_{i,q} \right|}{\sum_{i \in I} \frac{N_{i,j,q} P_{i,q} + N_{i,j,q-1} P_{i,q-1}}{2}},$$

where $P_{i,q}$ and $N_{i,j,q}$ are the price and number of shares of stock i owned by institution j in quarter q, respectively. The churn ratio is widely adopted as a measure of investor trading horizon (Gaspar, Massa, and Matos, 2005; Yan and Zhang, 2009; Cella et al., 2013).

Bushee (1998, 2001) and Bushee and Noe (2000) and classify institutional investors as either *PASSIVE* (i.e., quasi-indexer) or *NONPASS* (i.e., dedicated or transient).[26]

We summarize the results by investor type in Table 5. Each reported coefficient estimate represents a separate regression using local ownership by investor type as our dependent variable and a COVID measure as our test variable. Model specifications, including fixed effects, are the same as those used in equations 2b and 4b. The results are consistent with our expectations. First, we observe negative and significant coefficient estimates on *Post-COVID × COVID Growth* for short-term and non-passive investors (Panel A). The coefficient estimates on *Post-COVID × COVID Severity* is insignificant for long-term investors and the magnitude is larger for non-passive investors than passive investors. The results from estimating our triple-difference specifications (reported in Panel B) reveal that only short-term investors react more negatively if they reside in markets where REITs have larger portfolio allocations. In addition, the magnitude of economic significance on the triple interaction term is larger among non-passive investors than passive investors and comparable between short-term and long-term investors.[27]

3.4 Firm-Investor-MSA level Analysis

Our final tests explore whether the impact on institutional ownership of salient local shock is more pronounced in investors' home MSAs. The difference between this analysis and those in sections 3.3 and 3.4 is that we now include all firm-investor-MSA-time pairs regardless of where the investor is headquartered. This allows us to examine the effects of an investor's location on firm ownership (equation (6)). We posit that information salience is stronger in investors' home markets.

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[26] For example, Bushee (1998, 2001) classifies institutional investors into three groups based on observable patterns in their portfolio turnover, diversification, and momentum trading. These three groups are labeled by Bushee (1998) as "transient," "dedicated," and "quasi-indexer." The classification of quasi-indexers, dedicated, and transient investors can be downloaded from Professor Bushee's website: https://accounting-faculty.wharton.upenn.edu/bushee/ (Accessed: March 6, 2021).

[27] Although the coefficient of *Post-COVID × COVID Growth × PropSHR* is smaller for non-passive investors than passive investors (-0.086 versus -0.103), the mean value of LIO for non-passive is also smaller than that for passive investors (0.42% versus 0.60%). Thus, the effects of increases in *COVID Growth* or *PropSHR* on LIO relative its mean are comparable between the two groups.

We conduct our analysis at the firm-investor-MSA level using the following specifications:

$$LIO_{i,j,m,t} = \alpha + \beta_1 Post_t \cdot COVID_m + \gamma_{i,t} + \delta_{i,m} + \varepsilon_{i,j,m,t}. \quad (5)$$

$$LIO_{i,j,m,t} = \alpha + \beta_1 Post_t \cdot COVID_m \cdot Investor\ HQ_j + \beta_2 \cdot Post_t \cdot COVID_m + \gamma_{i,t} + \delta_{i,m} + \varepsilon_{i,j,m,t}. \quad (6)$$

$LIO_{i,j,m,t}$ is the ownership of firm *i* by investor *j* for any MSA *m* in quarter *t*. *m* includes MSAs in which the REIT owns any property—even if no investors are located there. Note that the sum of *h* MSA investor headquarters in equations (2)-(4) is a subset of the sum of *m* MSAs. $Investor\ HQ_i$ is equal to one if investor *j* is headquartered in MSA *m*, and 0 otherwise.

The summary statistics of our firm-investor-MSA-level variables are displayed in Table 1. Relative to MSAs in which at least one investor is headquartered, our sample of MSAs that includes those with no local investors tend to be smaller and hit less hard by COVID. This can be seen by comparing the means of our COVID severity measures in Panel D to those in Panel C. Only 1.3% of the MSAs in which a REIT owns properties are also the investor's home.

Unreported results based on the estimation of our double interaction model (equation (5)) are consistent with the previous results: the estimated coefficient on β_1 is negative and significant. Table 6 summarizes the results from estimating equation (6). The coefficient estimates on both triple interaction terms, *Post-COVID × COVID Growth × Investor HQ* and *Post-COVID × COVID Severity × Investor HQ*, are negative and significant, suggesting that the negative ownership reaction to geographically dispersed local shocks that we document is more pronounced in MSAs that are home to an investor. This is consistent with the importance of information saliency; that is, investors respond more to information about their home markets (e.g., Pounder and John, 1996; McCann et al., 2016).

To illustrate the economic importance of *Investor HQ* on investor reactions to the local pandemic shock, we tabulate the distribution of the quarterly change in $LIO_{i,j,m,t}$ within the same firm for two otherwise similar MSAs, except one is the investor's home MSA, the other is not. As our sample is constructed at the granular, firm-investor-MSA level, the absolute change of $LIO_{i,j,m,t}$ is very small. However, the economic significance relative to the mean is still quite large. The mean (median) quarterly change is 0.0043 (0) percentage points, and the 25 (75) percentile is -0.0032 (0.003). For a one-standard-deviation increase in $COVID\ Growth_m$ ($COVID\ Severity_m$), the additional reduction in local ownership in MSAs in which the investor is located is -0.0067 (-0.005), which is far larger than both the mean and lower quartile of quarterly changes in local ownership prior to COVID.

3.5 Responses to Salient Local Shocks and REIT Portfolio Performance

Taken together, the previous sections demonstrate that institutional investors reacted to COVID-induced, geographically dispersed, local shocks. However, the above tests do not address whether the reduction in the ownership of REITs with a presence in the investor's home market is (a) *sentiment/salience-driven* (Shiller, 2015; DeVault et al., 2019; Korniotis and Kumar, 2013; Tversky and Kahneman, 1973; Klibanoff et al., 1998; Bordalo et al., 2012; Alok et al., 2020) or (b) *information-driven*; that is, driven by the information advantages enjoyed by local investors (Coval and Moskowitz 2001; Kacperczyk and Seru 2007; Bernile et al. 2015). In this section, we further explore these two potential drivers of trading behavior by investigating the subsequent returns on investors' REIT portfolios.

Our test assumes that if local investors are more informed about their home markets than their non-local peers, reducing their holdings of REITs with a local presence should produce higher risk-adjusted returns when their home markets are more adversely impacted by the COVID shock. However, if the previously documented effects of COVID severity on share ownership are primarily driven by a shift in local sentiment or salience bias, investors might be overly risk-averse about

the prospects of REITs with a local presence and therefore reduce their holdings of local REITs more than what is justified by available information (Strong and Xu, 2003, Cao et al., 2011, Solnik and Zuo, 2017). These sentiment-driven trades (e.g., heavy selling of local stocks) should be associated with relatively poor performance of their REIT portfolios.

We first track local ownership percentages before the COVID crisis (2019Q4 through 2020Q3). We calculate an investor's "local" REIT ownership as the proportion of the investor's REIT portfolio allocated to REITs headquartered in the same MSA as the investor or allocated to REITs that own property in the MSA in which the investor is located.[28] As reported in Panel A of Table 7, local REIT holdings comprised 42.0% of an average investor's REIT portfolio at the end of 2019, suggesting that REITs with a presence in the investor's home market are a significant portion of a typical investor's total REIT holdings This allocation declined to 40.1% in 2020Q3, representing an average reduction of 30 million USD in REIT holdings over three quarters.

We further partition our sample based on the median of *COVID Growth* in the investor's home MSA.[29] In Panel B and Panel C, we show that investors located in both high-severity and low-severity MSAs reduced their local ownership by 2020Q3. A simple double-mean difference (Panel D), reveals that investors located in low-severity MSAs reduced their allocations to local stocks in a manner similar to investors located in high-severity MSAs. This suggests a potential overaction to the local shock by those investors headquartered in low-severity MSAs. This finding is similar to the finding reported by Alok et al. (2020) that mutual fund managers who

[28] We also examine alternative definitions of investor's "local" REIT ownership. Instead of any MSA that a REIT owns property, we include, for example, the top-3 MSAs in which they are invested. This (stricter) classification generates a lower percentage of "local" ownership. However, the portfolio results are very similar as those reported in Table 7 when we use the alternative classification of local stocks.

[29] Results based on alternative critical values of *COVID Growth* and *COVID Severity* (e.g., 25th and 75th percentiles) are consistent with those reported in Table 7 and are available upon request.

are exposed to a rare and devastating climatic event overact to climate risk and underweight disaster zone stocks in their portfolios.[30]

To investigate whether this overreaction is associated with subsequently worse performance, we calculate the monthly performance of the REIT portfolios owned by 13F institutions during the first three quarters of 2020. First, we estimate a Fama-French four-factor model (FFM 4-factor) for each REIT in month t using return data from months t-60 to t and save the coefficients on each systematic risk factor. We then use these estimated coefficients to calculate the risk-adjusted excess return (alpha), $\alpha_{i,q+1,t}$, for each REIT in month t+1. This process is repeated for each month of the sample period, producing a monthly time series of alphas for each REIT.

Using these estimated firm-level alphas, we next calculate the alpha earned by each investor on its REIT portfolio in each month based on their REIT portfolio holdings at the beginning of the quarter. This process of value-weighting the alphas of the individual REITs owned by the investor produces a monthly time series of alphas for each investor's REIT portfolio.

Our previous results in Table 5 suggest that short-term and non-passive investors react more negatively if they reside in markets where REITs have larger portfolio allocations. Do these investors subsequently experience a worse performance relative to their counterparts? In Table 8, Panel A, we separate investors into short-term versus long-term and passive versus non-passive subgroups and report monthly REIT portfolio alphas for these subsets of investors. The top row in Panel A displays the arithmetic mean of the alphas for REIT portfolios owned by each type. The results suggest that short-term (non-passive) investors experienced significantly worse performance on their REIT portfolios than long-term (passive)

[30] Noted that this finding of an insignificant difference in reductions of local stocks between investors located in low-severity MSAs and high-severity MSAs is not contradictory to the previous findings using firm-MSA level. This is because the outcome variables in the firm-MSA level analysis are constructed with respect to the firm (i.e., the denominator is a firm's shares held by all institutional investors) whereas the outcome variables in this exercise are constructed with respect to the investor (i.e., the denominator is the total dollar amount of REIT shares held by the investor).

investors. When we further separate each investor type based on the COVID severity in their headquarters (rows B and C), we find that the performance differences are driven entirely by the low-severity group. This finding indicates that investors located in low-severity markets may have overreacted to the pandemic shock.

To further investigate this hypothesis, we examine investors' trading frequency directly. In Panel B, we divide investors into two subsets based on their local REIT holdings during the first quarter of 2020. We use net changes in quarterly REIT ownership to measure the aggregate or local (net) trading by institutions during 2020Q1. Aggregate REIT ownership is the percentage of an investor's stock portfolio allocated to equity REITs. The local REIT ownership of an investor equals the total ownership (in dollars) of REITs with a presence in the investor's home market divided by the investor's total equity REIT holdings. An investor is categorized as a "heavy seller of REITs" if the net decrease in her local REIT ownership is greater than the sample median during the first quarter of 2020. Similarly, an investor is categorized as a "heavy local seller" of REITs if the net decrease in her ownership of REITs with a local presence is greater than the sample median during the first quarter of 2020.[31] Unlike the analysis performed at the investor level (Panel A), this investor-MSA level exercise enables us to take advantage of our granular data and directly examine investors' returns associated with changes in local ownership.

Results reported in the top row of Panel B suggest no significant underperformance among heavy sellers. However, when we compare the mean of REIT portfolio alphas for heavy sellers with a local presence to non-heavy sellers with a local presence during 2020Q1, the portfolios of heavy sellers significantly underperformed. The FFM 4-factor alphas for REIT portfolios owned by heavy sellers of local REITs averaged 23 basis points per month. The corresponding monthly alpha for non-heavy *local* sellers averaged 31 basis points. This seven-basis-point difference is highly significant (*t*-stat=-6.45) and is consistent with the conjecture that biased

[31] Alternative specifications of a heavy seller (e.g., top quartile, top decile) yield similar results.

trades based on sentiment or familiarity by heavy sellers of REITs with a local presence lead to a worse portfolio performance.

We further partition the REIT portfolios owned by heavy sellers and non-heavy sellers of REITs with a local presence using the median of *COVID Growth.* We find that the average risk-adjusted return is lowest among heavy sellers of REITs that are located in MSAs less exposed to the spread of the virus. This finding is consistent with the results in Panel A: non-passive and short-term investors may have been overly pessimistic about the future prospects of their local REIT holdings and therefore oversold during the early stage of the COVID crisis. REIT portfolios owned by heavy sellers of REITs with a local presence persistently underperformed throughout the first three quarters of 2020.

4. Conclusion

This paper examines how institutional investors react to geographically dispersed local shocks during periods of market turmoil. Using a granular dataset that links asset locations, firm locations, and investor locations, we examine the impact of geography on investors' reactions during the unexpected COVID-19 pandemic. To examine the extent to which the colocation of a firm's assets and its investors influences institutional ownership decisions, we conduct four empirical exercises, expanding from the firm level to the firm-MSA level, to the firm-investor level, and, eventually, to the firm-investor-MSA level.

Our firm-level results suggest that during the early stages of the pandemic institutional investors reduced their holdings more in REITs with larger allocations to areas heavily affected by the pandemic. The results from the remaining three exercises confirm that investors do react to geographically dispersed local shocks because they reduced their ownership of REITs with an economic presence in the investors' home markets more in markets that were hit harder in the early stage of

the pandemic. In addition, reductions in the ownership of REITs with an economic presence in the investors' home markets were more pronounced in markets in which REITs were more heavily invested. Ownership reductions were also larger among short-term and nonpassive investors. Finally, our analysis of the performance of institutional investors' REIT portfolios after the onset of the crisis suggests some investors overreacted to local COVID-19 shocks and that this overreaction was likely sentiment-driven or driven by salience bias. Together, our findings shed light on the behavior of different types of institutional investors during a market crisis and highlight the importance of recognizing the role of geography in shaping institutional investment decisions.

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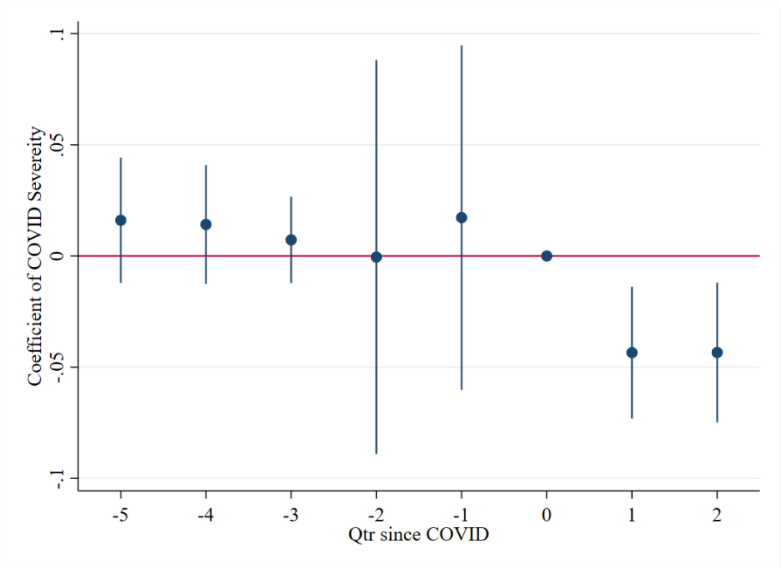
Figure 1: Firm-level Institutional Ownership and Local Shock from COVID-19

This figure shows the relative time graphs for difference-in-difference (DID) estimated coefficients on the relationship between firm-level institutional ownership and COVID exposure, measured as *COVID Growth* in Panel A and *COVID Severity* in Panel B. Time zero is defined as 2020Q1, during which the first reported case occurred in the U.S. See Table A1 in the appendix for variable descriptions.

(A) *COVID Growth*$_i$



(B) *COVID Severity*$_i$

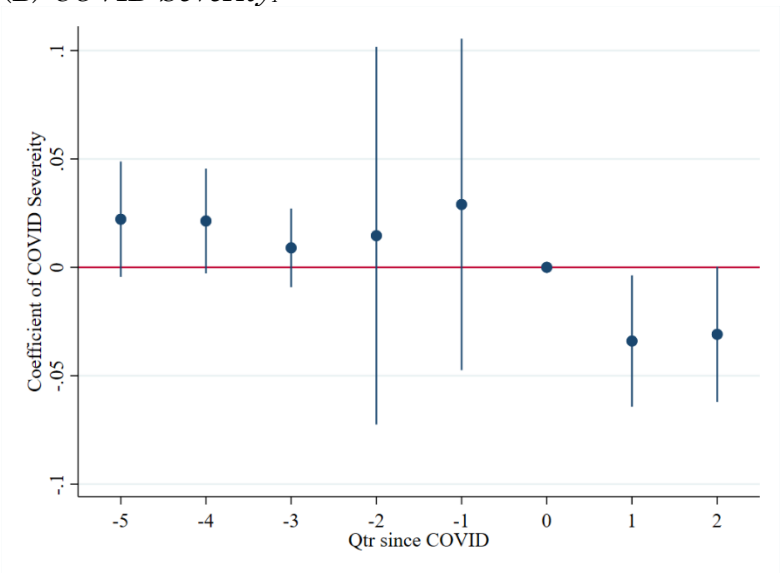


Table 1: Summary Statistics

This table shows summary statistics (number of observations, mean, standard deviation (SD), and 25th, 50th, and 75th percentiles) of key variables used in our analysis. Table A1 in the appendix defines all variables and lists all data sources.

	Mean	SD	p25	p50	p75
Firm-level (N=3,009)					
IO	0.772	0.247	0.667	0.850	0.942
COVID Growth$_i$	0.069	0.014	0.061	0.070	0.078
COVID Severity$_i$ (%)	0.053	0.074	0.024	0.032	0.043
HOMECON	0.150	0.246	0.002	0.044	0.161
GEOHHI	0.187	0.228	0.045	0.098	0.213
PropHHI	0.879	0.196	0.856	0.986	1.000
MKTCAP	5.078	7.431	1.103	2.661	5.731
IVOL	0.014	0.008	0.010	0.012	0.015
ILLIQUID	1.330	16.261	0.004	0.011	0.038
LOGPRC	3.312	0.955	2.741	3.257	3.931
LAG3MRET	0.010	0.140	-0.065	0.019	0.095
MB	2.601	12.553	1.309	1.885	2.642
ROA	0.013	0.008	0.010	0.014	0.017
LEVERAGE	0.491	0.142	0.412	0.483	0.570
Firm-MSA-level (N=31,721)					
LIO$_{ilt}$(%)	2.857	7.251	0.028	0.174	1.422
COVID Growth$_l$	0.094	0.018	0.083	0.094	0.108
COVID Severity$_l$ (%)	0.170	0.175	0.060	0.091	0.195
REIT HQ	0.047	0.211	0	0	0
PropSHR	4.243	9.088	0.567	1.501	4.173
Firm-Investor (HQMSA)-level (N=166,600)					
LIO$_{ij(l=HQ)t}$(%)	0.541	2.222	0.006	0.036	0.203
COVID Growth$_l$	0.115	0.022	0.096	0.118	0.140
COVID Severity$_l$ (%)	0.387	0.280	0.088	0.303	0.727
REIT HQ	0.112	0.316	0	0	0
PropSHR	8.382	14.786	1.218	3.568	8.607
Firm-Investor-MSA-level (N=12,679,004)					
LIO$_{ijlt}$(%)	0.474	2.104	0.005	0.029	0.168
COVID Growth$_l$	0.074	0.022	0.058	0.073	0.089
COVID Severity$_l$ (%)	0.125	0.164	0.046	0.071	0.132
Investor HQ	0.013	0.115	0	0	0

Table 2: Firm-level Institutional Ownership and Geographically Weighted COVID-19 Exposure

This table shows difference-in-differences (DID) regression results on the relationship between firm-level institutional ownership and firm-level geographically weighted COVID-19 exposure, measured by *COVID Growth* or *COVID Severity* interacted with *Post-COVID*, for the period from 2017Q1 through 2020Q3. The dependent variable, *IO*, is the ratio of the number of shares held by institutional investors to the total number of shares outstanding of firm *i* in quarter *t*. *Post-COVID* indicates 2020Q1, 2020Q2, and 2020Q3. $COVID\ Growth_i$ is the firm-level average daily geographically weighted growth rates of COVID-19 cases over January 21, 2020, and April 15, 2020. $COVID\ Severity_i$ is the log of geographically weighted number of COVID-19 cases scaled by population on April 15, 2020. The weights for $COVID\ Growth_i$ and $COVID\ Severity_i$ are the percentage of a firm's portfolio allocated to each county at the end of 2019Q4. The numbers in parentheses are *t*-statistics. Standard errors are clustered at the firm level. Firm fixed effects and Year-Quarter fixed effects are included in the regressions. Table A1 in the appendix defines all variables and lists all data sources. *p < .1; **p < .05; ***p < .01.

	(1) *IO*	(2) *IO*
Post-COVID × COVID Growth$_i$	-1.633***	
	(-3.41)	
Post-COVID × COVID Severity$_i$		-0.026**
		(-2.22)
HOMECON	-0.078	-0.066
	(-0.48)	(-0.38)
GEOHHI	-0.064	-0.063
	(-0.55)	(-0.61)
PropHHI	-0.074	-0.077
	(-0.55)	(-0.58)
MKTCAP	-0.005**	-0.005**
	(-2.46)	(-2.48)
IVOL	0.471	0.424
	(0.44)	(0.40)
ILLIQUID	-0.000**	-0.000*
	(-2.31)	(-1.82)
LOGPRC	0.096***	0.092***
	(4.65)	(4.43)
LAG3MRET	-0.050**	-0.046*
	(-2.05)	(-1.89)
MB	0.000***	0.000***
	(6.22)	(6.04)
ROA	-0.595	-0.473
	(-1.30)	(-1.07)
LEVERAGE	0.044	0.039
	(0.46)	(0.40)
Constant	0.565***	0.328
	(4.02)	(0.71)
Firm Fes	Yes	Yes
Year-Quarter Fes	Yes	Yes
R-squared	0.808	0.807
# Obs	3,009	3,009

Table 3: Local Institutional Ownership and Local Shock: Firm-MSA-level Analysis

This table shows regression results on the relationship between firm-MSA-level institutional ownership and MSA-level shock induced by COVID-19, proxied by *COVID Growth*$_h$ (or *COVID Severity*$_h$) interacted with *Post-COVID,* in 2017Q1-2020Q3. The dependent variable, $LIO_{i,h,t}$, is the MSA-level ownership of firm *i* in quarter *t*, calculated as the aggregate ownership share of institutional investors headquartered in MSA *h* as a fraction of total institutional ownership share in firm *i* in quarter *t*. *Post-COVID* indicates 2020Q1, 2020Q2 and 2020Q3. *COVID Growth*$_h$ is the average daily growth rate of COVID-19 cases in MSA *h* over January 21, 2020, and April 15, 2020. *COVID Severity*$_h$ is the log of the number of COVID-19 cases scaled by population in MSA *h* on April 15, 2020. *REIT HQ* is a dummy variable equals to 1 if firm *i* is headquartered in MSA *h* in quarter *t*. *PropSHR* is the percentage share of properties (based on total adjusted cost) held by firm *i* in MSA *h* in the previous year. The numbers in parentheses are *t*-statistics. Standard errors are clustered at the firm-quarter level. Table A1 in the appendix defines all variables and lists all data sources. Firm × Year-Quarter fixed effects and Firm × MSA fixed effects are included in the regressions. *p < .1; **p < .05; ***p < .01.

	(1) $LIO_{i,h,t}$	(2) $LIO_{i,h,t}$	(3) $LIO_{i,h,t}$	(4) $LIO_{i,h,t}$	(5) $LIO_{i,h,t}$	(6) $LIO_{i,h,t}$
Post-COVID × COVID Growth$_h$	-3.145*		-0.915		-0.944	
	(-1.96)		(-0.58)		(-0.53)	
Post-COVID × COVID Severity$_h$		-0.583***		-0.356*		-0.184
		(-3.00)		(-1.85)		(-0.83)
Post-COVID × COVID Growth$_h$ *× REIT HQ*			-24.087**			
			(-2.27)			
Post-COVID × COVID Severity$_h$ *× REIT HQ*				-1.631*		
				(-1.84)		
Post-COVID × COVID Growth$_h$ *× PropSHR*					-0.665**	
					(-2.39)	
Post-COVID × COVID Severity$_h$ *× PropSHR*						-0.073***
						(-3.43)
Firm × Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm × MSA FEs	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.969	0.969	0.969	0.969	0.969	0.969
# Obs	31,721	31,721	31,721	31,721	31,721	31,721

Table 4: Local Institutional Ownership and Local Shock: Firm-Investor (HQMSA)-level Analysis

This table shows regression results on the relationship between firm-investor (HQMSA)-level institutional ownership and MSA-level shock induced by COVID-19, proxied by *COVID Growth*$_h$ (or *COVID Severity*$_h$) interacted with *Post-COVID,* in 2017Q1-2020Q3. The dependent variable, $LIO_{i,j,h,t}$, is the ownership of institution *j* (headquartered in MSA *h*) of firm *i* in quarter *t*, calculated as the share of institutional investor *j* headquartered in MSA *h* as a fraction of total institutional ownership share in firm *i* in quarter *t*. *Post-COVID* indicates 2020Q1, 2020Q2, and 2020Q3. *COVID Growth*$_h$ is the average daily growth rate of COVID-19 cases in MSA *h* over January 21, 2020, and April 15, 2020. *COVID Severity*$_h$ is the log of the number of COVID-19 cases scaled by population in MSA *h* on April 15, 2020. *REIT HQ* is a dummy variable equals to 1 if firm *i* is headquartered in MSA *h* in quarter *t*. *PropSHR* is the percentage share of properties (based on total adjusted cost) held by firm *i* in MSA *h* in the previous year. The numbers in parentheses are *t*-statistics. Standard errors are clustered at the firm-quarter level. Table A1 in the appendix defines all variables and lists all data sources. Firm × Year-Quarter fixed effects and Firm × Investor fixed effects are included in the regressions. *p < .1; **p < .05; ***p < .01.

	(1) $LIO_{i,j,h,t}$	(2) $LIO_{i,j,h,t}$	(3) $LIO_{i,j,h,t}$	(4) $LIO_{i,j,h,t}$	(5) $LIO_{i,j,h,t}$	(6) $LIO_{i,j,h,t}$
Post-COVID × *COVID Growth*$_h$	-0.331**		-0.272		0.158	
	(-2.19)		(-1.63)		(0.85)	
Post-COVID × *COVID Severity*$_h$		-0.031**		-0.028**		0.015
		(-2.44)		(-2.02)		(0.94)
Post-COVID × *COVID Growth*$_h$ × *REIT HQ*			0.091			
			(0.11)			
Post-COVID × *COVID Severity*$_h$ × *REIT HQ*				0.024		
				(0.42)		
Post-COVID × *COVID Growth*$_h$ × *PropSHR*					-0.087***	
					(-3.83)	
Post-COVID × *COVID Severity*$_h$ × *PropSHR*						-0.006***
						(-4.12)
Firm × Year-Quarter FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm × Investor FEs	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.936	0.936	0.936	0.936	0.936	0.936
# Obs	166,600	166,600	166,600	166,600	166,600	166,600

Table 5: Local Institutional Ownership by Investor Type and Local Shock: Firm-Investor (HQMSA)-level Analysis

This table shows regression results on the relationship between firm-investor (HQMSA)-level institutional ownership and MSA-level shock induced by COVID-19, proxied by *COVID Growth*$_h$ (or *COVID Severity*$_h$) interacted with *Post-COVID,* in 2017Q1-2020Q3. The dependent variable, $LIO_{i,j,h,t}$, is the ownership of institution *j* within firm *i*, calculated as the share of institutional investor *j* headquartered in MSA *h* as a fraction of total institutional ownership share in firm *i* in quarter *t*. *Post-COVID* indicates 2020Q1, 2020Q2, and 2020Q3. *COVID Growth*$_h$ is the average of daily growth rates of COVID-19 cases in MSA *h* over January 21, 2020, and April 15, 2020. *COVID Severity*$_h$ is the log of the number of COVID-19 cases scaled by population in MSA *h* on April 15, 2020. *PropSHR* is the percentage share of properties (based on total adjusted cost) held by firm *i* in MSA *h* in the previous year. Columns (1) and (2) present the results based on the sub-sample of short-term and long-term investors, respectively. The classification of short-term and long-term investors is based on Cella et al. (2013). An investor is classified as a short-term investor if the churn ratio is below the median during the prior quarter. Columns (3) and (4) present the results based on the sub-sample of passive and nonpassive investors, respectively. The classification of passive and nonpassive investors is based on Bushee (2001). The numbers in parentheses are *t*-statistics. Standard errors are clustered at the firm-quarter level. Table A1 in the appendix defines all variables and lists all data sources. Firm × Year-Quarter fixed effects and Firm × Investor fixed effects are included in the regressions. *p < .1; **p < .05; ***p < .01.

$LIO_{i,j,h,t}$	(1) *SHORT-TERM*	(2) *LONG-TERM*	(3) *NONPASS*	(4) *PASSIVE*
Panel A				
Post-COVID × *COVID Growth*$_h$	-0.345*	0.212	-0.516***	-0.286
	(-1.75)	(0.61)	(-3.12)	(-1.53)
Post-COVID × *COVID Severity*$_h$	-0.044***	0.010	-0.049***	-0.032**
	(-2.73)	(0.36)	(-3.42)	(-2.06)
Panel B				
Post-COVID × *COVID Growth*$_l$ × *PropSHR*	-0.249***	-0.033	-0.086***	-0.103***
	(-3.65)	(-1.26)	(-3.84)	(-3.41)
Post-COVID × *COVID Severity*$_l$ × *PropSHR*	-0.021***	-0.003	-0.046**	-0.008***
	(-3.75)	(-1.43)	(-2.53)	(-3.90)

Table 6: Local Institutional Ownership and Local Shock: Firm-Investor-MSA-level Analysis

This table shows regression results on the relationship between firm-investor-MSA-level institutional ownership and MSA-level shock induced by COVID-19, proxied by *COVID Growth*$_m$ (or *COVID Severity*$_m$) interacted with *Post-COVID,* in 2017Q1-2020Q3. The dependent variable, $IO_{i,j,m,t}$, is the ownership of institution *j* of firm *i* for any MSA *m* in quarter *t*, calculated as the share of institutional investor *j* as a fraction of total institutional ownership share in firm *i* that has property allocation in MSA *m* in quarter *t. m* includes MSA in which investors are headquartered and MSAs in which the REIT owns any property. *Post-COVID* indicates 2020Q1, 2020Q2, and 2020Q3. *COVID Growth*$_m$ is the average of daily growth rates of COVID-19 cases in MSA *m* over January 21, 2020, and April 15, 2020. *COVID Severity*$_m$ is the log of the number of COVID-19 cases scaled by population in MSA *m* on April 15, 2020. *Investor HQ* is a dummy variable equals to 1 if investor *j* is headquartered in MSA *m* in quarter *t*. The numbers in parentheses are *t*-statistics. Standard errors are clustered at the firm-quarter level. Table A1 in the appendix defines all variables and lists all data sources. Firm × Year-Quarter fixed effects and Firm × Investor fixed effects are included in the regressions. *p < .1; **p < .05; ***p < .01.

	(1) $LIO_{i,j,m,t}$	(2) $LIO_{i,j,m,t}$
Post-COVID × *COVID Growth*$_m$ × *Investor HQ*	-0.309** (-2.52)	
Post-COVID × *COVID Severity*$_m$ × *Investor HQ*		-0.030*** (-2.84)
Firm × Year-Quarter Fes	Yes	Yes
Firm × Investor Fes	Yes	Yes
R-squared	0.938	0.938
# Obs	12,679,004	12,679,004

Table 7: Investor Local Ownership – Summary Statistics

This table shows descriptive statistics (mean and median) for investors' local ownership. If a REIT holds any properties in a given investor's home MSA, the REIT is classified as "local" for that investor. Local ownership is the total dollar amount of local REIT shares divided by the total dollar amount of all REIT shares held by an institutional investor in quarter *t*. Columns (1)-(4) include summary statistics for each quarter from 2019Q4-2020Q3. Column (5) shows the difference between 2019Q4 and 2020Q3. "A. Local Ownership" includes all investors. "B. Local ownership (High Severity)" ("C. Local ownership (Low Severity)") includes investors headquartered in MSAs with *COVID Growth* above (below) the median. "D. Diff-in-Diff (High minus Low)" show the difference between mean differences of the high severity group and mean differences of the low severity group. Column (6) shows test statistics, representing *t*-statistics for mean differences and *z*-statistics for median differences. See Table A1 for variable descriptions.

		(1)	(2)	(3)	(4)	(5) = (1) – (4)	(6)
		2019Q4	*2020Q1*	*2020Q2*	*2020Q3*	*Diff*	Test statistics
A. Local Ownership	Mean	0.420	0.401	0.402	0.401	-0.02	-2.50**
	Median	0.360	0.348	0.342	0.341	-0.02	-2.95***
B. Local Ownership (High Severity)	Mean	0.477	0.456	0.458	0.458	-0.02	-1.94**
	Median	0.456	0.434	0.434	0.426	-0.03	-2.23**
C. Local Ownership (Low Severity)	Mean	0.363	0.348	0.350	0.346	-0.01	-1.66*
	Median	0.298	0.263	0.271	0.270	-0.03	-2.17**
D. Diff-in-Diff (High minus Low)	Mean					-0.01	0.49

Table 8: Portfolio Analysis

This table reports the monthly average of investors' portfolio risk-adjusted excess returns (alphas) from 2020Q1 to 2020Q4 (based on Fama-French Momentum 4-factor model) for 13(f) institutional investors by investor type in Panel A and by investors' trade in Panel B. In Panel A, columns (1) and (2) present the results based on the sub-sample of short-term and long-term investors, respectively. The classification of short-term and long-term investors is based on Cella et al. (2013). An investor is classified as a short-term investor if the churn ratio is below the median during the prior quarter. Columns (4) and (5) present the results based on the sub-sample of passive and nonpassive investors, respectively. The classification of passive and nonpassive investors is based on Bushee (2001). Results in row "A. All" show the overall returns. Results in rows "B. HQ High Severity" and "C. HQ Low Severity" further classify investors' headquartered MSAs into high-severity and low-severity groups, respectively. The reported statistics in columns (1)-(2) and (4)-(5) are equally weighted averages across all investors in each subgroup. Column (3) ((6)) reports the differences between values in columns (1) and (2) ((4) and (5)) and their statistical significance. In Panel B, investors are classified as *Heavy Sellers* of REIT stocks and *Non-heavy Sellers* of REITs. In "A. All Trades," heavy (non-heavy) sellers include investors who decreased their REIT holdings from 2019Q4 to 2020Q1 more (less) than the median investor. If a REIT owns any property in a given investor's home MSA, the REIT is classified as "local" for that investor. In "B. Local REIT Portfolios," heavy (non-heavy) sellers include investors who decreased their "local" REIT holdings from 2019Q4 to 2020Q1 more (less) than the median investor. "B. Local REIT Portfolios" are divided into "High Severity" and "Low Severity" portfolios based on *COVID Growth* in the investor's MSA headquarters (i.e., above or below median). The reported statistics in columns (1) and (2) are equally weighted averages across all investors in each subgroup. Columns (3) and (4) report the differences between values in columns (1) and (2) and their statistical significance.

Panel A: by Investor Type

	(1)	(2)	(3) = (1)-(2)	(4)	(5)	(6) = (4)-(5)
	SHORT-TERM	*LONG-TERM*	Diff	*NON-PASSIVE*	*PASSIVE*	Diff
A. All	0.260	0.290	-0.030***	0.246	0.294	-0.048***
			(-2.60)			(-4.08)
B. HQ High Severity	0.308	0.291	0.017	0.301	0.298	0.003
			(0.88)			(0.13)
C. HQ Low Severity	0.224	0.290	-0.066***	0.211	0.290	-0.080***
			(4.85)			(-5.85)

Panel B: by Investors' Trades

	(1)	(2)	(3) = (1) – (2)	*t*-statistic
	Heavy Sellers	*Non-Heavy Sellers*	Diff	
A. All Trades	0.269	0.282	-0.014	-1.17
B. Local Trades (Trades of REITs with a presence in the investor's home MSA)	0.235	0.310	-0.075	-6.45***
- *High Severity*	0.264	0.325	-0.061	-3.10***
- *Low Severity*	0.214	0.296	-0.082	-6.08***

Table A1: Variable Definitions

Variable	Source	Definition
Dependent Variables		
$IO_{i,t}$	Thomson Reuters	The number of firm *i*'s outstanding shares held by institutional investors in quarter *t* divided by the total number of firm *i*'s outstanding shares in quarter *t*.
$LIO_{i,h,t}$	Thomson Reuters, SEC	The number of firm *i*'s shares owned by all institutional investors headquartered in MSA *h* in quarter *t* divided by the total number of firm *i*'s shares owned by all institutional investors in quarter *t*.
$LIO_{i,j,h,t}$	Thomson Reuters, SEC	The number of firm *i*'s shares owned by the *jth* institutional investor headquartered in MSA *h* in quarter *t* divided by the total number of firm *i*'s shares owned by all institutional investors in quarter *t*.
$LIO_{i,j,h,t}$ *SHORT-TERM*	Thomson Reuters, SEC	$LIO_{i,j,h,t}$ for short-term investor. An investor is categorized as a short-term investor of firm *i* if the churn ratio is below median during quarter *t*-1. Cella et al. (2013).
$LIO_{i,j,h,t}$ *LONG-TERM*	Thomson Reuters, SEC	$LIO_{i,j,h,t}$ for long-term investor.
$LIO_{i,j,h,t}$ *PASSIVE*	Thomson Reuters, SEC	$LIO_{i,j,h,t}$ for passive investor. An investor is categorized as a passive (non-passive) investor if it is a quasi-indexer (dedicated or transient investor). Bushee (1998, 2001).
$LIO_{i,j,h,t}$ *NONPASS*	Thomson Reuters, SEC	$LIO_{i,j,h,t}$ for nonpassive investor.
$LIO_{i,j,m,t}$	Thomson Reuters, SEC	The number of firm *i*'s shares owned by the *jth* institutional investor for any MSA *m* in quarter *t* divided by the total number of firm *i*'s shares owned by all institutional investors in quarter *t*. *m* includes MSA in which investors are headquartered and MSAs in which the REIT owns any property.
COVID Shock Proxies		
Post-COVID	JHU COVID-19 Global Cases, S&P Global	A dummy variable that indicates 2020Q1, 2020Q2, and 2020Q3.
$COVID\ Growth_i$	JHU COVID-19 Global Cases, S&P Global	Firm-level average daily geographically weighted growth rates of COVID-19 cases over January 21, 2020, and April 15, 2020. It is calculated, for each firm, the percentage of its property portfolio, based on depreciated book values, invested in each MSA at the end of 2019. These portfolio allocations are then matched with the average of daily growth rates of MSA-level COVID-19 confirmed cases, which are obtained from the Coronavirus COVID-19 Global Cases database at Johns Hopkins University. Next, these MSA-level growth rates are value-weighted by the percentage of a firm's property portfolio invested in each MSA at the end of 2019. Lastly, $COVID\ Growth_i$ is calculated as the average of daily geographically weighted growth rates over January 21, 2020, and April 15, 2020.

Table A1 Continued

Variable	Source	Definition
COVID Severity$_i$	JHU COVID-19 Global Cases, S&P Global	Firm-level geographically weighted COVID severity. It is calculated, for each firm, the percentage of its property portfolio, based on depreciated book values, invested in each MSA at the end of 2019. These portfolio allocations are then matched with the MSA-level number of COVID-19 cases scaled by population as of April 15, 2020. Next, these MSA-level infection rates are value-weighted by the percentage of a firm's property portfolio invested in each MSA at the end of 2019. This variable is shown as a percentage in Table 1 for presentation purposes and in a log form in regressions.
COVID Growth$_m$	JHU COVID-19 Global Cases, S&P Global	MSA-level average of daily growth rates of COVID-19 cases in MSA *m* over January 21, 2020, and April 15, 2020.
COVID Severity$_m$	JHU COVID-19 Global Cases, S&P Global	MSA-level number of COVID-19 cases scaled by population in MSA *m* as of April 15, 2020. This variable is shown as a percentage in Table 1 for presentation purposes and in a log form in regressions.
Geography Variables		
REIT HQ	S&P Global	A dummy variable equals 1 if firm *i* headquartered in MSA *l* in quarter *t*
PropSHR	S&P Global	Percentage share of properties (based on total adjusted cost) held by firm *i* in MSA *l* in the previous year
Investor HQ	SEC	A dummy variable equals 1 if investor *j* headquartered in MSA *l* in quarter *t*
GEOHHI	S&P Global	Herfindahl Indexes of firm *i*'s property weights across MSAs in quarter *t*
PropHHI	S&P Global	Herfindahl Indexes of firm *i*'s portfolio weights in across property types in quarter *t*
HOMECON	S&P Global	The percentage of a firm *i*'s total property portfolio located in the headquarter market in quarter *t*
Firm-level Controls		
MKTCAP	COMPUSTAT	Stock price multiplied by the number of shares outstanding
IVOL	CRSP	The standard deviation of residuals of monthly Fama-French-Carhart 4-factor-model regressions of daily stock returns
ILLIQUID	CRSP	Average Amihud (2002) daily volume price impact firm *i* during quarter *t*.
LOGPRC	CSRP	Log of annual stock price
LAG3MRET	CSRP	Stock returns in the past three months
MB	COMPUSTAT	Market-to-book ratio
ROA	COMPUSTAT	The ratio of net income to book value of total assets
LEVERAGE	COMPUSTAT	Sum of total long-term debt and debt in current liabilities divided by total assets
Fixed Effects		
γ_i		firm fixed effects
δ_t		year-quarter fixed effects
$\gamma_{i,t}$		firm-by-year-by-quarter fixed effects
$\delta_{i,m}$		firm-by-MSA fixed effects

Table A1 Continued

Variable	Source	Definition
Portfolio Construction		
Local Ownership	Thomson Reuters, SEC	The total dollar amount of local REIT shares divided by the total dollar amount of all REIT shares held by an institutional investor in quarter *t*
High Severity versus Low Severity	JHU COVID-19 Global Cases, SEC	High (Low) Severity portfolio consists of the set of firms that are (not) headquartered in MSAs with *COVID Growth* above the median
Heavy Sellers versus Non-Heavy Sellers	Thomson Reuters	Heavy (non-heavy) sellers include investors who decreased their REIT holdings from 2019Q4 to 2020Q1 more (less) than the median investor
Local Heavy Sellers versus Local Non-Heavy Sellers	Thomson Reuters, SEC	Local heavy (non-heavy) sellers include investors who decreased their "local" REIT holdings from 2019Q4 to 2020Q1 more (less) than the median investor. If a REIT owns any property in a given investor's home MSA, the REIT is classified as "local" for that investor.