REITS IN TIME OF COVID 19

by

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Abstract

This paper examines the net impact of COVID-19 on US REITs returns by asset class relative to the recession caused by the Global Financial Crisis over the period of 2007-2009. The result indicates that the net impact of COVID-19 is positive and statistically significant on the returns for industrial REITs and office REITs, while the effect on residential and retail REITs is minimum. E-commerce and the demand for storage, distribution, and shipping attribute to the minimum price drawdown for industrial REITs during the recession in 2020 relative to office, residential, and retail REITs. Temporary closure of non-essential business, social distancing, and percentage rent clause attribute to the similar severity of price drawdown in residential and retail REITs in 2020 relative to the Global Financial Crisis.

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Chapter 1

Introduction

The first case of the novel strain of coronavirus disease 2019 (COVID-19) was identified in Wuhan, China in December 2019, although the exact origin is currently still under debate. The United States reported the first case in January 2020, and President Donald Trump declared the U.S. outbreak a public health emergency on January 31. The World Health Organization characterized COVID-19 as a global pandemic on March 11, 2020.[1] Governments around the world started to implement urgent measures to combat the spread of the disease. Temporary closures of non-essential businesses, social distancing, and travel restriction have resulted in substantial declines in Gross Domestic Production (GDP) and employment. According to the Organisation for Economic Co-operation and Development (OCED) quarterly national accounts, the quarterly growth rate of real GDP (percentage change from previous quarter) experienced a dramatic decline starting from 0.5% in 2019 Q4, -1.3% in 2020 Q1, to -8.9% in 2020 Q2 in the United States.[2] The substantial reduction in the private final consumption expenditure and Gross fixed capital formation[3] were the main drivers. Meanwhile, S&P 500 exhibited a series of declines, falling around 32% between February 10 and March 16, 2020.[4]

One of the industries most hard hit by COVID-19 is the real estate sector. Without the data on property prices, it would be difficult to quantify the impact of COVID-19 on the real estate sector. It is commonly believed that news regarding real estate fundamentals is reflected more rapidly in Real Estate Investment Trusts (REIT) share prices (capital market) than the property values (real activities). A REITs is a company that owns or finances income-producing real estate properties. The uniqueness of REITs is the minimum earning payout ratio and their tax-exempt status at the corporate level. To qualify each year under

[1] https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline

[2] available at https://stats.oecd.org/Index.aspx?QueryName=350

[3] Gross fixed capital formation measures the value of acquisitions of new or existing fixed assets less disposals of fixed assets

[4] available at https://ca.finance.yahoo.com/

the US Tax Code as a REIT, a corporation needs to meet certain regulatory requirements regarding the organization structure, business operation, and distribution of income. For example, a REIT must invest at least 75% total assets in real estate properties, earn at least 75% of gross income from rents from real estate properties, interest from mortgages, or from resale of real estate properties, and distribute at least 90% taxable income in the form of dividends. Krewson-Kelly and Mueller [2021] documents that equity REITs offer a greater compound annual returns compared to the S&P 500 Index over the 20, 25, and 30 years investment horizon. REITs are an effective hedge against inflation because the dividend growth of REITs would exceed the rate of inflation (measured by the increase in the Consumer Price Index). Further, REITs are proven to facilitate the diversification in a portfolio of stocks and bonds by enhancing the portfolio returns and reducing the portfolio risk. Furthermore, REITs are investment instruments for getting the exposure to the real estate market with flexibility and liquidity.

In the literture on COVID-19 and REITs, Ling et al. [2020] are the first to examine how regional exposure to COVID-19 negatively affects the return performance of U.S. REITs through their property holdings using a novel firm-level measure of geographically weighted COVID-19 growth.[5] The finding indicates that the property type focus of the REIT, the geographic allocation of properties, and the interaction between these two factors are the main contributors to the returns performance. Returns on retail, office, and residential REITs are negatively related to regional exposure while healthcare and technology REITs are positively related to such exposure. Milcheva [2021] assesses how COVID-19 affects the risk-return relationship in the developed Asian market (Hong Kong, Japan, China, and Singapore) and in the United States. Milcheva [2021] finds sharp declines in average daily returns as well as a dramatic increase in market and idiosyncratic risks as a result of COVID-19 pandemic. However, considerable variations in returns across the property types are witnessed in the United States while Asian region has little sectoral variation. Retail sector significantly under-performs during the pandemic in the US while in Asia the most affected sector is the office sector. This paper adds to the existing literature on REITs by being the first to isolate

[5] An average of the daily growth rates of COVID-19 in counties in which the firm owns properties weighted by the percentages of the firm's portfolio.

the net effect of COVID-19 using a different model relative to the recession caused by the Global Financial Crisis (GFC) over the period of 2007-2009.

Since by law, the equity REITs are required to earn at least 75% of gross income from the rent generated from real estate properties, social distancing and business lockdown result in substantial reduction in rent collection from these real estate properties. Hotels & motel and retail REITs are worst affected because of the travel bans. The greater systematic risk for retail REITs partially results from the percentage rent clause since landlords share in the risk in disruption in cash inflows with their tenants [Gyourko and Nelling, 1996]. In addition, REITs are also required to distribute at least 90% (95% prior to 2000) net income to shareholders in the form of dividends to maintain the tax-exempt status. More importantly, the minimum dividend requirement reduces retained earnings substantially and debt-financing may be preferable by REITs to raising capital even though tax-deductibility benefit is absent [Alhenawi, 2014] for non-tax benefits. Feng et al. [2007] report that the debt ratio on average in the REITs industry increased from 50% (IPO) to 65% in 10 years. The shortage of cash flow would affect the distribution of dividends and repayment of interest in the short run. The consequential changes in cap rate, discount rate, and future cash flows (that take into account inflation rates, vacancy rates, market rates, property level capital expenses, and net operating income) would have a significant impact on the fair value of real estate properties. Akinsomi [2021] compares the YTD returns of REIT sectors in the United States in March and April 2020 relative to those in 2019 and find that the lodging REITs experience the greatest loss (- 51.31%), followed by the retail REITs (-48.74%). Office REITs and residential REITs both suffer a loss of around -20%. A loss of -10% was seen in the industrial REITs. Data center REITs was the only REITs that witness gains of 8.8% in March and 17.66% in April, 2020. The author attributes it to the fact that data connectivity becomes essential when social distancing and movement restrictions are in place.

According to National Association of Real Estate Investment Trust (NAREIT), commericial real estate has been experiencing rising vacancy rate and falling rent growth in 2020, but exhibiting considerable variation across the property types, geographies and qualities of properties. Office and retail REITs vacancy rates increased, respectively, from 9.9% and 4.7%

in the first quarter of 2020 to 10.7% and 5.0% in the third quarter of 2020.[6] However, unlike Office and retail REITs, the increase (30 basis points) in the industrial REITs vacancy rates was due to the elevated pace of construction and excessive supply despite the great demand for logistic space from the booming e-commerce transactions. Even though the apartment REITs vacancy rates were flat, the population has migrated from urban cores to suburbs and smaller cities because of the concerns about the pandemic and practice of work-from-home. Valuation in the retail and office market fall by 3.2% and 3.8%, respectively, in the third quarter of 2020 relative to the same quarter of 2019. However, a steady growth is witnessed in the multifamily and industrial real estate properties.[7]

This paper intends to evaluate if the impact of the recession caused by COVID 19 on REIT returns by property type is systematically different from those of the recession caused by GFC and, if so, how the impact differs across different property types. In order to investigate the difference in how REIT returns evolve between the recession caused by GFC and the recession caused by COVID 19, this paper follows the chronology[8] provided by the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER). A recession is defined as the period between a peak of economic activities and its subsequent trough according to the NBER. The contraction caused by internal weakness — excessive leverage, overheated housing market, and financial crisis (the official determination provided by NBER) started from December 2007 (2007Q4) to June 2009 (2009Q2), lasting for 18 months. The recession caused by COVID 19 started from February 2020 to April 2020, lasting for 2 months.

This paper proceeds as follows. Sections 2 and 3 review the key characteristics of REITs and relevant literature. Sections 4 and 5 describe the data and methodology. Section 6 documents the empirical results, and Section 7 provides the conclusion.

[6] https://www.reit.com/data-research/research/nareit-research/2021-reit-outlook-economy-commercial-real-estate

[7] https://www.reit.com/data-research/research/nareit-research/2021-reit-outlook-economy-commercial-real-estate

[8] https://www.nber.org/research/business-cycle-dating

Chapter 2

Literature

2.1 Real Estate Investment Trusts

The REITs were authorized by the US Congress to be the trust for a long-term, passive, but still liquid investments in real estate properties in 1960 and have existed since 1961. Numerous regulatory changes have reshaped the landscape of the operating environment of REITs, resulting in the rapid growth and increased academic attention[Feng et al., 2011]. Based on their mode of operation, REITs can be broadly classified into the following three categories: mortgage, equity, and hybrid REITs. Equity REITs own or operate income-producing real estate properties. In contrast, mortgage REITs provide financing for income-producing real estate properties by purchasing or originating mortgages and/or mortgage-backed securities, thus earning incomes from these investments. Hybrid REITs operate as the blended model of equity and mortgage REITs. REITs can also be classified based on how they are traded. Publicly traded (listed) REITs are registered with the Security and Exchange Commission (SEC) and their shares are traded on national stock exchanges and are available to the general public. Public non-traded (non-listed) REITs are registered with the SEC but they are traded over the counter with broker/dealers rather than being listed on national stock exchanges. Private REITs are exempt from the SEC registration and are available via private placements and/or crowdfunding portals. REITs can also be further categorized based on the type of commercial properties they specialize in, which include residential, retail, industrial, office, healthcare, lodging, self-storage, infrastructure, data centers, and specialty REITs.

Real estate fundamentals are the dominant factors in determining REIT performance over the long term. Real estate cycles play an important role but the cycles for each property type are unique in terms of length and magnitude of the cycles. The discussion on real estate cycles started in 1933 by Homer Hoyt. Mueller [1995] first theorizes that the commercial real estate market is influenced by the dynamics between real estate's physical market (the

demand and supply of physical real space) cycles and financial (debt and equity) market cycles. The demand for space is affected not only by the level of employment but also the employment growth rate with strong cyclic characteristic [Wheaton, 1987]. However, considerable amount of time is needed to create the supply to meet the new demand. The lag between the demand for and the supply of space is another contributing factor in cyclicality of the real estate's physical market. Developers have to speculate and start the construction before the actual demand materializes to gain market shares. Wheaton [1987] suggests that supply seems to respond directly to macroeconomic conditions because developers adjust their expectations to macroeconomic indicators rather than to actual local demand. Occupancy rates reflect the interaction between the supply of and demand for space and they in turns impact rental growth rates. Occupancy rates and rental growth rates determine property incomes in the long run. The financial market cycles concern how capital flows to real estate properties and how much influence rental growth rates have on property prices. Because investors and suppliers cannot project future demand accurately and respond rapidly to strong demand and high rental rate with new supply, the financial market cycles would lag behind the physical market cycles.

Each type of real estate properties is associated with its distinct supply and demand fundamentals and in turn affects the expected cash flows from these properties. Industrial and residential properties serve a critical function in the economy. They tend to have fairly high occupancy rates regardless of the business cycles. Therefore, industrial and residential REITs are viewed as defensive investments, exhibiting less volatility, especially during times of recession. Industrial REITs own and manage industrial properties that are leased to tenants looking for space to be used in manufacturing, warehousing, and distribution of goods. Block [2011] documents that national warehouse/industrial occupancy in the United States ranges between 89% and 95%. Demand for industrial properties is reported to be strongly correlated with the growth in GDP and consumer spending. Because the construction of industrial properties is fairly simple and takes typically six to nine months to complete, the supply of newly constructed industrial properties would track demand closely. Therefore, industrial properties are less volatile in the United States. Lin et al. [2020] illustrates that industrial

and logistic REITs have increasingly replaced the traditional industrial properties with logistic properties to accommodate the flourishing growth of e-commerce, offshore manufacturing, and the increasing cost of freight transport. The prevailing practice of telecommuting and movement restrictions caused by the COVID-19 pandemic have further fostered e-commerce rapidly from a "want" to a "need" [Block, 2011]. The permanent change in consumer buying habits and the dynamic supply chain ecosystem with high digital technologies have created sustained and strong demand for warehousing and logistics. Industrial property landlords often use triple-net or modified-gross leases. Triple-net leases are the lease agreements in which the tenant pays the landlord a fixed monthly rent, property tax, insurance, and all costs associated with property operations and maintenance. Modified-gross leases require the tenant to pay the monthly rent, property tax, and insurance. Industrial rents typically increases annually and tend to be tied to increase in the Consumer Price Index (rent escalation clause).

Residential REITs own and manage residential property units for renting out to tenants for non-business purposes. Residential REITs may be categorized into either single or multi-family structures and include family houses, apartment buildings, condominiums, vacation homes, student housing, etc. The duration of a rental agreement in general is 12 months and tenants need to provide notice at least one month ahead if they want to cancel the lease. The rental agreement is similar to a full-service lease in which the landlord is responsible for all monthly expenses associated with operating the property, including utilities, water, taxes, janitorial, trash collection, and landscaping. But the landlord would factor in the rental rate monthly operating costs and thus, tenants essentially cover all associated expenses. Demand for residential housing is positively affected by the increasing employment rate during expansions as well as during recessions [Block, 2011]. When employment decreases, coupled with a wide range of incentives offered by apartment landlords to maintain the occupancy level, some home owners may go back to renting. The risk of oversupply is the main concern in the dynamic of demand and supply. As rental rates for residential housing increase, developers respond to strong demand with greater supply, which in turn leads to lower occupancy rates and rental rates. During the COVID-19 pandemic, tenants have been able to negotiate lower rental rates in response to the financial impact that regional lockdown have on household income [Akinsomi, 2021].

Office REITs specialize in leasing office space in central business districts (CBD) and suburban areas. Office REIT returns exhibit greater cyclical fluctuations relative to other property-types of equity REIT because office REITs' longer building cycles result in periodic overbuilding[Block, 2011]. Demand for office space is positively affected by increasing employment rates during expansions [Block, 2011]. Location plays an essential role in determining current rental rates, future rental growths, and occupancy rates in the market of office buildings [Block, 2011]. Large office properties can accommodate multiple tenants, lower tenant concentration, and thus help diversify idiosyncratic risk. Full-service leases with an initial term of five to seven years are commonly used by office building landlords [Block, 2011]. In this case, the tenants pays the landlord a fixed monthly rent that includes an expense stop, which means the landlord is responsible for the operating expenses of the property and common area maintenance up (CARM) to a pre-specified amount. The annual rent escalation is also stated in the lease to ensure the profit margin. Social distancing, working from home (WFH) policies and virtual meetings are put into place during the COVID-19 pandemic. The shift in positive attitudes of US executives and employees about remote work is evident based on PwC's US Remote Work Survey in 2021 January.[9] In addition, PwC indicated that hybrid workplaces where a large number of office employees rotate in and out of offices configured for shared spaces are likely to become the norm. The perception that the future demand for office space may be permanently dampened because of the prevailing practice of remote working is reflected in the sharp drop in the pricing of Office REITs. The concept of co-working spaces (CWSs) has been gaining popularity and the 2019 Global Coworking Survey projects that there would be 2.17 million members working in 22,400 co-working spaces around the world.[10] Krewson-Kelly and Mueller [2021] indicate that about 10% of new office space in the US is leased to firms like WeWork that leases space for long term, undertakes renovation, and then subleases office space in short-term contracts for significantly higher rental prices to entrepreneurs, freelancers, and start-ups who value flexibility. Financial Time has noted that "the mismatch in rental periods is seen by many in

[9]https://www.pwc.com/us/en/library/covid-19/us-remote-work-survey.html

[10]https://www.deskmag.com/en/coworking-news/2019-state-of-coworking-spaces-2-million-members-growth-crisis-market-report-survey-study

the industry as a potential weakness in its model during a recession."[11] NAREIT cites data from CoStar and S&P Global Market Intelligence and shows that REITs in the US have little exposure to WeWork.[12]

Retail REITs can be further categorized into three types: shopping center, regional mall, and freestanding REITs. Retail REITs landlords in general employ net or modified gross lease and may also receive percentage rents which are calculated as a portion (typically 1% to 2%) of the gross revenue that a tenant gains in any given year above the initial year's gross revenue [Krewson-Kelly and Mueller, 2021]. During the economic contractions, the landlord may receive no percentage rents and it presents a potential downward risk to the Retail REIT's earnings. During the COVID-19 pandemic, numerous studies show that Retail REITs have seen their share prices tumbled [Akinsomi, 2021, Milcheva, 2021, Ling et al., 2020], when the social distancing and non-essential business closures are implemented. The growth of e-commerce has been shrinking the profit margin of traditional retail stores. The COVID-19 shock has accelerated e-commerce to gain a greater market share. The fear that consumers' spending behavior may permanently change and might dampen the demand for future retail space is reflected into the sharp drop in retail REIT prices. Retailers associated with essential business such as Krogers, Target Corporation, Walmart, and Home Depot have not been negatively affected by the COVID-19 shock.

Real estate fundamentals, lease structure, and cost of capital are primary drivers of REIT performance [Krewson-Kelly and Mueller, 2021]. Consistent demand for certain properties could be translated into steady occupancy rates and thus affects profitability over the long term. The length and type of leases that a REIT employs could help predict cash flows during times of economic expansion and contraction. The cost of capitals, which is also known as the weighted average cost of debt and equity, and the degree of leverage reflects how a management team finances its operations, determining the evolution of long-term returns.

[11] https://www.ft.com/content/83decf7a-c04d-11e9-b350-db00d509634e
[12] https://www.reit.com/news/blog/market-commentary/reits-have-limited-exposure-to-wework

2.2 Relevant Literature

There exists a considerable body of literature on the determinants of returns on REITs. The modern financial theory indicates that macroeconomic variables systematically influence stock market returns. The unsystematic or company-specific risk can be mitigated through diversification and no extra reward is earned by bearing diversifiable risk. In the earlier stage, following the multi-factor APT (Arbitrage Pricing Theory) model proposed by Ross [1976], Chen et al. [1986], Roll and Ross [1984], general economic state variables, which explain asset pricing, have been incorporated in the return generating function of REIT indices (at the aggregate level). For example, the unexpected changes in the risk and term premiums influence the discount rate, future cash flows, and, ultimately, REIT returns. The unexpected inflation influences the relative price change and affects expected cash flows. Chan et al. [1990] reports that the unexpected changes in inflation, term spread and credit spread consistently drive equity REIT returns over the period of 1973–1987. Redman and Manakyan [1995] extends research in the determinants of REIT returns by examining the linkage between the risk-adjusted performance of REITs and financial and property characteristics over the period of 1986-1990. They find that none of the financial variables can explain the variation in risk-adjusted REIT returns but location of properties, ownership of health care properties, and investment in securitized mortgages can positively affect REIT returns.

Fama and French [1992] documents the set of variables that have no special standing in asset-pricing theory but have been empirically found to have the predictive power for stock returns. They show that the common variation in stock returns can be well captured by the size of the firm (market capitalization) and the book-to-market values (BE/ME—the ratio of the book value of a firm's common stock to its market value). Fama and French [1992] also reports that a firm with high BE/ME tends to have low returns and small firms tend to have lower returns than big firms; they suggest that these two variables are proxies for the size and value factors in returns. Fama and French [1993] regress monthly excess returns of stocks and bonds on the returns of a stock market portfolio and mimicking portfolios for size and value factors, and term and credit spreads. Their results indicate that the stock market factor, factors for size and value consistently drives stock returns. Factors for term and credit spreads have predictive power in bond returns. Using the five-factor model of

Fama and French [1993], Peterson and Hsieh [1997] find that returns on equity REITs are significantly related to the market portfolio's excess returns (Rm-Rf), SMB (Small Minus Big), and HML (High Minus Low) over the period of 1976-1992. SMB is the difference between the returns on small and big stock portfolios and captures the returns attributable to the size factor. HML is the difference between the returns on high and low BE/ME portfolios and captures the returns attributable to the value factor.

A structural change in REIT pricing in the early 1990s was documented in the literature and the Revenue Reconciliation Act of 1993 was used as the dividing point between the vintage (1980-1992) and new REIT eras (starting from 1993) in the standard practice [Chiang, 2015]. It is suggested that since 1992, an increase in analyst following and greater involvement of institutional investors help REIT share price better reflect the performance of the underlying asset holding [Clayton and MacKinnon, 2003]. In other words, the short-run link between REIT prices and their fundamentals has been strengthened. Clayton and MacKinnon [2003] show that the variation in REIT returns explained by the large-cap stock factor (S&P 500) fall from 72% in the early 1980s to 9% in the 1990s. In addition, a significant small-cap stock factor (Russell 2000) and a significant real estate factor (unsmoothed NCREIF total return index) emerge in the late 1980s and during the 1990, respectively.[13]

Firm-specific accounting variables are significant contributors to the return generating process of individual REITs. Chiang [2015] utilizes the traditional asset valuation model, in which asset prices are equal to the present values of expected future cash flows discounted by the expected required rate of return, and shows that a positive relationship between dividend yields and REIT returns emerged over the new REIT era. The dividend yield (or current yield) on a REIT is calculated by dividing the annualized dividends by its current REIT price. Even though the contractual nature of the rental lease has historically enabled REITs to pay dividends even during recessions, the Global Financial Crisis in 2008 serves as a warning that the distribution of REIT dividends may not be not guaranteed. The widespread dividend cuts in 2008 highlight the importance of sustainability of dividends. The dividend safety can be quantified and evaluated from two perspectives: financial leverage and expected dividend payout ratio. Leverage can enlarge gain and loss but a higher

[13]Clayton emphasizes that the indices are utilized as proxies for the underlying state variables shared by REITs in the multi-factor model.

leverage comes with a higher risk. Common shareholders have the residual claim on earnings and assets and a higher leverage means higher interest and principal payments, less financial flexibility, and a greater probability of default in the case of recession. The debt-to-total market capitalization and debt-to-tangible book value ratios are two commonly-used leverage metrics. The payout ratio is defined as the proportion of net income a company pays out to its common share holders as a dividend. The REIT's expected dividend payout ratio is obtained by dividing current annualized dividend by an estimate of next year's expected fund from operation (FFO) per share. The dividend/FFO payout ratio signals the ability of a REIT to pay its current dividend.

Funds from operations (FFO) and net income (NI) are generally accepted accounting principle (GAAP) earning measure and are commonly used by practitioners in analyzing REITs. FFO is clearly defined by NAREIT in 2002 as NI excluding gains (or loss) from sales of property, plus depreciation and amortization, and adjustments for unconsolidated partnerships and joint venture in the FFO White paper.[14] FFO has been strongly promoted by NAREIT because the implicit assumption that the value of real estate assets diminished predictably over time is embedded in the calculation of the GAAP performance measure NI (NI - historical cost depreciation). FFO is a proxy for the REIT's free cash flow, which is higher than after-tax income that takes into account the non-cash expenditures. Adjusted Funds from Operations (AFFO) is another supplemental measure of a REIT's operating performance. It is regarded as a better metric for evaluating a REIT's ability to pay dividends than FFO because amortized expenses (non-cash items) are added back to and recurring capital expenditures are subtracted from NI. Krewson-Kelly and Mueller [2021] indicates that REITs measure earning growth as year-over-year change in FFO, as opposed to a change in earnings per share (EPS) employed by non-REIT corporations. EPS is calculated as NI net of preferred dividends divided by weighted average shares outstanding. However, FFO is not governed by GAAP and it is not audited. Vincent [1999] regresses market-adjusted returns on changes in FFO and earnings per share and finds that both FFO and earnings per share (NI divided by the number of shares outstanding) consistently provide incremental information content.

[14] https://www.reit.com/nareit/advocacy/policy/nareit-ffo-white-paper-and-related-implementation

Chapter 3

Data

3.1 Quarterly Returns of Listed Equity REIT

There are currently 220 U.S. publicly-traded REITs listed and traded on the U.S. stock exchanges with a total capitalization of approximately US$1.321 trillion in September 2021.[15] There are 180 equity REITs and 40 mortgage REITs which account for 95.2% and 4.8%, respectively, of the all publicly-traded REITs in the United States.[16] This paper focuses exclusively on the equity REITs to reduce the potential for heteroskedasticity problem inherent in the mixed sample of equity, mortgage, and hybrid REITs. This paper also excludes healthcare facility, lodging/resort, diversified, specialty, hotel & motel, and real estate services REITs and REITs for which price information is not available. There are 20 office REITs, 12 residential REITs, 11 industrial REITs, and 24 retail REITs on the list of 67 REITs. The price information of 67 listed equity REITs from October 2007 to March 2020 are obtained from Yahoo Finance using the R package "BatchGetSymbols". Then the quarterly return is calculated by dividing the daily adjusted price (for dividends and stock spilt) at the end of each quarter by the daily adjusted price at the start of each quarter minus 1 (quarterly return $= \frac{P_t}{P_{t-90}} - 1$). The purpose is to match the time frequency of firm accounting data (on a quarterly basis). The returns are expressed in percentage terms. An overview of the quarterly returns of 67 equity REITs during the period from October 2007 to March 2020 is provided in Tables (3.1) and (3.2). Office REITs deliver relatively low returns (1.8879%) on average compared to residential and industrial REITs. The quarterly mean returns for office REITs vary widely, and the standard deviations of the two office REITs reach as high as 27.1965 and 29.1159, respectively. The quarterly mean returns for residential REITs (2.9769%) are relatively higher and vary less. The greatest mean returns (3.5394%) are witnessed in the industrial REITs, but the variation is prominent. The quarterly mean returns for retail REITs are relatively low and vary widely.

[15] available at https://www.reit.com/data-research/reit-market-data/reit-industry-financial-snapshot
[16] available at https://stockmarketmba.com/whatisareit.php

Table 3.1: Descriptive Statistics for Office and Residential REITs Quarterly Returns

	Ticker	**Mean**	**StDev**	**Max**	**Min**	**Skewness**	**Kurtosis**
Office REITs							
	ARE	2.8547	14.5500	51.7189	-45.5372	-0.2368	3.6655
	BDN	2.9118	29.1159	159.5305	-60.2510	2.7757	14.6294
	BXP	1.7269	14.0439	38.7742	-37.6219	-0.2647	1.9103
	CLI	0.1325	13.6442	40.3821	-33.5106	0.1562	0.5684
	CMCT	-0.8898	16.6981	24.6782	-67.3734	-1.5178	3.4748
	COR	6.9007	13.7323	38.4508	-19.3713	0.1723	-0.5570
	CUZ	0.4411	16.4673	38.3901	-49.3766	-0.7582	1.3598
	DEI	2.3281	14.6217	34.4217	-40.9819	-0.7328	1.5619
	DLR	4.2847	11.0080	27.8279	-27.7777	-0.2396	0.0809
	EQC	2.3261	17.2572	78.8871	-47.9605	1.3705	7.3319
	FSP	-0.1511	11.0972	19.4852	-31.0184	-0.3377	-0.1867
	HIW	2.2922	12.8104	41.5983	-26.1230	0.2608	0.3337
	HPP	2.9321	11.9807	31.7526	-30.7772	-0.3014	0.9052
	KRC	2.2844	14.3783	33.6959	-45.3855	-0.4959	1.3719
	OFC	0.9743	13.3771	31.0601	-29.6474	-0.2449	-0.2558
	OPI	0.4094	13.2421	30.4217	-34.3418	-0.3813	0.1969
	PDM	1.4408	8.8092	25.6796	-20.7514	-0.0549	0.7093
	SLG	2.4659	27.1965	115.7642	-58.0747	1.5342	6.4323
	VNO	0.7056	15.3110	43.2096	-42.0379	-0.4198	1.9204
	WRE	1.3885	12.7644	34.8668	-35.4600	0.0043	0.9906
	Total	1.8879	16.7010	159.5305	-67.3734		
Residential REITs							
	ACC	2.0866	12.6062	31.1331	-37.5701	-0.6852	1.7511
	AIV	3.0546	19.4856	65.8137	-55.6760	0.0976	4.1606
	AVB	2.4223	12.2378	31.4347	-34.2577	-0.5676	0.9316
	BRT	1.5193	18.0936	62.7630	-57.9067	0.0532	3.4117
	CPT	2.7593	13.3600	46.2630	-28.0321	0.1519	1.5253
	ELS	4.1070	10.2253	23.3373	-25.6081	-0.5704	0.4126
	EQR	3.0930	13.0872	38.9513	-33.3628	-0.3534	0.9319
	ESS	2.8923	11.8776	28.7085	-33.0791	-0.5949	0.8883
	MAA	3.2774	10.1852	23.6235	-21.8510	-0.2309	-0.4465
	SUI	5.2670	13.9928	61.7645	-27.9983	0.8280	4.1418
	UDR	3.5285	14.4289	51.0507	-37.5984	-0.0053	2.4846
	UMH	1.7158	14.1154	48.0407	-30.9556	0.5684	1.0699
	Total	2.9769	15.2254	65.8137	-57.9067		

Notes: No sufficient accounting data are available from Mergent Online regarding CMCT, COR, HPP, OPI, and PDM (Office REITs) and for BRT, ELS, and SUI (Residential REITs).

Table 3.2: Descriptive Statistics for Industrial and Retail REITs Quarterly Returns

	Ticker	**Mean**	**StDev**	**Max**	**Min**	**Skewness**	**Kurtosis**
Industrial REITs							
	CUBE	5.2122	24.9711	130.5632	-62.2723	1.8501	11.5480
	DRE	3.1649	18.2856	69.1153	-52.1461	0.0697	3.8656
	EGP	3.3216	10.5428	26.6931	-24.5426	-0.2391	0.0495
	EXR	5.9095	14.7262	48.0496	-43.2287	-0.4385	2.2473
	FR	3.8671	24.8732	74.0000	-72.5040	-0.1675	2.7670
	LSI	3.4206	12.3558	24.9511	-40.4685	-0.7547	1.3797
	MNR	2.6510	10.4763	21.8227	-23.5695	-0.3355	-0.5305
	PLD	2.9370	15.2507	30.8977	-45.4079	-0.8883	1.4347
	PSA	3.5185	10.9112	28.0474	-26.1591	-0.1844	-0.0792
	SELF	1.2395	10.4171	32.4426	-20.7264	0.6313	0.9637
	TRNO	3.6917	9.6963	25.9567	-24.7066	-0.0617	0.8042
	Total	3.5394	17.3884	130.5632	-72.5040		
Retail REITs							
	ADC	3.9960	12.0946	28.9803	-31.9524	-0.2290	0.2793
	AKR	0.5417	13.6315	22.4949	-50.0699	-1.3886	3.0777
	ALX	1.7149	15.1373	66.8213	-32.3965	1.4026	5.5885
	BFS	0.7607	12.7837	29.3959	-39.6840	-0.7676	1.9624
	CDR	0.9840	32.6169	158.2858	-74.7942	1.8184	9.2329
	EPR	2.3739	19.4314	65.5889	-62.2106	-0.3778	3.3772
	FRT	1.2115	11.8980	23.8856	-39.5257	-0.8232	1.4176
	GTY	2.3646	15.7512	56.7043	-41.9437	0.0448	2.7386
	HMG	5.7331	50.4824	317.3038	-48.9437	4.8027	26.4067
	KIM	0.6083	19.1336	48.2300	-58.1319	-0.8292	1.6435
	KRG	-0.8554	19.2107	39.1975	-54.5032	-0.6209	0.9215
	MAC	1.5937	31.5421	148.2265	-76.0571	1.5574	8.5333
	NNN	2.5249	11.3476	22.8775	-36.5346	-0.8599	1.4235
	O	3.3809	10.6379	23.3780	-26.2444	-0.2758	-0.4406
	PEI	-0.9268	25.6138	56.7872	-80.9082	-0.4330	1.2677
	REG	0.9381	13.7124	33.4912	-38.2903	-0.6203	0.7877
	ROIC	1.3598	10.9249	16.1900	-51.4322	-2.6922	10.7390
	RPT	1.3724	20.8537	70.4861	-70.2108	-0.5969	4.0528
	SITC	1.4689	31.9213	144.6002	-84.1559	1.4696	7.4044
	SKT	-0.3709	13.1306	22.9726	-62.3287	-1.9607	7.6797
	SPG	1.7145	17.1956	56.4830	-60.6230	-0.5734	4.1293
	UBA	1.4796	11.4137	28.6008	-39.2738	-0.6615	1.7949
	UBP	1.1351	10.1621	18.1103	-39.4589	-1.2143	3.1563
	WSR	1.7020	14.5270	25.8728	-54.4217	-1.4469	3.9257
	Total	1.5336	21.74876	317.3038	-84.1559		

Notes: No sufficient accounting data are available from Mergent Online regarding PSA, SELF, STAG, and TRNO (Industrial REITs) and for ALX, HMG, ROIC, RPT, and UBP (Retail REITs).

3.2 Main Market Index and REIT Returns by Property Type

Correlation coefficients are commonly used to measure the direction and strength of the linear association between two variables. The correlation matrix presented in Table (3.3) is computed for the quarterly total returns of office, retail, industrial, and residential REIT indexes from NAREIT as well as the quarterly returns of S&P 500 and Russell 2000 from Yahoo Finance. As Table (3.3) demonstrates, office REITs have an extremely high positive correlation with retail and residential REITs, as well as industrial REITs during the period from January 2007 to November 2021. The linear association between retail and residential REITs (0.8923) as well as between retail and industrial REITs (positive 0.8043) are also strong but relatively weaker than that between retail and office REITs (0.9070). The lowest correlation is seen between industrial and residential REITs (0.7788). The S&P 500 index represents the large capitalization stocks in the US while the Russell 2000 represents the small-cap to mid-cap firm shares in the US. All four REITs are strongly associated with both the market indexes. The result is consistent with the literature that macroeconomic variables that have been found to be statistically significant in explaining stock returns also have the predictive power for REIT returns [Clayton and MacKinnon, 2003].

Table 3.3: Correlation Matrix for Return Series

	Office	**Retail**	**Industrial**	**Residential**	**S&P500**	**Russell 2000**
Office	1.0000	0.9070	0.8574	0.9080	0.7797	0.7991
	(0.0000)	(0.0558)	(0.0682)	(0.0555)	(0.0829)	(0.0796)
Retail		1.0000	0.8043	0.8923	0.7683	0.7763
		(0.0000)	(0.0787)	(0.0598)	(0.0848)	(0.0835)
Industrial			1.0000	0.7788	0.8040	0.7375
			(0.0000)	(0.0831)	(0.0788)	(0.0895)
Residential				1.0000	0.6493	0.6641
				(0.0000)	(0.1007)	(0.0990)
S&P500					1.0000	0.9329
					(0.0000)	(0.0477)
Russell 2000						1.0000
						(0.0000)

Notes: The daily data of S&P 500 and Russell 2000 are sourced from Yahoo Finance using the R package "BatchGetSymbol" and cover the period from January 2007 to November 2021. The daily return is the first difference in the logarithm of the daily adjusted price (for dividends and stock split) $[log(\frac{P_t}{P_{t-1}}) = log(1+r) \approx r]$. Then the daily return is converted into the quarterly value through $\prod_{t=1}^{T}(1+r_t)-1$. The monthly total returns of office, retail, industrial, and residential REIT indexes of the FTSE Nareit U.S. Real Estate Index Series are obtained from NAREIT.[17] The monthly returns are also transformed into quarterly returns.

As Figure (3.1) demonstrates, industrial REITs experienced a greatest loss during the recession caused by the GFC in 2008-2009. However, the least affected sector was industrial REITs when the external COVID-19 shock hit. The result is in line with the facts that the prevailing practice of remote working and movement restrictions caused by COVID-19 further boosts the growth of e-commerce and that the demand for warehousing and logistics is strong during the COVID-19 pandemic. Retail REITs are among the least stable and most volatile property types during the unsettled times. The greatest price drawdown was witnessed in retail REITs during the COVID-19 pandemic and the magnitude of the price drawdown was more severe during the COVID-19 pandemic than during the GFC. The Russell 2000 index declined more substantially than office and residential REITs did in 2020, which is the opposite of what happened during the GFC in 2008-2009. The duration of the COVID recession is much shorter than that of the GFC.

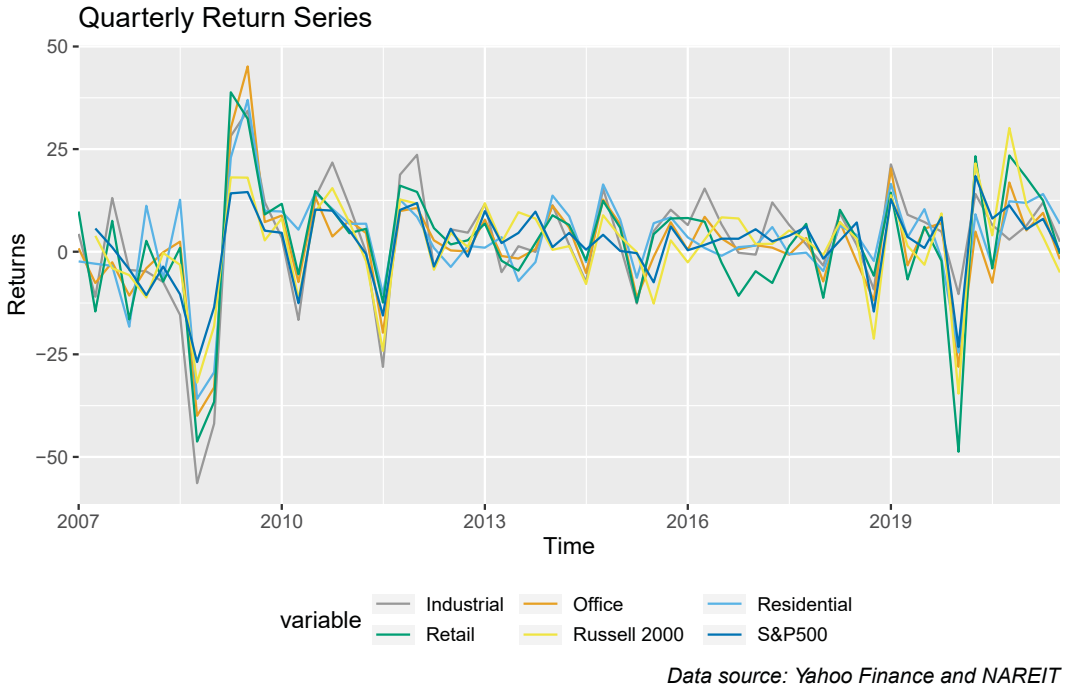

Figure 3.1: Total Return Indices

3.3 Asset-Pricing/Macro Control Variables

General economic state variables such as inflation, the credit spread between low-grade bonds and high-grade bonds, and the term spread between long-term and short-term government bonds are statistically significant in explaining equity REIT returns [Chan et al., 1990, Redman and Manakyan, 1995]. Three Fama-French factors—the excess return on the stock market portfolio (Rm-Rf), the size factor (SMB—returns on portfolios of small minus big stocks), and the value factor (HML—returns on portfolios of high minus low book-to-market stocks)—have also been extensively employed in the return generating process of the NAREIT Equity REITs Index. The excess return on the market (Rm-Rf) is the value-weighted return on all NYSE, AMEX, and NASDAQ stocks minus the one-month Treasury bill rate. These variables have been empirically examined and are jointly regarded as a proxy for a set of latent variables that determine equity REIT returns. The excess return on equity REITs as dependent variable is calculated by subtracting the short-term interest rate (TB3) from the REIT returns[Fama and French, 1993].

Table (3.4) reports the term spread (TSpread) has a moderate correlation (-0.5878) with the short-term interest rate (TB3). The term spread is also negatively correlated with the rate of inflation but the correlation is substantially weaker. The credit spread (CSpread) is positively correlated with the term spread (0.2568). The term spread has little correlation with the excess market return (Rm-Rf), size factor (SMB), and value factor (HML). Similar to the term spread, the correlations between the credit spread and the three stock market factors are also low. The short-term interest rate is negatively correlated to all the macro/asset-pricing variables except the rate of inflation but these correlation is low. The rate of inflation is negatively correlated with the bond market factors but positively correlated to the stock market factors. The low correlation (0.1747) between HML and SMB is attributed to how these variables are constructed as two distinct factors for asset pricing.

Figure (3.2) reports that HML and SMB declined substantially in 2020. However, HML rebounded quickly and achieved a record-breaking high while SMB climbed back gradually over time. The rate of inflation dived hard into the negative territory and reached -3.43% in 2008 while a minor dip was witnessed in 2020. The credit spread rose substantially during the GFC to compensate for the greater uncertainty. The increase in the credit spread during

the COVID-19 pandemic was minor.

Table 3.4: Correlation Matrix for Asset Pricing/Macro Control Variables

	TSpread	**TB3**	**CPI**	**CSpread**	**Rm-Rf**	**SMB**	**HML**
TSpread	1.0000	-0.5878	-0.1170	0.2568	0.0205	0.1052	-0.0288
	(0.0000)	(0.1122)	(0.1377)	(0.1340)	(0.1386)	(0.1379)	(0.1386)
TB3		1.0000	0.2151	-0.1071	-0.1888	-0.1269	-0.2355
		(0.0000)	(0.1354)	(0.1379)	(0.1362)	(0.1376)	(0.1348)
CPI			1.0000	-0.3907	0.0990	0.2058	0.2199
			(0.0000)	(0.1277)	(0.1380)	(0.1357)	(0.1353)
CSpread				1.0000	0.0474	-0.1606	-0.1358
				(0.0000)	(0.1385)	(0.1369)	(0.1374)
Rm-Rf					1.0000	0.2408	0.4792
					(0.0000)	(0.1346)	(0.1217)
SMB						1.0000	0.1747
						(0.0000)	(0.1365)
HML							1.0000
							(0.0000)

Notes: The data from October 2007 to March 2020 on the three-month U.S. Treasury bills (TB3), the term spread (TSpread) between 10-Year Treasury constant maturity and 3-month Treasury constant maturity, the credit spread (CSpread) between Moody's Seasoned Baa Corporate Bond Yield and Moody's Seasoned Aaa Corporate Bond Yield, the rate of inflation (CPI) are obtained from the Federal Reserve Economic Data (FRED).[18] The Fama-French three factors which are the excess return on the market (Rm-Rf), the size factor (SMB—returns on portfolios of small minus big stocks), and the value factor (HML—returns on portfolios of high minus low book-to-market stocks ratio) are obtained from the Kenneth French's database.[19] CPI is obtained by dividing the Consumer Price Index for All Urban Consumers: All Items in the U.S. City Average (CPIAUCSL) by its lagged value and then take the log $[log(\frac{CPIAUCSL_t}{CPIAUCSL_{t-1}}) = CPI]$. The frequency of the data is monthly and is annualized. Hence, the monthly data needs to be divided by 12 and then are converted into the quarterly values $\prod_{t=1}^{T}(1+r_t)-1$ to match the time frequency of firm accounting data (on a quarterly basis). The data is expressed in percentage terms.

3.4 Firm Accounting Variables

The estimates of the discount rate and expected cash flows are two main ingredients in the evaluation of an asset. The main sources of information needed for the estimation are the firm's financial statements. To estimate the discount rate, an understanding of the business and financial risks is essential. To obtain the estimate of expected cash flows, we need to have a clear picture of how historical cash flows are composed and what factors will contribute to short-term and long-run growth of these cash flows [Reilly and Brown, 2011]. Compared

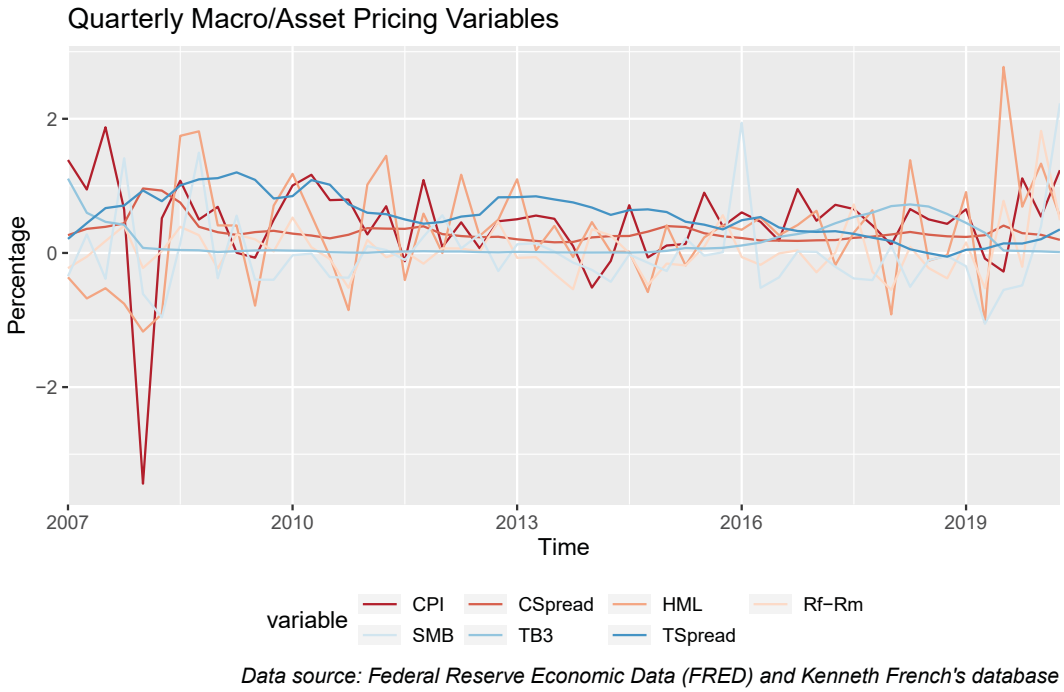

Figure 3.2: Macro/Asset Pricing Variables

with numbers in isolation, relative financial ratios derived from the financial statements are more informative in comparing a firm's performance relative to the aggregate economy, the relevant industries, its major competitors within the industry, and its historical performance. There are four main dimensions in ratio analysis: internal liquidity, operating performance, risk, and growth [Reilly and Brown, 2011]. Internal liquidity ratios, such as current ratio (CR), indicate the ability of a firm to meet short-term financial obligations by comparing near-term financial obligations to current assets. Operating performance ratios have two subcategories: operating efficiency ratios and operating profitability ratios. In the case of REITs, it makes more sense to focus on the operating profitability ratios which analyze the profits as a percentage of the assets and capital employed, including return on assets and return on equity. Return on asset (ROA) and return on equity (ROE) are used to evaluate the efficiency in employing asset and capital. The main difference between ROA and ROE is whether the denominator takes into account a company's debt ($ROE = \frac{Net\ Income}{Shareholder\ Equity}$ and $ROA = \frac{Net\ Income}{Total\ Assets}$). Risk analysis is concerned with examining the major factors that cause a firm's cash flows to vary [Reilly and Brown, 2011]. There are two main components: business risk and financial risk. Business risk is defined as "the uncertainty due to the firm's variability of operating earnings caused by its products, customers, and the way it produces

its products". Financial risk is defined as "the additional uncertainty of returns to equity holders due to a firm's use of fixed financial obligation securities" [Reilly and Brown, 2011]. When a firm raises capital through selling bonds, the interest payments on capital are fixed contractual obligations. Leverage can magnify the gain and loss. However, the earnings available to common stockholders will decline by a larger percentage than operating earnings during a recession.

The firm accounting data over the period of 2007Q4–2021Q3 are obtained from the Mergent Online. The accounting data can be grouped into four main categories: Operating Performance (ROA, ROE, Return on Investment, and EBITDA margin); Internal Liquidity (Current Ratio and Net Current Assets/Total Assets), Risk (in terms of financial risk) (Long-Term Debt to Equity ratio and Total Debt To Equity Ratios), and Asset Management (Total Asset Turnover and Cash&Equivalents Turnover). For more information, please see Table (3.5).

Table 3.5: Glossary and Definitions of Financial Ratios

Symbol	Variable	Definition and Formula
Basic Series		
NS	Net Sales	Revenue - Sale Returns - Allowances - Discounts
CA	Current Assets	Cash and cash equivalents + short term investment + Net Receivables + Inventories
SE	Shareholder Equity	Total Assets - Total Liabilities
CL	Current Liabilities	Cash + Cash Equivalent + account receivables + inventories + marketable securities + other liquid assets
LL	Total Long Term Liabilities	Obligations that are not due within the next 12 months
DP	Dividend Paid Out	Commonly the distribution of some of a company's earnings to a class of its shareholders
OP	Operating Income	Net Earnings + Interest Expense + Income Taxes
EBITDA	Earning Before Interest, Tax, Depreciation, and Amortization	Operating Profit + Depreciation + Amortization
IT	Income Tax	
Derived Series		
Profitability Ratios		
ROA	Return on Asset	$\frac{Net\ Income}{Total\ Assets}$
ROE	Return on Equity	$\frac{Net\ Income}{Shareholder\ Equity}$
ROI	Return on Investment	$\frac{Operating\ Income}{Average\ Operating\ Assets}$
EBITDAMA	EBITDA Margin	$\frac{Operating\ Income(EBIT) + Depreciation + Amortization}{Net\ Sale}$
Liquidity Ratios		
CR	Current Ratio	$\frac{Current\ Assets}{Current\ Liabilities}$
NCATA	Net Current Assets % TA	$\frac{Net\ Current\ Assets}{Total\ Assets}$
Risk		
LTDE	LT Debt to Equity	$\frac{Total\ Long\ Term\ Debt}{Total\ Equity}$
TDE	Total Debt to Equity Ratio	$\frac{Total\ Debt}{Total\ Equity}$
Asset Management		
TAT	Total Asset Turnover	$\frac{Net\ Sales}{Average\ Total\ Net\ Assets}$
CET	Cash & Equivalents Turnover	$\frac{Net\ Sales}{Cash\ and\ Equivalents}$
Per Share		
CFPS	Cash Flow Per Share	$\frac{Net\ Sales}{Average\ Total\ Net\ Assets}$
BVPS	Book Value Per Share	$\frac{Dividends\ Paid\ Out}{Operating\ Income\ After\ Tax}$

Notes: The quarterly firm accounting variables are obtained from Mergent Online.

Chapter 4

Methodology

In the following, several hypotheses are proposed and evaluated. The prevailing practice of remote working and movement restrictions caused by COVID-19 further boosts the growth of e-commerce, and the demand for warehousing and logistics is strong, which drives the performance of industrial REITs. Therefore, the first hypothesis is that the net impact of COVID-19 on industrial REITs is positive ($H1$). The shift in positive attitudes of US executives and employees about remote work is evident based on PwC's US Remote Work Survey in 2021 January.[20] In addition, PwC indicated that hybrid workplaces where a large number of office employees rotate in and out of offices configured for shared spaces are likely to become the norm. Therefore, the second hypothesis is that the net impact of COVID-19 on office REITs is negative ($H2$). NAREIT reports that the apartment vacancy rates were flat in 2020 but the population spreads from urban cores to suburbs due to the safety concern and remote working. COVID-19 has aggravated the affordable housing crisis and millions of Americans face deep rental debt.[21] Emergency Rental Assistance Program was rolled out to help qualifying households ease the financial burden. Therefore, the third hypothesis is that the net impact of COVID-19 on residential REITs should be negative as well ($H3$). While we test all these hypotheses, we could also test the fourth hypothesis that the net impact of COVID-19 on retail REITs is negative ($H4$). Although considerable empirical research has documented that retail REITs have experienced the greatest price drawdown during the COVID-19 pandemic, here we use a different research methodology.

This paper estimates the impact of the recession with COVID 19 on REIT returns by incorporating two dummy variables $BEAR_t$ and $COVID_t$. To control for unobserved omitted variables $Z_{k,i}$ that vary across firms but do not change over time, a parameter (intercept) $\alpha_{k,i} = \beta_{k,0} + \beta_{k,5}Z_{k,i}$ associated with a specific firm i from one of the four property types k in the panel data is introduced:

$$R_{k,i,t} = \beta_{k,1}BEAR_t + \beta_{k,2}COVID_t \times BEAR_t + \beta_{k,3}Control_{k,i,t} + \beta_{k,4}BEAR_t \times Control_{k,i,t} + \alpha_{k,i} + u_{k,i,t} \tag{4.1}$$

[20] https://www.pwc.com/us/en/library/covid-19/us-remote-work-survey.html

[21] https://home.treasury.gov/policy-issues/coronavirus/assistance-for-state-local-and-tribal-governments/emergency-rental-assistance-program

where the first subscript, k, in $R_{k,i,t}$ and $u_{k,i,t}$ indicates the property type of REITs ($k = 1$ for industrial, $k = 2$ for office, $k = 3$ for residential, and $k = 4$ for retail); the second subscript, i, refers to the firm i, and the third subscript, t, refers to time. The slope coefficients in the population regression equations for each firm in the same REIT type are the same, hence the subscript i is dropped. Following Fama and French [1996], the dependent variable is $R_{k,i,t}$ — ith REIT excess return from the property type k at time t (REIT return minus three-month Treasury bill rate) for the property type k and time t. $Control_{k,i,t}$ is a vector of control variables for the ith firm from the property type k at time t, which include the macro/asset-pricing variables and firm accounting variables. $COVID_t$ is a dummy variable that is 1 if t is 2020 Q1 and 0 otherwise. $BEAR_t$ is another dummy variable that is 1 if t belongs to one of elements in the vector ("2007 Q4", "2008 Q1", "2008 Q2", "2008 Q3", "2008 Q4", "2009 Q1", "2009 Q2", "2020 Q1") and 0 otherwise. These two dummy variables are defined based on the chronology provided by the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER). A recession is defined as the period between a peak of economic activities and its subsequent trough according to the NBER. The recession caused by excessive leverage, overheated housing market, and financial crisis started from December 2007 (2007Q4) to June 2009 (2009Q2), and the recession caused by COVID-19 started from February 2020 to April 2020. The error term is assumed to have a population mean of zero and is uncorrelated with all the independent variables. The coefficient of interest is $\beta_{k,2}$. This coefficient measures the net impact of COVID-19 on kth REIT excess return.

For the sake of simplification, equation (4.1) can be re-defined using matrix notation and we focus on one specific REIT type at a time. First stack observations across time for each firm i in the same REIT type,

$$\underset{T\times 1}{\mathbf{y}_{\mathrm{i}}} = \underset{T\times K}{\mathbf{X}_{\mathrm{i}}}\boldsymbol{\beta} + \alpha_i \boldsymbol{\iota}_T + \underset{T\times 1}{\mathbf{u}_{\mathrm{i}}}, \tag{4.2}$$

where

$$\underset{T\times 1}{\mathbf{y}_{\mathrm{i}}} = \begin{bmatrix} R_{i1} \\ R_{i2} \\ \vdots \\ R_{iT} \end{bmatrix}, \quad \underset{T\times K}{\mathbf{X}_{\mathrm{i}}} = \begin{bmatrix} x_{i1}^1 & x_{i1}^2 & x_{i1}^3 & \dots & x_{i1}^K \\ x_{i2}^1 & x_{i2}^2 & x_{i2}^3 & \dots & x_{i2}^K \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{iT}^1 & x_{iT}^2 & x_{iT}^3 & \dots & x_{iT}^K \end{bmatrix}, \quad \underset{K\times 1}{\boldsymbol{\beta}} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_K \end{bmatrix}, \quad \underset{T\times 1}{\mathbf{u}_{\mathrm{i}}} = \begin{bmatrix} u_{i1} \\ u_{i2} \\ \vdots \\ u_{iT} \end{bmatrix},$$

for $i = 1, \ldots, N$, and $\boldsymbol{\iota}_T$ is a $T \times 1$ vector of unity.

Then, stacking the entire data set by individuals,

$$\underset{NT\times 1}{\mathbf{y}} = \underset{NT\times K}{\mathbf{X}}\boldsymbol{\beta} + \mathbf{D}\underset{N\times 1}{\boldsymbol{\alpha}} + \underset{NT\times 1}{\mathbf{u}}, \tag{4.3}$$

where

$$\underset{NT\times N}{\mathbf{D}} = \mathbf{I}_{\mathrm{N}} \otimes \boldsymbol{\iota}_T = \begin{bmatrix} 1 & 0 & 0 & \cdots & 0 \\ 0 & 1 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \cdots & 1 \end{bmatrix} \otimes \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix},$$

$$\underset{NT\times 1}{\mathbf{y}} = \begin{bmatrix} \mathbf{y}_1 \\ \mathbf{y}_2 \\ \vdots \\ \mathbf{y}_{\mathrm{N}} \end{bmatrix}, \quad \underset{NT\times K}{\mathbf{X}} = \begin{bmatrix} \mathbf{X}_1 \\ \mathbf{X}_2 \\ \vdots \\ \mathbf{X}_{\mathrm{N}} \end{bmatrix}, \quad \underset{K\times 1}{\boldsymbol{\beta}} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_K \end{bmatrix}, \quad \underset{N\times 1}{\boldsymbol{\alpha}} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_N \end{bmatrix}, \quad \underset{NT\times 1}{\mathbf{u}} = \begin{bmatrix} \mathbf{u_1} \\ \mathbf{u_2} \\ \vdots \\ \mathbf{u_N} \end{bmatrix},$$

In the context of the de-meaned approach, the fixed effect model transforms data to deviations from mean levels for each unit and variable to eliminate α_{ki}.
Define the projection matrices:

$$\underset{T\times T}{\mathbf{Q}_T} = \mathbf{I}_T - \boldsymbol{\iota}_T(\boldsymbol{\iota}_T{}'\boldsymbol{\iota}_T)^{-1}\boldsymbol{\iota}_T' = \mathbf{I} - \mathbf{P}_T, \tag{4.4}$$

$$\mathbf{P}_T = \boldsymbol{\iota}_T(\boldsymbol{\iota}_T'\boldsymbol{\iota}_T)^{-1}\boldsymbol{\iota}_T' = T^{-1}\boldsymbol{\iota}_T\boldsymbol{\iota}_T', \tag{4.5}$$

$$\mathbf{Q}_T\mathbf{y}_{\mathrm{i}} = \mathbf{Q}_T\mathbf{X}_{\mathrm{i}}\boldsymbol{\beta} + \alpha_i\mathbf{Q}_T\boldsymbol{\iota}_T + \mathbf{Q}_T\mathbf{u}_i \rightarrow \tilde{\mathbf{y}}_i = \tilde{\mathbf{X}}_i\boldsymbol{\beta} + \tilde{\mathbf{u}}_i. \tag{4.6}$$

We obtain the de-meaned model as

$$\begin{bmatrix} \tilde{\mathbf{y}}_1 \\ \tilde{\mathbf{y}}_2 \\ \vdots \\ \tilde{\mathbf{y}}_N \end{bmatrix} = \begin{bmatrix} \tilde{\mathbf{X}}_1 \\ \tilde{\mathbf{X}}_2 \\ \vdots \\ \tilde{\mathbf{X}}_N \end{bmatrix} \boldsymbol{\beta} + \begin{bmatrix} \tilde{\mathbf{u}}_1 \\ \tilde{\mathbf{u}}_2 \\ \vdots \\ \tilde{\mathbf{u}}_N \end{bmatrix}, \tag{4.7}$$

or

$$\tilde{\mathbf{y}} = \tilde{\mathbf{X}}\boldsymbol{\beta} + \tilde{\mathbf{u}}. \tag{4.8}$$

The vector of estimators is computed as OLS on transformed data:

$$\hat{\boldsymbol{\beta}}_{FE} = (\tilde{\mathbf{X}}^T\tilde{\mathbf{X}})^{-1}\tilde{\mathbf{X}}^T\tilde{\mathbf{y}}, \tag{4.9}$$

$$\hat{\tilde{\mathbf{u}}} = \tilde{\mathbf{y}} - \tilde{\mathbf{X}}\hat{\boldsymbol{\beta}}_{FE}. \tag{4.10}$$

Following the approach of [Newey and West, 1987] in computing the heteroskedasticity and serial correlation consistent standard errors for within groups estimators in a panel data setting, the covariance matrix of the OLS estimator β_{FE} can be computed as:

$$Var(\hat{\boldsymbol{\beta}}_{FE}) = Var(\boldsymbol{\beta} + (\tilde{\mathbf{X}}^T\tilde{\mathbf{X}})^{-1}\tilde{\mathbf{X}}^T\tilde{\mathbf{u}}) = (\tilde{\mathbf{X}}^T\tilde{\mathbf{X}})^{-1}\tilde{\mathbf{X}}^T E(\tilde{\mathbf{u}}\tilde{\mathbf{u}}^T)\tilde{\mathbf{X}}(\tilde{\mathbf{X}}^T\tilde{\mathbf{X}})^{-1}, \tag{4.11}$$

$$\widehat{Var}(\hat{\boldsymbol{\beta}}_{FE}) = (\tilde{\mathbf{X}}^T\tilde{\mathbf{X}})^{-1}(\frac{N}{N-K}\sum_{i=1}^{N}\hat{\tilde{\mathbf{u}}}_i^2\tilde{\mathbf{X}}_\mathbf{i}^T\tilde{\mathbf{X}}_\mathbf{i} + \frac{N}{N-K}\sum_{l=1}^{m}(1-\frac{l}{m+1})\sum_{t=l+1}^{N}\hat{\tilde{\mathbf{u}}}_t\hat{\tilde{\mathbf{u}}}_{t-l}(\tilde{\mathbf{X}}_\mathbf{t}^T\tilde{\mathbf{X}}_{t-l} + \tilde{\mathbf{X}}_{t-l}^T\tilde{\mathbf{X}}_t))(\tilde{\mathbf{X}}^T\tilde{\mathbf{X}})^{-1}. \tag{4.12}$$

Robust covariance estimators can be ontained using the vcovNW() function from an R package **plm** for panel data. Valid hypothesis testing can be performed in the presence of heteroskedasticity and serial correlation of unknown form after $\widehat{Var}(\hat{\boldsymbol{\beta}}_{FE})$ is obtained.

Since the goal is to determine the net impact of COVID-19 on REIT excess return, the inclusion of the interactions between accounting variables and $BEAR_t$ as explanatory variables may block the channel of the impact of COVID-19. To select the most reliable model, five different scenarios are examined. In scenario 1, REIT excess returns are regressed on all macro/asset-pricing variables and two dummy variables. In scenario 2, the interaction terms between macro/asset-pricing variables and $BEAR_t$ are added to the model in scenario 1. In scenario 3, the joint explanatory power of the macro/asset-pricing variables and firm accounting data are examined and no interaction terms are involved. In scenario 4, only the interactions between firm accounting variables and $BEAR_t$ enter into the model in scenario 3 in addition to the two dummy variables, macro/asset pricing variables, as well as firm accounting variables. In scenario 5, the interaction terms between macro/asset-pricing variables and $BEAR_t$ as well as the interaction between accounting data and $BEAR_t$ are incorporated into the combination of the model in scenario 2 & 4. Model selection can be

carried out by performing a Wald Test:

$$\mathbf{H}_0 : \mathbf{H}\boldsymbol{\beta} = \mathbf{r} \quad v.s. \quad \mathbf{H}_a : \mathbf{H}\boldsymbol{\beta} \neq \mathbf{r} \tag{4.13}$$

where the constraint $\mathbf{H}\boldsymbol{\beta} = \mathbf{r}$ implies a model that is nested in the larger model without the constraint.

$$W(\hat{\boldsymbol{\beta}}_{FE}) = (\mathbf{H}\hat{\boldsymbol{\beta}}_{FE} - \mathbf{r})^T(\mathbf{H}\widehat{Var}(\hat{\boldsymbol{\beta}}_{FE})\mathbf{H}^T)^{-1}(\mathbf{H}\hat{\boldsymbol{\beta}}_{FE} - \mathbf{r}) = \mathrm{q}F(\hat{\boldsymbol{\beta}}_{FE}) \overset{a}{\sim} \chi^2(q) \tag{4.14}$$

$$F(\hat{\boldsymbol{\beta}}_{FE}) \overset{a}{\sim} F(q, NT - N - K) \tag{4.15}$$

Chapter 5

Result

Table (5.1) compares the fit of the restricted and unrestricted regressions. The p-values of $F(\hat{\boldsymbol{\beta}}_{FE})$ and $W(\hat{\boldsymbol{\beta}}_{FE})$ for industrial REITs are smaller than 0.05. The constraints on parameters from the restricted models in scenarios 1, 2, 3, and 4 have significantly reduced the ability of the model to fit the data. Therefore, the model in scenario 5 is prevailing for industrial REITs. The same conclusion can be drawn for office REITs. In the case of residential REITs, the p-values for the restricted model in scenario 1 are 1, which indicates that the variations in residential REITs' excess returns can be well captured by macro/asset-pricing variables and two dummy variables $BEAR_t$ and $COVID_t$. For retail REITs, the p-values of $F(\hat{\boldsymbol{\beta}}_{FE})$ and $W(\hat{\boldsymbol{\beta}}_{FE})$ for the restricted model in scenario 2 are 0.918998 and 0.920817, respectively. Hence, the joint null hypothesis that the coefficients on the firm accounting variables are zero cannot be rejected at the significant level of 5%.

The greatest values in adjusted R^2 in Table (5.6) are observed in the model for scenario 5 for industrial and office REITs. For residential REITs, the model for scenario 5 have the highest value of adjusted R^2 (0.55) even though the Wald Test shows that the model in scenario 1 is preferable. In the case of retail REITs, 55% of the variation in excess returns can be predicted by the model in scenario 5. Hence, macro/asset-pricing variables and firm accounting variables jointly explain the variances in industrial and office REIT excess returns. However, none of the firm accounting variables consistently explain the excess returns of REITs across property types. On the contrary, macro/asset-pricing variables are statistically significant in capturing common (systematic) variation in the excess returns of REITs, which is in line with considerable empirical research. The fractions of return variance explained increase slightly when firm accounting data are included in Table (5.4). However, Table (5.3) indicates that the increases in the proportion of the total variation in REIT excess returns are relatively more prominent when the interactions between macro/asset-pricing variables and $BEAR_t$ are taken into account.

Table (5.6) reports regressions of quarterly returns for industrial, office, residential, and retail REITs, respectively, over the three-month Treasury bill rate on the dummy variables $COVID_t \times BEAR_t$ and $BEAR_t$ and a set of control variables including macro/asset-pricing variables, firm accounting variables, the interactions between macro/asset-pricing variables as well as firm accounting variables and $BEAR_t$ over the period from October 2007 to March 2020. The risk premiums (REIT return minus the risk-free rate) on industrial, office, residential, and retail REITs are significantly related to the value factor (HML). However, the sectoral variation seems wider, ranging from 6.36 to 11.32. The size effect (SMB) is pronounced in the excess returns of office REITs, but the magnitude of coefficients on SMB is relatively small. The market factor $(Rm - Rf)$ is a significant driver in excess returns of industrial, office, and retail REITs in the model for scenario 4 presented in Table (5.5). Once the interaction between the market factor and $BEAR_t$ is included, the effect on the excess returns of the market factor becomes statistically insignificant.

The net impact of COVID-19 is significant statistically for the excess returns of industrial REITs at the level of 0.1% and the coefficient is positive in the model for scenarios 2 and 5. This indicates strong evidence for the first hypothesis. The commonality shared by these models is the inclusion of the interaction terms between the macro/asset-pricing variables and $BEAR_t$. Similarly, the COVID-19 specific effect on the excess returns of office REITs is positive and statistically significant at the level of 1%. It provides strong evidence against the second hypothesis. The net impact of COVID-19 on residential REITs is not statistically significant in the model for scenario 1 advocated by the Wald Test. The model in scenario 4 indicates that the net impact of COVID-19 on residential REITs is negative and statistically significant at the level of 5%. On the contrary, the models in scenarios 2 and 5 show the evidence that the pure impact of COVID-19 on residential REITs is positive and statistically significant at the level of 0.1% and 1%, respectively. The result is mixed for the third hypothesis. The models for scenarios 2 and 5 shows that the net impact of COVID-19 on retail REITs is not statistically significant. However, the models for scenarios 1, 3, and 4 indicate that the net impact of COVID-19 on retail REITs is negative and statistically significant at the level of 0.1%. The result is also mixed for the fourth hypothesis.

The rate of inflation is negatively correlated to REIT excess returns across four property types in the model for scenario 5. In this case, these REITs are not a hedge against inflation over the sample period. The credit spread, which proxies the probability of default, consistently drives the equity REITs, and the coefficients differ substantially across four property types, ranging from 25.94 to 50.36. There is a positive link between the term spread and residential REIT excess returns.

Total Asset Turnover (TAT) is negatively related to residential REIT risk premium and the magnitude is extremely high (85.55). Earnings before Interest, Tax, Depreciation, and Amortization Margin (EBITDAMA) is positively related to the industrial REIT excess returns. Firm accounting variables seem to play an important role during the recession since the interactions between firm accounting variables and $BEAR_t$ become statistically significant for office REITs.

Table 5.1: Model Selection

Comparison	$F(\hat{\beta}_{FE})$	df_1	df_2	**P-value**	$W(\hat{\beta}_{FE})$	df	**P-value**
Scenario 4 v.s. Scenario 5							
Industrial REITs	36.566	6	354	2.00801e-034	219.39	6	1.40387e-044
Office REITs	26.455	6	689	2.06362e-028	158.73	6	1.09999e-031
Residential REITs	61.554	6	373	8.00936e-053	369.32	6	1.09547e-076
Retail REITs	73.918	6	832	6.81906e-074	443.51	6	1.22366e-092
Scenario 3 v.s. Scenario 5							
Industrial REITs	68.346	18	354	2.50063e-103	1230.2	18	3.77734e-250
Office REITs	13.96	18	689	4.5695e-036	251.28	18	4.47786e-043
Residential REITs	66.92	18	373	8.13453e-105	1204.6	18	1.15668e-244
Retail REITs	30.77	18	832	1.06341e-079	553.86	18	4.75282e-106
Scenario 2 v.s. Scenario 5							
Industrial REITs	5.5204	24	354	5.12459e-014	132.49	24	5.48342e-017
Office REITs	1.6335	24	689	0.0291212	39.203	24	0.0259989
Residential REITs	1.6176	24	373	0.0346223	38.822	24	0.0285068
Retail REITs	0.6249	24	832	0.918998	14.998	24	0.920817
Scenario 1 v.s. Scenario 5							
Industrial REITs	122	30	354	3.66808e-167	3660	30	$=\sim 0$
Office REITs	9.5052	30	689	2.94797e-035	285.16	30	2.34739e-043
Residential REITs	-23.259	30	373	1	-697.76	30	1
Retail REITs	20.11	30	832	1.17272e-078	603.31	30	6.11227e-108

Table 5.2: Model Result — Scenario 1

Variable	**Industrial**	**Office**	**Residential**	**Retail**
TSpread	0.18	1.91	3.36*	2.26
	(1.46)	(1.23)	(1.48)	(1.29)
CPI	1.93	0.53	1.92*	1.53
	(1.19)	(0.92)	(0.83)	(0.96)
CSpread	−0.98	0.68	1.03	2.80
	(6.99)	(5.09)	(4.91)	(5.14)
Rm-Rf	5.51**	5.47***	3.03*	6.34**
	(1.84)	(1.28)	(1.38)	(1.37)
SMB	4.33***	5.29***	5.90***	4.89***
	(1.12)	(0.91)	(1.27)	(1.07)
HML	9.57***	11.08***	7.31***	11.11***
	(1.71)	(1.25)	(1.06)	(1.53)
BEAR	−2.89	−1.58	−6.37**	−2.04
	(3.17)	(2.33)	(2.12)	(2.41)
COVID	8.54**	0.89	−2.87	−22.41***
	(3.27)	(4.06)	(3.24)	(4.28)
R^2	0.33	0.39	0.43	0.33
Adj. R^2	0.31	0.38	0.41	0.31
N	11	20	12	24
T	$40-50$	$38-50$	50	$38-50$
Num. obs.	540	960	600	1179
F-statistic	$F_{8,49}=23.9683$	$F_{8,49}=39.4466$	$F_{8,49}=41.0235$	$F_{8,49}=49.7224$
P-value	$1.8586e-14$	$9.05642e-019$	$3.99434e-019$	$6.73672e-021$

$^{***}p<0.001$; $^{**}p<0.01$; $^{*}p<0.05$

Table 5.3: Model Result — Scenario 2

Variable	**Industrial**	**Office**	**Residential**	**Retail**
TSpread	−0.36	1.45	3.25*	2.07
	(1.27)	(1.13)	(1.34)	(1.11)
CPI	−3.58*	−5.48***	−5.65***	−6.46***
	(1.41)	(0.94)	(0.99)	(1.05)
CSpread	39.28***	28.28***	27.69***	42.60***
	(5.39)	(5.11)	(6.00)	(5.32)
Rm-Rf	4.27*	3.51*	0.42	3.71
	(1.83)	(1.28)	(1.28)	(1.36)
SMB	0.15	2.45**	2.22*	0.04
	(0.72)	(0.86)	(1.21)	(0.83)
HML	7.06***	10.33***	7.29***	9.77***
	(1.00)	(0.74)	(0.84)	(1.21)
BEAR	−85.91**	−46.28*	−127.00***	−34.30
	(26.68)	(20.82)	(20.47)	(21.41)
COVID	42.98***	25.48***	38.07***	2.85
	(8.35)	(7.19)	(5.65)	(7.18)
TSpread:BEAR	165.53***	104.53**	179.95***	65.63
	(43.46)	(30.62)	(31.30)	(33.39)
CPI:BEAR	24.76***	16.35**	34.82***	17.23**
	(6.03)	(4.70)	(4.49)	(4.83)
CSpread:BEAR	−59.25***	−57.10***	−10.96	−38.25*
	(15.28)	(13.89)	(12.74)	(12.64)
Rm-Rf:BEAR	−191.87***	−91.02*	−223.73***	−81.62
	(49.41)	(38.90)	(38.13)	(38.86)
SMB:BEAR	44.63***	21.57**	51.72***	30.43***
	(8.67)	(7.69)	(6.96)	(6.64)
HML:BEAR	8.76**	3.16	−2.28	8.38**
	(5.23)	(4.22)	(2.55)	(4.21)
R^2	0.50	0.47	0.56	0.43
Adj. R^2	0.48	0.46	0.55	0.41
N	11	20	12	24
T(Unbalanced Panel)	$40-50$	$38-50$	50	$38-50$
Num. obs.	540	960	600	1179
F Statistics	$F_{14,49}=24.6103$	$F_{14,49}=33.9667$	$F_{14,49}=42.5513$	$F_{14,49}=48.5629$
P-value	$2.09606e-017$	$2.24471e-020$	$1.59762e-022$	$8.3471e-024$

$^{***}p<0.001$; $^{**}p<0.01$; $^{*}p<0.05$

Table 5.4: Model Result — Scenario 3

Variable	**Industrial**	**Office**	**Residential**	**Retail**
ROA	0.38	0.85	−0.30	0.22
	(0.80)	(0.36)	(0.30)	(0.43)
ROE	−0.30	−0.34*	0.14	−0.02
	(0.40)	(0.14)	(0.12)	(0.16)
ROI	0.04	−0.41	0.93	0.00
	(0.43)	(0.20)	(0.57)	(0.27)
EBITDAMA	0.08**	0.01	0.04	0.00
	(0.02)	(0.01)	(0.02)	(0.01)
CR	0.03	−0.37	0.13	0.07
	(0.68)	(0.15)	(0.27)	(0.07)
NCATA	0.08	0.20	0.15	−0.23
	(0.40)	(0.10)	(0.30)	(0.28)
LTDE	−10.53	−33.64	−124.49	3.36
	(21.33)	(11.76)	(49.81)	(35.99)
TDE	10.41	32.66	125.25	−3.56
	(21.32)	(11.60)	(49.72)	(35.46)
TAT	6.63	53.04	−71.81*	−73.33
	(52.39)	(34.10)	(33.06)	(46.82)
CET	0.00	0.01	−0.00	0.01
	(0.00)	(0.01)	(0.00)	(0.01)
CFPS	0.06	−0.99**	0.02	−0.31
	(0.67)	(0.44)	(0.40)	(0.72)
BVPS	−0.25	0.15	0.01	0.02
	(0.23)	(0.13)	(0.06)	(0.12)
TSpread	−0.32	1.83	4.13	3.15
	(2.38)	(1.51)	(2.01)	(2.01)
CPI	2.15	0.66	1.23	1.50
	(1.35)	(0.92)	(0.96)	(1.00)
CSpread	−4.10	−2.41	2.05	2.48
	(8.14)	(5.50)	(5.98)	(5.89)
Rm-Rf	6.42*	5.54**	3.60	5.53**
	(2.12)	(1.35)	(1.61)	(1.41)
SMB	5.00***	6.19***	4.84***	5.91***
	(1.29)	(1.00)	(1.30)	(1.19)
HML	11.15***	12.10***	6.47***	10.78***
	(2.19)	(1.46)	(1.08)	(1.67)
BEAR	−0.77	1.09	−5.32*	−0.27
	(3.76)	(2.58)	(2.52)	(2.56)
COVID	11.56	−3.65	−5.60	−22.43***
	(3.87)	(4.39)	(3.44)	(4.57)
R^2	0.42	0.47	0.42	0.41
Adj. R^2	0.38	0.44	0.38	0.38
N	8	15	9	19
T(Unbalanced Panel)	50	$47 - 50$	$36 - 50$	$1 - 50$
Num. obs.	400	742	420	889
F Statistics	$F_{20,49} = 28.5712$	$F_{20,49} = 16.5867$	$F_{20,49} = 15.7685$	$F_{20,49} = 23.8185$
P-value	$2.15879e-020$	$2.1024e-015$	$5.82583e-015$	$1.10981e-018$

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 5.5: Model Result — Scenario 4

Variable	Industrial	Office	Residential	Retail
ROA	0.86	0.65	0.20	0.18
	(0.51)	(0.26)	(0.32)	(0.34)
ROE	−0.52	−0.17	−0.11	0.06
	(0.26)	(0.10)	(0.13)	(0.12)
ROI	−0.31	−0.31	0.63	−0.00
	(0.45)	(0.21)	(0.58)	(0.27)
EBITDAMA	0.10**	−0.01	0.03	−0.00
	(0.02)	(0.01)	(0.02)	(0.01)
CR	−0.01	−0.20	0.13	0.07
	(0.71)	(0.13)	(0.27)	(0.07)
NCATA	0.08	0.17	0.01	−0.26
	(0.40)	(0.10)	(0.30)	(0.29)
LTDE	−17.33	−26.56	−93.57	2.16
	(22.18)	(15.26)	(54.28)	(39.52)
TDE	17.28	29.70	93.94	−1.60
	(22.17)	(15.39)	(54.27)	(39.46)
TAT	44.08	20.73	−94.65*	−83.47
	(45.61)	(36.46)	(45.93)	(47.26)
CET	0.00	0.00	0.00	0.01
	(0.00)	(0.01)	(0.00)	(0.01)
CFPS	0.12	−0.59	0.27	−0.80
	(0.63)	(0.35)	(0.42)	(0.60)
BVPS	−0.16	0.10	−0.06	−0.01
	(0.20)	(0.14)	(0.06)	(0.13)
TSpread	−0.05	1.83	4.13	2.96
	(2.34)	(1.48)	(2.08)	(1.95)
CPI	1.43	0.53	0.33	1.88*
	(1.33)	(0.90)	(1.12)	(1.15)
CSpread	−4.69	−0.64	1.40	2.01
	(8.87)	(5.37)	(6.27)	(6.19)
Rm-Rf	6.17*	5.27**	3.62	5.75**
	(2.10)	(1.42)	(1.65)	(1.39)
SMB	4.60**	5.71***	4.98***	5.97***
	(1.30)	(0.98)	(1.31)	(1.21)
HML	10.98***	11.95***	6.39***	10.38***
	(2.07)	(1.44)	(1.06)	(1.51)
BEAR	−25.28	0.67	−12.88	−0.00
	(26.46)	(11.25)	(16.29)	(17.47)
COVID	10.17	−4.07	−15.62*	−22.79***
	(5.80)	(5.54)	(7.41)	(5.97)
ROA:BEAR	−17.05***	−6.42**	−4.15*	−0.77
	(6.17)	(2.75)	(2.37)	(2.00)
ROE:BEAR	5.25***	1.74*	1.28**	−0.29
	(1.97)	(0.90)	(0.65)	(0.57)
ROI:BEAR	−1.22	0.34	0.23	0.75
	(1.69)	(0.76)	(1.52)	(1.27)
EBITDAMA:BEAR	0.53*	0.17*	0.33*	−0.06
	(0.27)	(0.08)	(0.14)	(0.22)
CR:BEAR	10.34	−2.19	5.29*	0.18
	(4.20)	(1.36)	(3.61)	(0.29)
NCATA:BEAR	−2.98	1.14	−1.09	0.05
	(1.82)	(0.75)	(1.55)	(0.70)
LTDE:BEAR	−0.02	−80.60**	−91.64	−15.10
	(58.34)	(35.67)	(146.69)	(88.12)
TDE:BEAR	−13.12	62.91*	80.36	13.47
	(55.90)	(31.44)	(148.36)	(86.10)
TAT:BEAR	149.37	111.04*	38.65	38.09
	(153.06)	(35.97)	(72.48)	(80.80)
CET:BEAR	0.00	0.13***	0.00	−0.02
	(0.01)	(0.11)	(0.01)	(0.05)
CFPS:BEAR	−0.60	−1.06	−0.68	0.63
	(1.60)	(1.47)	(1.31)	(1.39)
BVPS:BEAR	−0.12	0.19	0.01	−0.02
	(0.46)	(0.23)	(0.28)	(0.19)
R^2	0.45	0.50	0.45	0.42
Adj. R^2	0.39	0.47	0.40	0.39
N	8	15	9	19
T(Unbalanced Panel)	50	47 − 50	35 − 50	1 − 50
Num. obs.	400	742	420	889
F Statistics	$F_{32,49} = 31.5862$	$F_{32,49} = 14.1114$	$F_{32,49} = 26.3358$	$F_{32,49} = 14.9124$
P-value	$3.15954e-023$	$1.36026e-015$	$1.90128e-021$	$4.31564e-016$

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 5.6: Model Result — Scenario 5

Variable	Industrial	Office	Residential	Retail
ROA	0.79	0.56	0.01	0.11
	(0.46)	(0.25)	(0.26)	(0.33)
ROE	−0.46	−0.14	−0.03	0.04
	(0.24)	(0.09)	(0.11)	(0.12)
ROI	−0.47	−0.18	0.35	0.10
	(0.43)	(0.18)	(0.52)	(0.26)
EBITDAMA	0.11***	−0.02	0.03	−0.01
	(0.02)	(0.01)	(0.02)	(0.01)
CR	−0.14	−0.11	0.30	0.02
	(0.47)	(0.11)	(0.21)	(0.06)
NCATA	−0.05	0.12	−0.08	−0.16
	(0.30)	(0.09)	(0.27)	(0.25)
LTDE	−11.91	−21.76	−84.68	10.76
	(15.78)	(13.32)	(44.82)	(30.13)
TDE	12.02	23.87	85.21	−9.81
	(15.78)	(13.42)	(44.78)	(30.00)
TAT	38.78	9.42	−89.78*	−55.90
	(45.28)	(34.25)	(41.00)	(36.72)
CET	0.00	0.00	0.00	−0.00
	(0.00)	(0.01)	(0.00)	(0.01)
CFPS	0.04	−0.66	0.32	−0.68
	(0.52)	(0.30)	(0.39)	(0.53)
BVPS	−0.05	0.09	−0.03	0.09
	(0.18)	(0.13)	(0.05)	(0.11)
TSpread	0.30	1.30	4.65*	2.65
	(1.88)	(1.28)	(1.93)	(1.62)
CPI	−3.84*	−5.93***	−5.51***	−6.42***
	(1.46)	(1.01)	(1.06)	(0.98)
CSpread	41.32***	26.34***	32.91***	50.11***
	(6.30)	(5.81)	(6.80)	(5.54)
Rm-Rf	4.69	3.20	1.10	3.13
	(2.03)	(1.33)	(1.47)	(1.27)
SMB	0.07	3.04**	1.25	0.43
	(0.84)	(0.98)	(1.10)	(0.88)
HML	7.97***	11.32***	6.36***	8.96***
	(1.19)	(0.83)	(0.92)	(0.80)
BEAR	−75.68	−62.30*	−114.70***	−13.11
	(38.22)	(26.87)	(35.47)	(31.57)
COVID	46.83***	22.01**	34.46**	3.88
	(12.08)	(8.39)	(9.71)	(11.26)
ROA:BEAR	−8.30	−4.51*	−0.22	−0.46
	(4.33)	(2.33)	(1.07)	(1.92)
ROE:BEAR	2.63*	1.21	0.13	−0.17
	(1.40)	(0.77)	(0.31)	(0.49)
ROI:BEAR	0.39	−0.03	−1.08	0.85
	(1.39)	(0.74)	(1.14)	(1.09)
EBITDAMA:BEAR	0.13	0.14*	0.01	−0.08
	(0.19)	(0.07)	(0.08)	(0.18)
CR:BEAR	6.32	−2.04	1.17	0.28
	(3.46)	(2.06)	(3.20)	(0.38)
NCATA:BEAR	−3.15	0.91	0.49	−0.81
	(1.92)	(0.61)	(1.35)	(0.68)
LTDE:BEAR	48.67	−73.42**	−86.24	21.26
	(52.74)	(28.26)	(105.25)	(74.68)
TDE:BEAR	−56.90	60.38*	84.47	−22.49
	(52.80)	(24.95)	(107.14)	(72.91)
TAT:BEAR	−58.65	117.65*	31.55	25.42
	(150.24)	(56.04)	(58.63)	(74.05)
CET:BEAR	0.00	0.11**	−0.00	−0.05
	(0.01)	(0.10)	(0.01)	(0.05)
CFPS:BEAR	0.32	−0.95	0.30	0.19
	(1.76)	(1.37)	(1.00)	0.17
BVPS:BEAR	−0.45	0.17	−0.07	−0.03
	(0.40)	(0.22)	(0.21)	(0.16)
TSpread:BEAR	193.18***	118.59**	173.82***	44.67
	(58.03)	(35.67)	(52.07)	(42.35)
CPI:BEAR	26.06**	19.37***	32.47***	14.46**
	(8.15)	(5.20)	(7.60)	(5.90)
CSpread:BEAR	−81.95***	−51.37***	−24.18	−47.13**
	(16.71)	(13.75)	(12.68)	(14.39)
Rm-Rf:BEAR	−202.25**	−110.75*	−211.19***	−58.42
	(64.29)	(41.74)	(66.70)	(50.83)
SMB:BEAR	44.01***	24.09**	50.86***	28.40***
	(11.22)	(7.78)	(11.96)	(8.69)
HML:BEAR	8.75**	1.38	−1.57	10.24***
	(6.41)	(4.64)	(2.56)	(4.95)
R^2	0.61	0.57	0.60	0.55
Adj. R^2	0.56	0.54	0.55	0.52
N	8	15	9	19
T(Unbalanced Panel)	50	47 − 50	36 − 50	1 − 50
Num. obs.	400	742	420	889
F Statistics	$F_{38,49} = 49.3597$	$F_{38,49} = 19.7187$	$F_{38,49} = 54.4208$	$F_{38,49} = 24.431$
P-value	$2.61132e-028$	$3.15609e-019$	$2.63781e-029$	$2.72225e-021$

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Chapter 6

Conclusion

This paper examines the net impact of COVID-19 relative to the recession caused by the Global Financial Crisis. Three main hypotheses are formed as follows. Remote working and movement restrictions caused by COVID-19 further boost the growth of e-commerce, and the demand for warehousing and logistics is strong. Therefore, the first hypothesis is that the pure impact of COVID-19 on the excess returns of industrial REITs is positive. The shift in the positive attitude of US executives and employees about remote working is evident. Hybrid workplaces where a large number of office employees rotate in and out of offices configured for shared spaces are likely to become the norm. Therefore, the second hypothesis is that the pure impact of COVID-19 on office REITs is negative. COVID-19 has aggrevated the affordable housing crisis and millions of Americans face deep rental debt. The third hypothesis is that the pure impact of COVID-19 on residential REITs is negative. Two dummy variables $COVID_t$ and $BEAR_t$ are introduced. Three Fama-French factors– the excess return on the market (Rm-Rf), the size factor (SMB–returns on portfolios of small minus big stocks), and the value factor (HML–returns on portfolios of high minus low book-to-market stocks) serve as proxies for underlying state variables that affect the return generating process of equity REITs. The list of empirically determined variables: rate of inflation, the term spread, and the credit spread are also incorporated in the model. In addition, estimates of the discount variables and the stream of expected cash flows are two main ingredients in the valuation of an asset and firm accounting variables are important in deriving the estimates. Therefore, firm accounting variables are also included as control variables. The result indicates that the net impact of COVID-19 is statistically significant in explaining the excess returns for industrial and office REITs and the impact is positive.

Bibliography

Omokolade Akinsomi. How resilient are REITs to a pandemic? The COVID-19 effect. *Journal of Property Investment & Finance*, 39(1):19–24, January 2021. ISSN 1463-578X. doi: 10.1108/JPIF-06-2020-0065. URL https://www.emerald.com/insight/content/doi/10.1108/JPIF-06-2020-0065/full/html.

Yasser Alhenawi. The Determinants of Capital Structure in Real Estate Investment Trusts. SSRN Scholarly Paper ID 2532366, Social Science Research Network, Rochester, NY, December 2014. URL https://papers.ssrn.com/abstract=2532366.

Ralph L. Block. *Investing in REITs: Real Estate Investment Trusts*. John Wiley & Sons, September 2011. ISBN 978-1-118-11260-1. Google-Books-ID: DroPNYJwTGMC.

K. C. Chan, Patric H. Hendershott, and Anthony B. Sanders. Risk and Return on Real Estate: Evidence from Equity REITs. *Real Estate Economics*, 18(4):431–452, 1990. ISSN 1540-6229. doi: 10.1111/1540-6229.00531. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/1540-6229.00531. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1540-6229.00531.

Nai-Fu Chen, Richard Roll, and Stephen A. Ross. Economic Forces and the Stock Market. *The Journal of Business*, 59(3):383–403, 1986. ISSN 0021-9398. URL https://www.jstor.org/stable/2352710. Publisher: University of Chicago Press.

Kevin C.H. Chiang. What Drives REIT Prices? The Time-Varying Informational Content of Dividend Yields. *Journal of Real Estate Research*, 37(2):173–190, April 2015. ISSN 0896-5803. doi: 10.1080/10835547.2015.12091411. URL https://doi.org/10.1080/10835547.2015.12091411. Publisher: Routledge _eprint: https://doi.org/10.1080/10835547.2015.12091411.

Jim Clayton and Greg MacKinnon. The Relative Importance of Stock, Bond and Real Estate Factors in Explaining REIT Returns. *The Journal of Real Estate Finance and Economics*, 27(1):39–60, July 2003. ISSN 1573-045X. doi: 10.1023/A:1023607412927. URL https://doi.org/10.1023/A:1023607412927.

Eugene F. Fama and Kenneth R. French. The Cross-Section of Expected Stock Returns. *The Journal of Finance*, 47(2):427–465, 1992. ISSN 0022-1082. doi: 10.2307/2329112. URL https://www.jstor.org/stable/2329112. Publisher: [American Finance Association, Wiley].

Eugene F. Fama and Kenneth R. French. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1):3–56, February 1993. ISSN 0304-405X. doi: 10.1016/0304-405X(93)90023-5. URL https://www.sciencedirect.com/science/article/pii/0304405X93900235.

Eugene F. Fama and Kenneth R. French. Multifactor Explanations of Asset Pricing Anomalies. *The Journal of Finance*, 51(1):55–84, 1996. ISSN 0022-1082. doi: 10.2307/2329302. URL https://www.jstor.org/stable/2329302. Publisher: [American Finance Association, Wiley].

Zhilan Feng, Chinmoy Ghosh, and C. F. Sirmans. On the Capital Structure of Real Estate Investment Trusts (REITs). *The Journal of Real Estate Finance and Economics*, 34(1): 81–105, May 2007. ISSN 0895-5638, 1573-045X. doi: 10.1007/s11146-007-9005-2. URL http://link.springer.com/10.1007/s11146-007-9005-2.

Zhilan Feng, S. McKay Price, and C. Sirmans. AN OVERVIEW OF EQUITY REAL ESTATE INVESTMENT TRUSTS (REITS): 1993–2009. *Journal of Real Estate Literature*, 19(2):307–343, January 2011. ISSN 0927-7544, 1573-8809. doi: 10.1080/10835547.2011.12090304. URL https://www.tandfonline.com/doi/full/10.1080/10835547.2011.12090304.

Joseph Gyourko and Edward Nelling. Systematic Risk and Diversification in the Equity REIT Market. *Real Estate Economics*, 24(4):493–515, 1996. ISSN 1540-6229. doi: 10.1111/1540-6229.00701. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/1540-6229.00701. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1540-6229.00701.

Stephanie Krewson-Kelly and Glenn R. Mueller. *Educated REIT investing: the ultimate guide to understanding and investing in real estate investment trusts*. John Wiley & Sons, Inc, Hoboken, New Jersey, 2021. ISBN 978-1-119-70871-1 978-1-119-70904-6.

Yu-Cheng Lin, Chyi Lin Lee, and Graeme Newell. The added-value role of industrial and logistics REITs in the Pacific Rim region. *Journal of Property Investment & Finance*, 38(6):597–616, October 2020. ISSN 1463-578X. doi: 10.1108/JPIF-09-2019-0129. URL https://www.emerald.com/insight/content/doi/10.1108/JPIF-09-2019-0129/full/html.

David C Ling, Chongyu Wang, and Tingyu Zhou. A First Look at the Impact of COVID-19 on Commercial Real Estate Prices: Asset-Level Evidence. *The Review of Asset Pricing Studies*, 10(4):669–704, December 2020. ISSN 2045-9920, 2045-9939. doi: 10.1093/rapstu/raaa014. URL https://academic.oup.com/raps/article/10/4/669/5902841.

Stanimira Milcheva. Volatility and the Cross-Section of Real Estate Equity Returns during Covid-19. *The Journal of Real Estate Finance and Economics*, April 2021. ISSN 0895-5638, 1573-045X. doi: 10.1007/s11146-021-09840-6. URL https://link.springer.com/10.1007/s11146-021-09840-6.

Glenn R. Mueller. Understanding real estate's physical and financial market cycles. *Real Estate Finance*, 12(3):47, 1995. ISSN 0748318X. URL https://www.proquest.com/docview/223066482/abstract/423D5E39B2BE4F3CPQ/1. Num Pages: 6 Place: New York, United States Publisher: Aspen Publishers, Inc.

Whitney K. Newey and Kenneth D. West. A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. *Econometrica*, 55(3):703–708, 1987. ISSN 0012-9682. doi: 10.2307/1913610. URL https://www.jstor.org/stable/1913610. Publisher: [Wiley, Econometric Society].

James D. Peterson and Cheng-Ho Hsieh. Do Common Risk Factors in the Returns on Stocks and Bonds Explain Returns on REITs? *Real Estate Economics*, 25(2):321–345, 1997. ISSN 1540-6229. doi: 10.1111/1540-6229.00717. URL https://onlinelibrary.wiley.com/doi/abs/10.1111/1540-6229.00717. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1540-6229.00717.

Arnold L. Redman and Herman Manakyan. A multivariate analysis of REIT performance by financial and real asset portfolio characteristics. *The Journal of Real Estate Finance and Economics*, 10(2):169–175, March 1995. ISSN 0895-5638, 1573-045X. doi: 10.1007/BF01096988. URL http://link.springer.com/10.1007/BF01096988.

Frank Reilly and Keith Brown. *Investment Analysis and Portfolio Management*. South-Western College Pub, Mason, OH, 10th edition edition, December 2011. ISBN 978-0-538-48238-7.

Richard Roll and Stephen A. Ross. The Arbitrage Pricing Theory Approach to Strategic Portfolio Planning. *Financial Analysts Journal*, 40(3):14–26, May 1984. ISSN 0015-198X. doi: 10.2469/faj.v40.n3.14. URL https://doi.org/10.2469/faj.v40.n3.14. Publisher: Routledge _eprint: https://doi.org/10.2469/faj.v40.n3.14.

Stephen A Ross. The arbitrage theory of capital asset pricing. *Journal of Economic Theory*, 13(3):341–360, December 1976. ISSN 0022-0531. doi: 10.1016/0022-0531(76)90046-6. URL https://www.sciencedirect.com/science/article/pii/0022053176900466.

Linda Vincent. The information content of funds from operations (FFO) for real estate investment trusts (REITs). *Journal of Accounting and Economics*, 26(1):69–104, January 1999. ISSN 0165-4101. doi: 10.1016/S0165-4101(98)00039-1. URL https://www.sciencedirect.com/science/article/pii/S0165410198000391.

William C. Wheaton. The Cyclic Behavior Of The National Office Market. *AREUEA Journal*, 15(4):281, 1987. ISSN 02700484. URL https://www.proquest.com/docview/211104871/abstract/5417836B91004AF9PQ/1. Num Pages: 19 Place: Blooomington, United Kingdom Publisher: Blackwell Publishing Ltd.

Appendix A

Appendix: Descriptive Statistics for the GFC Period

Table A.1: Descriptive Statistics for Office and Residential REITs Quarterly Returns

	Ticker	**Mean**	**StDev**	**Max**	**Min**	**Skewness**	**Kurtosis**
Office REIITs							
	ARE	-12.1080	23.8650	14.8134	-45.5371	-0.3243	-1.8612
	BDN	-24.2486	26.1066	2.6906	-60.2511	-0.2649	-1.9593
	BXP	-14.2955	17.7885	3.4963	-37.6219	-0.3822	-1.9428
	CLI	-10.2607	12.0565	7.1086	-25.9595	0.1401	-1.6911
	CMCT	-9.3319	17.8808	14.1507	-34.9850	-0.1063	-1.6899
	CUZ	-17.0190	26.4821	12.6597	-49.3766	-0.0530	-1.9777
	DEI	-15.5815	20.0851	4.3568	-40.9819	-0.4018	-1.9597
	DLR	-1.6305	15.6116	13.9407	-27.7777	-0.5129	-1.4296
	EQC	-13.2783	19.3694	1.6468	-47.9605	-0.8018	-1.1474
	FSP	-3.8904	12.2030	15.5627	-17.6064	0.3760	-1.5863
	HIW	-5.9295	13.5408	13.8862	-18.4943	0.3513	-1.8896
	KRC	-16.6140	17.0939	2.3671	-45.3855	-0.5612	-1.3614
	OFC	-5.2421	16.1407	18.0014	-23.2311	0.2656	-1.8459
	SLG	-28.0343	23.0645	-3.5048	-58.0747	-0.3615	-1.9301
	VNO	-16.0524	18.7998	3.5462	-41.5100	-0.1805	-2.0292
	WRE	-7.5266	20.5645	22.0146	-35.4600	0.1130	-1.6262
Residential REIITs							
	ACC	-4.7138	19.4518	20.8862	-37.5702	-0.4018	-1.1301
	AIV	-20.6544	28.3528	10.3532	-55.6760	-0.2042	-1.9727
	AVB	-11.7278	17.2916	10.4230	-34.2578	0.1342	-1.8342
	BRT	-21.8410	20.3626	-4.6439	-57.9067	-0.7376	-1.1877
	CPT	-13.3783	16.7510	9.5205	-28.0321	0.3847	-1.9667
	ELS	-3.4423	17.3655	20.6353	-25.6081	0.0890	-1.8393
	EQR	-9.6003	21.7813	17.6250	-33.3628	0.2242	-1.9469
	ESS	-9.0813	20.1735	20.0573	-33.0791	0.3009	-1.7759
	MAA	-6.1843	13.3413	17.5702	-21.8510	0.6364	-0.9878
	SUI	-10.4351	15.7439	10.9078	-27.9983	0.1238	-1.8706
	UDR	-9.8020	26.3602	24.8475	-37.5984	0.2254	-1.9367
	UMH	-13.4541	3.3236	-9.2985	-17.4119	0.0945	-1.9190

Notes: The price information of 67 listed equity REITs **from October 2007 to June 2009** are obtained from Yahoo Finance using the R package "BatchGetSymbols". Then the quarterly return is calculated by dividing the daily adjusted prices (for dividends and stock spilt) at the end of each quarter by the daily adjusted price at the start of each quarter minus 1 (quarterly return $= \frac{P_t}{P_{t-90}} - 1$). The purpose is to match the time frequency of firm-specific accounting data (on a quarterly basis). The returns are expressed in percentage terms. No sufficient accounting data are available from Mergent Online regarding CMCT, COR, HPP, OPI, and PDM (Office REITs) and for BRT, ELS, and SUI (Residential REITs).

Table A.2: Descriptive Statistics for Industrial and Retail REITs Quarterly Returns

	Ticker	**Mean**	**StDev**	**Max**	**Min**	**Skewness**	**Kurtosis**
Industrial REITs							
	CUBE	-17.7816	35.6673	26.7337	-62.2723	-0.0858	-1.9666
	DRE	-21.2786	23.9878	7.2249	-52.1461	-0.2150	-1.9240
	EGP	-5.5953	16.0488	14.0243	-24.5426	0.2581	-1.9060
	EXR	-11.9119	21.7652	17.8891	-43.2288	-0.1152	-1.6088
	FR	-26.7531	33.2755	6.6800	-72.5040	-0.4414	-1.9093
	LSI	-9.6275	18.3405	9.3819	-40.4684	-0.4770	-1.3397
	MNR	-1.6514	12.9107	21.2035	-18.3893	0.5539	-0.8898
	PLD	-19.5168	17.4147	-3.5620	-45.4079	-0.5252	-1.8303
	PSA	-3.5900	20.4966	22.5199	-26.1591	0.3081	-1.9443
	SELF	-6.9138	8.6385	1.2382	-20.7264	-0.4209	-1.6493
Retail REITs							
	ADC	-7.8000	18.9355	23.9916	-31.9524	0.3829	-1.1906
	AKR	-11.8736	17.1373	8.6325	-39.7331	-0.4529	-1.4425
	ALX	-10.0678	23.1941	30.0136	-32.3965	0.5765	-1.2379
	BFS	-10.5942	17.0689	5.7341	-39.6840	-0.5479	-1.3122
	CDR	-18.0185	36.6466	18.3193	-74.7942	-0.3856	-1.7038
	EPR	-13.6500	24.7016	10.9202	-43.8499	-0.3107	-1.9816
	FRT	-8.7707	17.7520	23.8857	-25.7457	0.8285	-0.9063
	GTY	-0.7304	31.1557	56.7043	-38.1245	0.7482	-0.7269
	HMG	-20.8979	9.9473	-11.7647	-36.6667	-0.4981	-1.6452
	KIM	-20.8181	27.7749	8.9675	-58.1319	-0.1790	-1.8999
	KRG	-26.3465	20.0154	-9.0023	-54.5033	-0.4651	-1.9203
	MAC	-26.8989	31.8427	3.7898	-69.2977	-0.3770	-1.9386
	NNN	-4.8112	13.3081	15.9095	-25.6970	-0.0148	-1.0084
	O	-3.4659	10.2113	13.1100	-13.3510	0.4929	-1.5825
	PEI	-27.2595	19.3297	-8.8207	-55.9151	-0.4690	-1.8310
	REG	-12.9714	18.6849	13.2789	-38.2903	0.0672	-1.6737
	RPT	-14.9210	30.7502	8.6207	-70.2108	-0.8405	-1.1373
	SITC	-29.9659	34.1199	11.8780	-84.1558	-0.3351	-1.4920
	SKT	-2.5249	13.9360	22.9725	-14.8276	0.8615	-0.9940
	SPG	-12.7024	21.1286	9.6799	-42.4063	-0.1908	-1.8395
	UBA	-1.1097	16.6176	28.6008	-14.9493	0.7424	-1.1314
	UBP	-1.8467	11.3101	13.8327	-15.5306	0.2917	-1.8121

Notes: The price information of 67 listed equity REITs **from October 2007 to June 2009** are obtained from Yahoo Finance using the R package "BatchGetSymbols". Then the quarterly return is calculated by dividing the daily adjusted prices (for dividends and stock spilt) at the end of each quarter by the daily adjusted price at the start of each quarter minus 1 (quarterly return $= \frac{P_t}{P_{t-90}} - 1$). The purpose is to match the time frequency of firm-specific accounting data (on a quarterly basis). The returns are expressed in percentage terms. No sufficient accounting data are available from Mergent Online regarding PSA, SELF, STAG, and TRNO Industrial REITs) and for ALX, HMG, ROIC, RPT, and UBP (Retail REITs).

Appendix B

Appendix: Descriptive Statistics for the Macro/Asset Pricing Variables

Table B.1: Descriptive Statistics for Macro/Asset-Pricing Control Variables

	TSpread	TB3	CPI	CSpread	MktRf	SMB	HML
Observations	54.0000	54.0000	54.0000	54.0000	54.0000	54.0000	54.0000
Min	-0.0549	0.0033	-3.4395	0.1585	-0.5494	-1.0553	-1.1722
Max	1.2012	1.1076	1.8735	0.9609	1.8193	2.2295	2.7734
Mean	0.5529	0.1796	0.4439	0.3097	0.0463	-0.0063	0.2967
Median	0.5547	0.0367	0.5018	0.2699	0.0122	-0.0754	0.3748
Stdev	0.3214	0.2578	0.7015	0.1578	0.3972	0.6073	0.7920
Skewness	0.0898	1.5544	-2.9395	2.7314	1.6465	1.8078	0.4496
Kurtosis	-0.8630	1.6848	15.0204	8.0085	5.3716	4.0020	0.4249

Notes: The data **from October 2007 to March 2020** on the three-month U.S. Treasury bills (TB3), the spread between 10-Year Treasury constant maturity and 3-month Treasury constant maturity (TSpread), the spread between Moody's Seasoned Baa Corporate Bond Yield and Moody's Seasoned Aaa Corporate Bond Yield (CSpread), the rate of inflation (CPI) are obtained from the Federal Reserve Economic Data (FRED).[22] The Fama-French three factors which are the excess return on the market (Rm-Rf), the size factor (SMB — returns on portfolios of small minus big stocks), and the value factor (HML — returns on portfolios of high book-to-market minus low book-to-market stocks ratio) are obtained from the Kenneth French's database.[23] CPI is obtained by dividing the Consumer Price Index for All Urban Consumers: All Items in the U.S. City Average (CPIAUCSL) by its lagged value and then take the log $[log(\frac{CPIAUCSL_t}{CPIAUCSL_{t-1}}) = CPI]$. The frequency of the data is monthly and is annualized. Hence, the monthly data needs to be divided by 12 and then are converted into the quarterly values $\prod_{t=1}^{T}(1+r_t)-1$ to match the time frequency of firm accounting data (on a quarterly basis). The data is expressed in percentage terms.