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Impact of economic forces and fundamental variables on REIT returns

Mukesh K. Chaudhry[a], Vivek Bhargava[b] and Henry Shelton Weeks[b]

[a]Indiana University of Pennsylvania, Indiana, PA, USA; [b]Florida Gulf Coast University, Fort Myers, FL, USA

ABSTRACT

We examine the impacts of economic forces and fundamental variables on REIT returns. Our models endogenously select breakpoints to distinguish the heterogenous nature of the underlying properties with varying risk-return characteristics. Default risk premium and unanticipated inflation had an adverse effect, while GDP and federal funds rate had a positive effect on REITs. Market, size and value risk-premiums are significant for time periods that include the GFC but not for subsequent periods. Momentum is negative and significant for extreme events, and insignificant during calm periods. Higher beta values during the GFC followed by lower beta values confirm 'leveraging' and 'deleveraging' effects.

KEYWORDS

Economic and fundamental variables; breakpoints; sensitivity of returns; leveraging effects

JEL CLASSIFICATION

R3; R330; G10; G11; G12; G14

I. Introduction

Real estate prices provide important indications about future economic conditions. Miller, Peng, and Sklarz (2011) relate trends in house prices with the changes in gross metropolitan product (GMP) to reflect the role of real estate in the determination of economic growth. Similarly, Benjamin, Chinloy, and Jud (2004) describe a direct relationship between the consumption function of the US economy and the wealth effect arising from increases in the value of real estate.[1] Hence, unanticipated shocks to economic variables can adversely impact the economy, lowering both rental income and the value of real estate assets, leading to diminished returns for REITs.[2] Complexities and heterogeneity inherent in the real estate market generate linkages with a plethora of business activities through fundamental variables. This creates largely unforeseeable risks and contributes to market booms and busts inducing ripple effects in the macroeconomy. For example, Chan, Hendershott, and Sanders (1990) use REITs as a proxy for real estate returns and show that the changes in default and term risk premiums help to explain the co-movements of REITs with these variables.

Equity REITs (EREITs) have a strong correlation with small stocks, but a low correlation with bonds suggesting that their risk-return profile may resemble that of common stock. Quan and Titman (1999) find a significant long-term relationship between stock returns and the change in value of real assets and rental income. Likewise, Johnson (2002) suggests that momentum in real estate returns is caused by persistent shocks to dividend growth rates arising from infrequent structural shocks to the economy. Furthermore, long-term leases and spatial attributes of real estate allow REITs to provide investors with defensive performance during extreme market events. Consequently, Hung and Glascock (2008) indicate that high dividend payments by REITs can serve as a hedge against market downturns.

Uncertainty remains with respect to the risk-return constituents for real property as performance predictors vary over time and forecast domain. Omokolade et al. (2016) emphasize that there is interest in real estate return predictability and persistence as REITs are an alternative investment class with a high frequency of observable data. Knowledge of variability in economic and financial variables has important implications for

CONTACT Henry Shelton Weeks sweeks@fgcu.edu Florida Gulf Coast University, 10501 FGCU Blvd. South, Fort Myers, Florida 33965

[1]Another approach is suggested by Franses and Groot (2013) who associated GDP growth with the real estate rental prices.

[2]Real Estate Investment Trusts (REITs) are companies that own and operate income generating real estate properties in different real estate sectors and similar to mutual funds, REITs pool the capital of many investors who are able to participate in real estate investment without having to buy, own, and manage these properties. Many REITs are publicly owned and thus trade like stocks.

portfolio managers interested in exploiting investment opportunities and regulators seeking market stability (Schindler 2013; Adams, Fuss, and Schindler 2015). Given the dynamic nature of the factors that affecting REIT returns, the changing traits of real estate investment over time and forecast horizon merit investigation.

We employ a multiple structural break methodology for both economic and financial time-series variables to gain insight into the changing risk-return attributes of REITs. The REITs examined are characterized by underlying similarities as well as subtle differences that vary over time due to infrequent but detectable structural shifts.

The remainder of the paper is organized as follows. A review of the relevant literature is followed by sections presenting the methodology, empirical results, and conclusions.

II. Literature review

There is a close linkage between changes in economic growth and the long-run performance of equity returns. As noted by Cornell (2010), changes in GDP may be related to changes in earnings, which can prompt changes in equity prices. Flannery and Protopapadakis (2002) find an inverse relationship between equity returns and inflation. In addition, Chang, Chen, and Leung (2011) connect monetary policy changes with the federal funds rate, prompting adjustments in asset prices. Glascock, Lu, and So (2000) find that REITs behave more like stocks than bonds after the early 1990s implying that monetary policy modifications, GDP growth rate and inflation may impact REIT returns. Indeed, Chan, Erickson, and Wang (2003) disentangle total REIT returns suggesting that 'dividend yields' are generally stable and most of the changes occur in 'capital gains return'.

Financial theory is replete with papers linking economic conditions with excess equity returns. Chen, Roll, and Ross (1986), Fama and French (1989), and Campbell and Diebold (2009) find that factors such as market, size and value premia are closely linked to the forecast distribution of equity returns. Furthermore, these factors can also be related to short-term rates, default spreads, term spreads and dividend yields. Chen, Petkova, and Zhang (2008) find that the relationship between economic and fundamental factors can provide a deeper understanding of their association with a cross-section of stock returns. Similarly, economic factors such as real GDP growth and inflation can also explain asset returns. Fama and French (1992) and Liew and Vassalou (2000) associate size and value premium with GDP growth, while Liu and Zhang (2008) relate momentum to industrial production. Thus, non-diversifiable risk can be proxied by the inclusion of market, size, value and momentum factors.

Hoskins, Higgins, and Cardew (2004) posit that the relationship between real estate and economic variables is constantly changing. Hence, understanding the time variability of real estate returns can be useful in portfolio management. The intrinsic value of REITs is closely interwoven with the underlying asset base, which is quite different from other industries where this relationship is less clear cut (e.g. Ling, Ooi, and Xu 2019). Thus, REITs have a relatively less complicated capital structure enabling identification of a purer association between returns and economic and fundamental factors.

Capital structure plays a role in REIT performance with increases in leverage negatively impacting returns. The effect is stronger if debt is unsecured versus secured which restricts management's propensity to invest in suboptimal projects. Glascock and Ran (2018) find that REITs, depending on the underlying real property, are defensive assets with a lower asymmetric correlation structure with market returns. However, Lee (2010) finds that REITs provide diversification benefits until 1999 but become return enhancers afterwards. Thus, any study of the long-term performance of REITs must incorporate structural changes in the industry in relation to underlying assets.

III. Data and methodology

Monthly data for REITs spanning from January 1995 to April 2020 aggregating 304 months are downloaded from the National Association of Real Estate Investment Trusts (NAREIT) website and represent the FTSE, NAREIT real-estate index series. The diverse set of REITs employed includes equity, mortgage, office, industrials, retail, residential, health-care centres, hotels and self-storage. The retail REIT sector is subdivided into shopping-centres, enclosed malls and free-standing stores and the residential REIT sector into apartments and manufactured homes. Economic data for term premium (ten-year Treasury Bonds minus three months Treasury Bills), default premium (Moody's Baa Bonds minus Treasury Bonds), monetary policy variable (change in Federal Funds rate), unexpected inflation (percentage inflation minus lagged three-month treasury bill)[3] is downloaded from Federal Reserve Bank, St. Louis website. The data for Fama-French (FF) and Carhart four-factor model that includes momentum are downloaded from Ken French's website. All data are monthly and cover the identical timespan.

As stated above, the REIT data examined in this study are monthly. However, GDP data are available on a quarterly basis. This issue is addressed using the Chow-Lin method (Chow and Lin 1971), a regression-based interpolation technique that finds values of a series by relating one or more higher-frequency indicator series to a lower-frequency benchmark series.

In time-series analysis and forecasting, data may be non-stationary implying non-constancy of parameters. Consequently, the application of linear models such as regression analysis may produce spurious results. Furthermore, as pointed out by Nelsen and Plosser (1982), random walk behaviour could be caused by changes in the trend arising from a random shock to the time series followed by another disturbance. Initially, it was assumed that the time series would revert over a business cycle and become stationary. However, in several instances, this mean-reversion need not occur. Perron (1989, 1997) distinguishes between the frequency of shocks and the relationship to random walk behaviour versus trend break process. For instance, if shocks are frequent, it may give rise to a random walk process, but if the shocks are infrequent, then it could be characterized as a trend break process. Since, in our analysis, the infrequent structural breaks to the intercept, slope or both could be identified, a multiple structural breakpoint analysis for REITs enables us to derive appropriate inferences about short-term and long-term relationships accounting for all disturbances or shocks over time between REITs versus economic and financial variables. Consider the following equation:

$$x_t = a + \xi x_{t-1} + e_t \text{and} E(e_t)^2 = \sigma^2 \quad (1)$$

where, $e_t{}^2$ is a time series of serially uncorrelated error terms with parameters that are a, ξ and σ^2. For stationarity to hold, these parameters should not vary with time. If a structural break occurs due to an external disturbance, one or more of these parameters may undergo changes. If the autoregressive parameter ξ changes, then the serial correlation of x_t also changes. The intercept term 'a' impacts mean values of x_t such that $E(x_t) = \mu = a/(1- \ \xi)$. Generally, when the intercept changes, there will be a change in μ or trend process of the time series, whereas the change in volatility would vary σ^2.[4]

The initial work on structural breaks follows Chow (1960) wherein the testing technique involves dividing a sample into two parts and checking for equality of parameters using ordinary least squares for each sub-period. An important drawback of this technique relates to, a priori, the selection of a break-date. The resulting problem with this technique is the exogenous selection of a break-date instead of an endogenous identification of the break specification. Furthermore, for detection of multiple structural breaks when the break-date is unknown (or it is endogenous), Bai and Perron (1998, 2003) develop a sequential structural break method where the sample is divided around each break-date and parameters are estimated using ordinary least squares, and the sum of squared errors is calculated and stored. The correct break-date is identified as the date when the residual variances

[3]This measure of unanticipated inflation has been extensively analysed by various researchers that includes a study by Titman and Warga (1989) who used this measure to investigate the relationship between stock returns as predictors of interest rates and inflation.

[4]Hansen (2001) suggests calculating structural break(s) with an unknown timing followed by estimating timing of structural break(s). Additionally, tests to distinguish between random walk process and broken trend function should be performed on a time series.

are minimized. The multiple linear regression model using structural break analysis for 'm' breaks is given by:

$$y_t = x_t\beta + z_t\lambda_j + \varepsilon_t \text{where} t = T_{j-1}+1, \ldots\ldots, T_j \quad (2)$$

and j = 1, ...,m + 1. y_t or REIT return (excess return) is the dependent variable at time t, x_t and z_t are vectors of covariates and β and λ_j (j = 1, ...,m + 1) are vectors of coefficients, ε_t is the error term at time t. Furthermore, the indices ($T_1, \ldots\ldots, T_m$) are unknown breakpoints. The method of estimation is based on the least square principle and for each *m*-divisions with break-dates ($T_1, \ldots, T_m$), the corresponding least square estimates of β and λ_j are computed by minimizing the sum of squared residuals. One of the critical parameters that plays a major role in the identification of appropriate breaks for the asymptotic distribution is the trimming value, the shortest time a break needs to be eligible to be included as structural. To test for the number of breaks, a recursive approach is employed by estimating linear intercepts and trends corresponding to the breakpoints. At each breakpoint, an F-Test is computed to determine if a statistically significant break occurred. After identifying the number and location of breaks using this recursive procedure, a least square model is fitted to estimate the intercept and trend coefficients. Additional details about this test are provided in the Appendix.

IV. Empirical results

Table 1 presents descriptive statistics for REIT returns, as well as financial and economic variables. The observed negatively skewed distributions reflect frequent small gains followed by infrequent large losses. This implies that the distributions have smaller maximum and larger minimum values. For example, mortgage REITs have a maximum monthly return of 19.4% and a minimum excess return of −53.7%. The sizable skewness in conjunction with high excess kurtosis reflects nonlinearities in REIT returns, which can result in catastrophic gains and losses.[5]

Storage REITs produced the highest mean returns, 1.298% per month, clearly exceeding the small-cap, mid-cap, and S&P500 returns of 0.751%, 0.704% and 0.608%, respectively. Only hotels and mortgage REITs generated average returns below

Table 1. Descriptive statistics for REITs, economic and financial variables.

	Mean	Median	Max.	Min.	St.Dev.	Skew	Kurt	Jarque-Bera	Sharpe Ratio
REITs									
All	0.913	1.244	27.975	−30.225	5.397	−0.96	10.18	700.4***	0.134
Equity	0.954	1.249	31.020	−31.668	5.574	−0.82	10.93	829.6***	0.137
Mortgage	0.695	1.601	19.411	−53.743	6.626	−2.52	18.78	3478.0***	0.076
Office	0.965	1.572	32.458	−31.796	6.167	−0.51	8.76	434.10***	0.126
Industrial	1.197	1.666	70.483	−56.188	8.388	0.264	27.69	7729.5***	0.120
Retail	0.868	0.125	43.516	−42.678	6.798	−1.02	16.74	2442.3***	0.100
Shopping Centers	0.768	1.304	39.573	−41.617	6.766	−1.113	14.82	1832.3***	0.085
Mall	0.900	1.319	59.091	−53.979	7.997	−0.61	21.62	4411.2***	0.089
Free Standing	1.128	1.609	20.559	−33.706	5.539	−0.95	8.40	415.63***	0.169
Residential	1.067	1.436	22.242	−26.656	5.563	−0.88	7.28	271.1***	0.158
Apartments	1.047	1.447	23.141	−26.832	5.689	−0.83	7.29	267.0***	0.151
Man. Homes	1.152	1.540	18.169	−22.730	5.197	−0.55	5.69	107.1***	0.185
Health	1.026	1.100	27.730	−33.449	6.263	−0.73	7.93	334.4***	0.133
Hotels	0.648	0.948	67.525	−36.555	8.866	0.61	15.29	1933.2***	0.052
Storage	1.298	1.597	21.928	−22.244	5.656	−0.36	4.70	43.37***	0.196
Economic and Financial									
Default	2.459	2.370	6.01	1.30	0.76	1.51	7.24	345.1***	
Term	1.571	1.545	3.69	−0.70	1.12	0.05	2.02	12.4***	
IP	0.091	0.153	5.51	−13.70	1.10	−6.66	86.41	90,964.1***	
GDP	0.161	0.209	0.609	−3.44	0.40	−6.55	56.51	38,453.2***	
Mid	0.751	1.176	16.03	−28.72	5.44	−1.19	7.51	331.7***	0.109
Small	0.704	1.282	17.36	−33.07	5.88	−1.25	7.73	364.7***	0.092
SPY	0.608	1.037	13.60	−18.14	4.54	−0.92	5.07	98.20***	0.096

*, **, *** represent significance at 10%, 5%, and 1% levels. All REITs and financial returns are calculated by $\ln(p_t/p_{t-1})$ where p is the stock index.

[5]As pointed out by Zhou (2013), for REITs, downside risks have generally become more common place than the upside gains. Since REITs are highly leveraged and there is a distinct problem of illiquidity in this market, during extreme and volatile periods there is a higher probability of large declines.

mid-cap and small-cap stocks (hotels = 0.648% and mortgage = 0.695%). Comparing Sharpe Ratios (SR) of REITs to the small-cap, mid-cap and S&P500 indices: equity, mortgage, shopping-centres, enclosed malls, and hotels underperformed, while office, industrials, free standing stores, residential, apartments, manufactured homes, healthcare and self-storage REITs outperformed the indices.

As Figure 1(a) reflects, most REITs outperformed the S&P 500 and small stocks but with higher volatility. There are several periods when REITs generate outsized returns followed by large losses signifying potential profit opportunities contingent upon the correct identification of sensitivities to changing market conditions. Data from the most recent 4 years indicate underperforming REITs included retail, shopping centres and malls

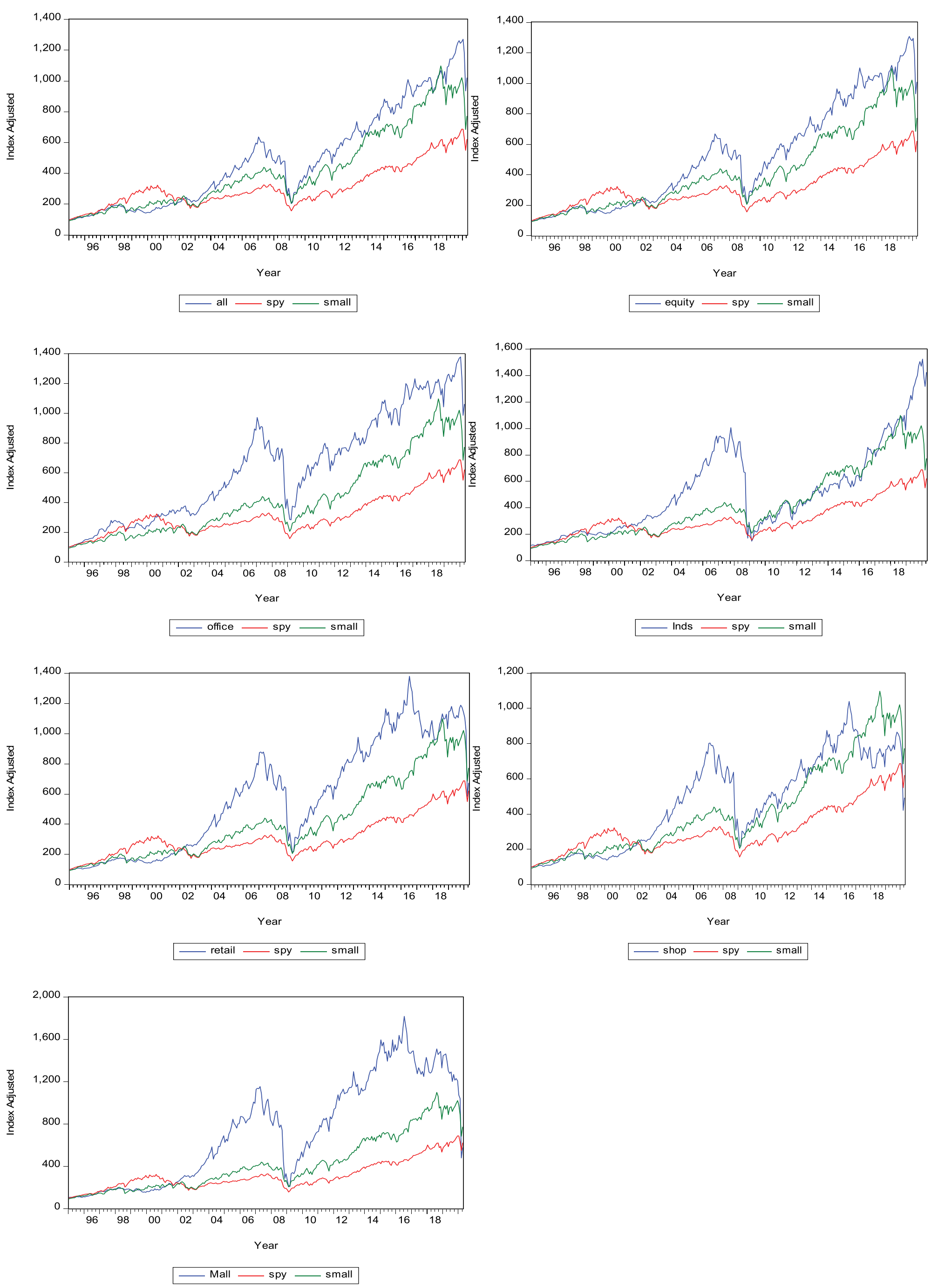

Figure 1. Index for REITs, S&P 500 and small-cap stocks: January 1995 to April 2020.

with returns of 1.46%, 1.14%, and −4.84%, respectively. In contrast, the highest average annual returns during the same period are from industrials and manufactured homes, 22.12% and 22.7%. Return determinant identification is critical to understanding this variability in performance. For example, Vogel (1997) considers office REITs, noting that higher returns are related to occupancy rate, rent, tenant improvements and operating costs.

The outlook for shopping malls has declined due to the threat posed by online retailers. Benjamin, Boyle, and Sirmans (1990) and Hendershott, Hendershott, and Hendershott (2000) point out that unless shopping mall operators adopt innovative strategies to combat online competition, their operating and financial performance will continue to falter. The underperformance of shopping centres and retailers reported in Figure 1(a) reflects the negative impact of online competition.

In contrast to other REITs, Figure 1(b) shows that free standing stores outperformed the S&P500 and small-cap indices since the beginning of the GFC. Similarly, residential units, apartments and health-care REITs outperformed the indices after the GFC but with higher

Figure 1. Continued.

volatility. Manufactured homes represent 15% of all housing units and 30% of new additions to single-family housing suggesting greater price inelasticity of demand during the recent period as advocated by Marshall and Marsh (2007). The graph of the manufactured home REIT index displays a structural shift following the GFC, when returns significantly outpace the small-cap and S&P500 indices. In contrast, hotel REITs underperform due to their aggressive growth strategy, high vacancy rates, and depressed prices (Kim, Mattila, and Gu 2002). Finally, as Figure 1(b) displays, the self-storage REITs exhibit the strongest performance, significantly outperforming the small-cap and S&P500 indices.

REITs provide significant diversification benefits for investors as evidenced by the correlation coefficients with the market indices. For instance, during the 1995–2004 sub-period the correlation coefficients for REITS and the S&P 500, mid-cap, and small-cap indices were 0.294, 0.426, and 0.460, respectively. While the correlations increased appreciably during the financial crisis reaching 0.811, 0.829 and 0.853, they declined somewhat in the post-financial crisis period. In the 2010–2020 sub-period, these correlations were 0.708, 0.739 and 0.685. The correlations in this later period reflect a reduction in the diversification benefit available in the more mature REIT market.

Figure 2 displays a plot of term spread, default or credit spread and change in the federal funds rate, used here to emulate monetary policy. These variables reflect the state of the economy at a specific point in time and are often employed to understand the market's time-varying behaviour. Additional economic variables include industrial production, real GDP and unanticipated inflation. The dispersion in term spread narrows, reaching low points in December 2000 at −0.70%, April of 2007 at −0.52% and August of 2019 at −0.36% suggesting that real estate returns, and the rental growth rate declined due to a short-term economic expansion. In contrast, the term spread peaks in March 2002 at 3.45%, August of 2003 at 3.48%, and July of 2010 at 3.67% indicating higher real estate returns and rental income due to short-term downturns in the economy (Plazzi, Torous, and Valkanov 2008). The default or credit spread widens in February 2001 to 2.95%, October 2001 to 3.34% and peaks at 6.01% in December 2008. As the default spread increases, there is a lower dispersion in real estate returns and the rental growth rate as the economy slows. The opposite is true for narrower defaults or credit spreads. Likewise, the monetary policy variable proxied by the change in the federal funds rate is −0.59% in May 2001, −0.96% in February 2008 and −0.93% in March 2020 with each decline indicating an economic downturn.

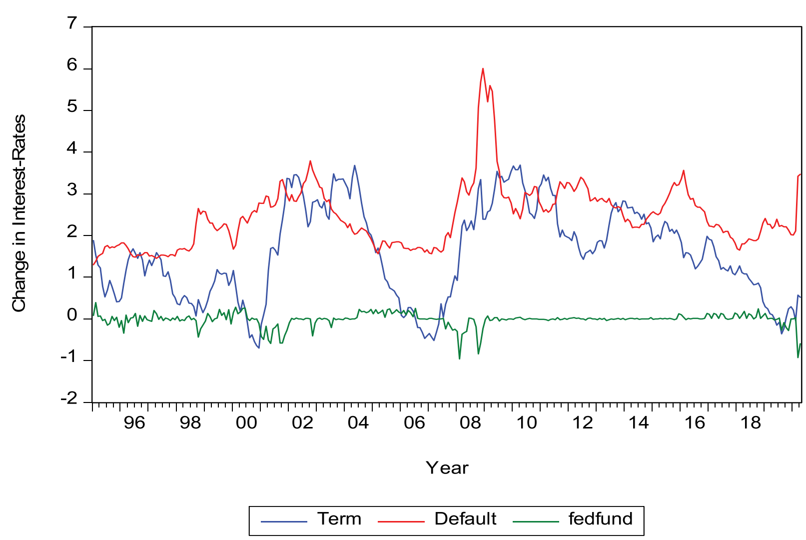

Figure 2. Plot of term (ten-year Treasury Bonds minus three-month Treasury Bills), default (Moody's Baa Bonds minus Treasury Bonds) and monetary policy variable (monthly change in Federal Funds rate). Monthly time series spans about twenty-five-year period from January 1995 to April 2020.

Several researchers use unexpected inflation to explain asset returns. Fama and Schwert (1977) and Fama (1981) find a negative relationship between expected inflation and real economic activity. Others examine the effect of unexpected inflation on REIT returns (e.g. Chan, Hendershott, and Sanders 1990; Adrangi, Chatrath, and Raffiee 2004). As Figure 3 reflects, unexpected inflation is more volatile than changes in the federal funds rate.

We analyse a standard multi-factor pricing model where typical macro-economic variables are included to explain return predictability.[6] Additionally, the dynamic evolution of these economic risk factors is considered as REIT exposure changes with business cycle fluctuations. As a result of the length of the time series employed, there is a strong likelihood that the determinant economic and fundamental factors, their significance, and the heterogeneous impact of shocks on the real-estate sector can be identified. Hence, macroeconomic factors provide information on differences in the pricing mechanism when applied to real estate in the context of the endogenous selection of break-points reflecting changes in trends for REIT indices. Thus, the following equation represents the time-series behaviour of cross-sectional REIT returns against standard economic variables:

$$R_t=\beta_0+\beta_{1t}Term_t+\beta_{2t}Default_t+\beta_{3t}GDPt+\varepsilon_t \quad (3)$$

where R_t represents REIT returns. The first independent variable in the model, term spread, is related to the short-term business cycle and, as classified by the National Bureau of Economic Research (NBER), tends to be higher (lower) in business cycle downturns (expansions). The default, or credit spread, indirectly impacts commercial real estate returns through external debt financing. Therefore, a larger (smaller) credit spread can be directly related to tightening (loosening) credit market conditions, which increases (decreases) the cost of financing properties leading to lower (higher) valuations and returns (e.g. Plazzi, Torous, and Valkanov 2008). Finally, the change in GDP is directly related to real estate values as higher GDP is associated with lower vacancy rates and increased rental income. Corgel and Djoganopoulos (2000) note that construction, real estate services and property insurance account for about 11% of the GDP.

To better understand the determinants of dispersion in REIT returns over time, we include another model derived from fundamental economic factors that incorporates unanticipated changes in inflation, monetary policy, and GDP. Simpson, Ramchander, and Webb (2007) and

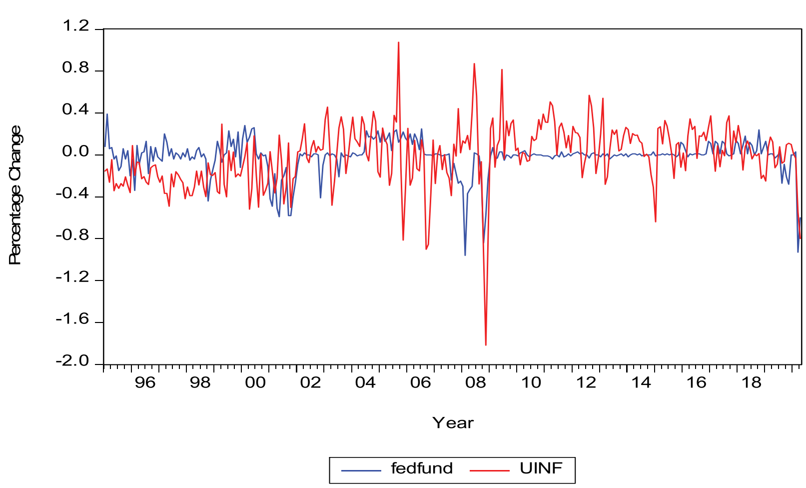

Figure 3. Plot of unanticipated inflation (UINF) which is computed by subtracting lagged risk-free rate from inflation and change in federal funds rate which is a proxy for change in the monetary policy by the Federal Reserve Bank. Monthly time series spans about twenty-five-year period from January 1995 to April 2020.

[6]For example, Chen, Roll, and Ross (1986) and McElroy, Burmeister, and Wall (1985) use different macroeconomic variables that include industrial production, change in consumption, anticipated and unanticipated inflation, default and term risk premium to explain behaviour of asset prices that include stock returns.

Hoesli, Lizieri, and Macgregor (2008) suggest that REIT portfolios provide a hedge against inflation. However, it is likely that various REIT sectors react differently to inflation.[7] The regression equation employed here is:

$$R_t = \beta_0 + \beta_{1t} UINF_t + \beta_{2t} FED_t + \beta_{3t} GDPt + \varepsilon_t \quad (4)$$

where R_t represents REIT returns and $UINF_t$, FED_t, and GDP_t represent unanticipated inflation, the change in federal funds rate and the change in GDP, respectively. As can be seen from Table 2, both models suggested in equations 3and 4, are tested using structural break analysis on a broad classification of REITs. For equity REITs, there is one breakpoint when regressed against term, default and change in GDP. However, three breakpoints are detected for equity REITs when regressed against changes in federal funds, unanticipated inflation and GDP. As Figure 2 reflects, the term premium widens between 2001 and 2004 indicating an expansion in economic activity following a cyclical trough. It subsequently narrows between 2006 and 2007 reflecting a peak in the business cycle prior to the slowdown in the economy and the corresponding impact on REIT returns. Table 2 confirms that GDP has an inverse effect on equity REIT returns for the first period that ended in June 2001. However, GDP has a positive effect on the returns when term-spread narrows in the second period. Since the GFC occurred within the second time-period, default risk has a significant negative effect on equity REITs. Interestingly, during the final period, the changes in GDP and default risk premium display significant positive influence on equity REIT

Table 2. REITs returns and economic variables.

	c	Term	Default	GDP		c	Fed	UINF	GDP
All REITs:		Break Date 1995M01 – 2001(M06)				Break Date 1995 M(01) – 2020(M04)			
	2.701	0.721	−0.239	−6.125*		0.671**	4.386**	−0.858	1.919**
	(0.69)	(0.64)	(−0.15)	(−1.88)		(1.99)	(2.25)	(−0.83)	(2.36)
		Break Date 2001M07 – 2009(M02)							
	2.699	0.379	−1.724**	8.389***					
	(1.32)	(0.70)	(−2.01)	(3.13)					
		Break Date 2009M03 – 2020(M04)							
	−5.058***	0.047	2.275***	2.258***					
	(−2.56)	(0.09)	(2.89)	(2.63)					
Adj. R2	0.142				**Adj. R2**	0.045			
F	5.56***				**F**	5.80***			
Break Test:	F	Scaled F	Critical Values (5%)	Trimming = 0.15					
0 vs 1	6.52	26.09	16.19						
1 vs 2	4.63	18.50	18.11						
2 vs 3	2.04	8.16	18.93						
Equity REITs:		Break Date 1995M01 – 2009(M02)				Break Date 1995 M(01) – 2001(M08)			
	3.963**	0.389	−0.201***	3.250		2.652**	−0.670	2.244	−4.147
	(2.35)	(0.95)	(−2.99)	(1.54)		(2.08)	(−0.20)	(0.64)	(−1.34)
		Break Date 2009M03 – 2020(M04)				Break Date 2001(M09) – 2008(M11)			
	−5.376***	0.064	2.408***	2.12***		−1.015	5.448**	2.525*	10.651***
	(−2.58)	(0.12)	(2.87)	(2.34)		(−1.44)	(2.06)	(1.74)	(4.31)
						Break Date 2008(M12) – 2012(M08)			
						0.946	−82.28***	−4.748	12.53***
						(0.80)	(−3.63)	(−1.35)	(2.71)
						Break Date 2012(M09) – 2020 M(04)			
						0.853	4.352	−5.329**	1.882*
						(1.56)	(0.82)	(−1.97)	(1.64)
Adj. R2	0.102				**Adj. R2**		0.188		
F	5.93***				**F**		5.69***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Value (5%)	
0 vs 1	7.03	28.12	16.19			5.34	21.37	16.19	
1 vs 2	4.43	17.73	18.11			5.15	20.62	18.11	
2 vs 3						5.25	21.20	18.93	
3vs4						0.55	2.19	19.64	

The trimming value is defined as the shortest time that a break needs to be eligible to be included as structural. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively. 't' values are in parentheses and critical values are from Bai and Perron. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

[7]For instance, commercial and business properties rise or fall gradually as compared to residential real estate, which experiences more immediate responses to changes in inflation.

returns. The second model clearly indicates that the change in federal funds has a significant positive effect on equity REITs in the second period followed by a negative effect in the third period. Thus, it seems the Federal Reserve Bank's monetary policy is appropriate for the performance of equity REITS before and during the GFC. A single breakpoint is detected for mortgage REITs under both models. As seen in equity REITs, GDP has a significant negative effect during the first period followed by a positive effect during the second period. Furthermore, the monetary policy variable has a negative effect on returns in the first period followed by a positive effect in the second period.

Table 3 presents results for office and industrial REITs. Consistent with the results of Bianchi, Guidolin, and Ravazzolo (2013) and others, industrial and office REITs display different risk characteristics from residential REITs as commercial and business properties usually react more slowly to macroeconomic factors. Furthermore, industrial buildings and offices are directly related to business activities implying greater potential reaction to changes in real GDP. Hence, office and industrial REITs may have large exposure to changes in short-term interest rates, GDP and unexpected inflation. Office REITs have a single break point in March 2009 for the first model with a significant positive constant followed by a significant negative

Table 3. REITs returns and economic variables.

	c	Term	Default	GDP		c	Fed	UINF	GDP
Mortgage REITs:		Break Date 1995M01 – 2002(M06)					Break Date 1995 M(01) – 2002(M06)		
	6.824**	1.380*	−1.440	−13.543***		7.558***	−7.275**	1.718	−16.930***
	(2.03)	(1.86)	(−1.08)	(−3.40)		(4.63)	(−2.00)	(0.74)	(−4.28)
		Break Date 2002M07 – 2020(M04)					Break Date 2002 M(07) – 2020(M04)		
	−2.078	0.306	0.548	3.938***		1.347***	3.233*	−2.405*	−1.952
	(−1.32)	(0.66)	(0.82)	(3.83)		(2.48)	(1.65)	(−1.67)	(−1.17)
Adj. R2	0.087				**Adj. R2**		0.129		
F	5.12***				**F**		6.64***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	5.42	21.66	16.19			6.30	25.21	16.19	
1 vs 2	2.23	8.93	18.11			2.53	10.12	18.11	
2 vs 3	2.06	8.25	18.93						
Office REITs:		Break Date 1995M01 – 2009(M03)					Break Date 1995 M(01) – 2000(M07)		
	4.707***	0.151	−2.075***	3.082		7.918***	−8.363**	8.540**	−12.092***
	(2.60)	(0.33)	(−2.91)	(1.32)		(3.92)	(−2.11)	(2.18)	(−3.15)
		Break Date 2009M04 – 2020(M04)					Break Date 2000 M(08) – 2020(M04)		
	−6.445***	0.213	2.629***	2.466**		0.881*	6.361**	−1.742	1.816*
	(−2.56)	(0.36)	(2.55)	(2.44)		(1.68)	(2.40)	(−1.24)	(1.65)
Adj. R2	0.095				**Adj. R2**	0.074			
F	5.54***				**F**	4.02***			
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	5.71	22.84	16.19			5.84	29.23	16.19	
1 vs 2	3.24	12.94	18.11			1.32	5.31	18.11	
Industrial REITs:		Break Date 1995M01 – 2005(M02)					Break Date 1995 M(01) – 2005(M01)		
	3.123	0.544	−0.775	−2.744		2.063*	1.172	1.355	−1.912
	(0.96)	(0.63)	(−0.61)	(−0.65)		(0.84)	(0.34)	(0.52)	(−0.53)
		Break Date 2005M03 – 2008(M11)					Break Date 2005 M(02) – 2008(M11)		
	17.404***	3.465*	−10.202*** 11.471**	−2.462**		13.835***	1.595	21.711***	
	(3.31)	(1.62)	(−3.73)	(1.97)		(−2.38)	(3.28)	(0.64)	(5.37)
		Break Date 2008M12 – 2020(M04)					Break Date 2008 M(12) – 2013(M03)		
	−8.480**	−0.999	4.586***	1.716		0.883	−263.7***	−2.866	9.896*
	(−3.35)	(−1.37)	(4.66)	(1.36)		(0.70)	(−9.09)	(−0.94)	(1.71)
							Break Date 2013 M(04) – 2020(M04)		
						−1.401*	−5.451	−4.198	1.948
						(−1.90)	(−0.80)	(−1.09)	(1.32)
Adj. R2	0.239				**Adj. R2**	0.403			
F	7.32***				**F**	14.64***			
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	10.59	42.36	16.19			12.63	49.45	16.19	
1 vs 2	8.44	33.75	18.11			19.48	77.91	18.11	
2 vs 3	1.26	5.08	18.83			9.58	38.34	18.83	
3 vs 4						0.52	2.09	19.64	

The trimming value is defined as the shortest time that a break needs to be eligible to be included as structural. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively. 't' values are in parentheses and critical values are from Bai and Perron. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

default spread. As a result, it is not surprising that the default risk premium negatively impacts office REITs. Sign reversals occur in the second period with the constant becoming negative and the default spread turning positive, but both remain statistically insignificant. GDP remains positive and becomes significant in the second period. For industrial REITs, Table 3 shows that default spread has a significant negative effect for the period ended in November 2008, but GDP is positive for both models. The monetary policy variable is positive and significant suggesting the sector benefitted from the Federal Reserve Bank's actions. Figure 1 (a) confirms that industrials display heterogeneous return dispersion for different time periods.

Table 4 presents results for the retail REIT breakpoint analysis after the GFC. Here, REIT returns are positively impacted by term spread during the first period. This impact coincides with the observation of narrow spreads signifying a short-term business expansion. Incidentally, the default spread positively influenced returns for retail REITs in the final period after January 2009, when the spread narrowed following the GFC. It is interesting to note the significant negative effect of unanticipated inflation for the retail sector in the two later time periods. As expected, the change in the GDP's influence is evident for the retail segment's return performance and predictability. Prior to the GFC, the constant has a positive coefficient but is insignificant. Following the GFC the constant becomes negative and significant. This likely reflects the changing taste and preferences of consumers. The change in the federal funds rate also has a significant positive impact on retail REIT returns reflecting monetary policy's positive effect on this segment following the GFC.

Due to the cyclical nature of real estate, valuations and occupancy vary over time. Default risk has a significant inverse effect on returns for shopping REITs and unanticipated inflation negatively influences their performance following the GFC. As seen with retail REITs, shopping malls are positively impacted by changes in federal fund rates and GDP. The constant is insignificant and negative after

Table 4. REITs returns and economic variables.

	c	Term	Default	GDP		c	Fed	UINF	GDP
Retail REITs:		Break Date 1995M01 – 2004(M03)					Break Date 1995 M(01) – 2008(M09)		
	1.646	0.722**	−0.355	−2.113		0.697	−0.3965	−0.849	1.862
	(1.13)	(2.29)	(−0.62)	(−1.14)		(0.94)	(−0.15)	(−0.49)	(0.77)
		Break Date 2004M04 – 2009(M03)					Break Date 2008 M(10) – 2016(M07)		
	2.036	−0.771	−1.775	15.134**		1.404	36.75***	−4.791**	5.676
	(0.54)	(−0.66)	(−1.09)	(2.38)		(1.49)	(5.00)	(−2.28)	(1.36)
		Break Date 2009M01 – 2020(M04)					Break Date 2016 M(08) – 2020(M04)		
	−8.243***	0.126	3.067**	5.407***		−0.201	16.81***	−17.02***	1.764
	(−2.64)	(0.18)	(2.29)	(3.46)		(−0.21)	(2.53)	(−3.00)	(1.18)
Adj. R2	0.159				**Adj. R2**	0.188			
F	6.23***				**F**	7.38***			
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	5.71	22.86	16.19			6.54	26.17	16.19	
1 vs 2	5.28	21.11	18.11			5.75	22.99	18.11	
2 vs 3	3.53	14.11	18.93			2.04	8.16	18.93	
Shopping REITs:		Break Date 1995M01 – 2009(M03)					Break Date 1995 M(01) – 2008(M09)		
	3.078*	0.409	−1.652**	3.910*		1.008	−0.339	−1.013	0.464
	(1.67)	(0.89)	(−2.28)	(1.65)		(1.36)	(−0.13)	(−0.58)	(0.19)
		Break Date 2009M04 – 2020(M04)					Break Date 2008 M(10) – 2016(M07)		
	−9.050***	−0.232	3.769***	3.864***		1.006	33.25***	−5.992***	6.676*
	(−3.00)	(−0.33)	(3.06)	(3.19)		(1.07)	(4.50)	(−2.84)	(1.59)
							Break Date 2016 M(08) – 2020(M04)		
						−0.118	14.134**	−19.49***	2.186
						(−0.12)	(2.12)	(−3.42)	(1.45)
Adj. R2	0.092				**Adj. R2**		0.175		
F	5.41***				**F**		6.83***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	4.60	18.40	16.19			6.02	24.09	16.19	
1 vs 2	4.25	16.99	18.11			5.73	22.93	18.11	
2 vs 3						1.62	6.50	18.83	

The trimming value is defined as the shortest time that a break needs to be eligible to be included as structural. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively. 't' values are in parentheses and critical values are from Bai and Perron. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

April 2009 reflecting their declining popularity due to shifting consumer preferences. For retail and shopping-centre REITs, *R*-square values between 15% and 18% are much higher than the *R*-squares reported in other studies. This is likely due to the identification of multiple structural breakpoints by the model employed and the subsequent reduction in noisy relationships between REIT returns and the economic variables.

Table 5 presents results for mall, free standing and residential REITs. Mall REITs are divided into two categories: regionals and super-regionals. Term spread for mall REITs is positive and significant until March 2004. As displayed in Figure 2, term spreads are narrow for most of this period signifying a short-term economic expansion. Default spread and change in GDP are positive and significant for the period after the GFC. However, the constant coefficient is negative suggesting recent overall sector weakness. Following the GFC, the coefficient for change in the federal funds rate is positive and significant, implying well-timed monetary policy actions by the Federal Reserve. In the case of free-standing REITs, the default spread for the period from May 2005 to March of 2009 is negative and significant, while the term premium is positive. As expected, the change in GDP favourably impacts returns after the GFC.

Table 5. REITs returns and economic variables.

	c	Term	Default	GDP		c	Fed	UINF	GDP
Mall REITs:	Break Date 1995M01 – 2004(M03)					Break Date 1995 M(01) – 2001(M06)			
	2.101	1.001***	−0.556	−2.344		3.362***	−2.491	3.920	−5.051**
	(1.18)	(2.70)	(−0.80)	(−1.04)		(3.13)	(−0.99)	(1.44)	(−2.10)
	Break Date 2004M04 – 2009(M03)					Break Date 2001 M(07) – 2008(M07)			
	1.852	−0.776	−1.368	13.73**		−1.296	−0.106	−2.080	14.75***
	(0.48)	(−0.64)	(−0.84)	(2.37)		(−1.31)	(−0.03)	(−1.08)	(3.81)
	Break Date 2009M04 – 2020(M04)					Break Date 2008 M(08) – 2020(M04)			
	−13.39***	0.597	4.925***	4.017***		1.156	34.77***	−3.180	−0.420
	(−3.68)	(0.69)	(3.31)	(2.75)		(1.35)	(4.80)	(−1.10)	(−0.22)
Adj. R2	0.173				**Adj. R2**	0.166			
F	6.75***				**F**	6.47***			
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	7.11	28.45	16.19			5.76	23.03	16.19	
1 vs 2	6.09	24.37	18.11			6.22	24.89	18.11	
2 vs 3	3.68	14.72	18.93			3.76	15.03	18.93	
Free-Standing	Break Date 1995M01 – 2005(M04)					Break Date 1995 M(01) – 2008(M10)			
REITs:	2.366	0.366	−1.076	−1.339		0.156	1.426	−2.198	−0.554
	(1.15)	(0.78)	(−1.16)	(−1.34)		(0.36)	(0.68)	(−1.53)	(−0.87)
	Break Date 2005M05 – 2009(M03)					Break Date 2008 M(11) – 2012(M07)			
	12.569***	4.143***	−7.132***	−0.063		−0.785	13.549	13.851***	2.446***
	(5.21)	(2.78)	(−5.42)	(−0.07)		(−0.75)	(0.85)	(3.55)	(2.49)
	Break Date 2009(M04) – 2020(M04)					Break Date 2008 M(08) – 2020(M04)			
	−3.160	0.512	1.190	2.032***		0.341	0.025	0.047	2.062***
	(−1.34)	(0.94)	(1.22)	(5.39)		(0.59)	(0.01)	(0.02)	(4.38)
Adj. R2	0.226				**Adj. R2**		0.279		
F	9.03***				**F**		11.65***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	6.87	27.50	16.19			10.17	40.68	16.19	
1 vs 2	5.16	20.62	18.11			6.74	26.97	18.11	
2 vs 3	3.14	12.57	18.83			1.39	5.56	18.83	
Residential REITs:	Break Date 1995M01 – 2009M02					Break Date 1995M01 – 2020M04			
	3.262**	0.148	−1.251*	2.458		0.797**	4.145**	−1.677	2.379***
	(1.92)	(0.36)	(−1.72)	(1.17)		(2.32)	(2.09)	(−1.59)	(2.87)
	Break Date 2009M03 – 2020M04								
	−5.875***	0.598	2.579***	2.241**					
	(−2.68)	(1.13)	(2.85)	(2.23)					
Adj. R2	0.121				**Adj. R2**		0.045		
F	6.21***				**F**		5.75***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15				
0 vs 1	6.43	25.73	16.19						
1 vs 2	3.66	14.65	18.11						

The trimming value is defined as the shortest time that a break needs to be eligible to be included as structural. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively. 't' values are in parentheses and critical values are from Bai and Perron. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

The next REIT sector examined is residential where the default risk premium is negative and significant prior to the GFC but becomes positive and significant afterwards. As seen in other sectors, GDP and change in federal funds rate have significant positive effects on these REITs. Another positive aspect of residential REITs is their shorter-term lease agreements that enable them to adjust rents to compensate for inflation.

As observed with residential REITs, from Table 6, the default risk-premium has a significant negative effect on apartment REIT returns until February of 2009 but a significant positive effect after GFC. GDP and change in federal funds rate positively impact the returns of these REITs.

Manufactured homes have a completely different risk structure than other residential REITs. Following REIT investment in this sub-sector and shifting consumer demographics, manufactured homes have become increasingly popular with retirees due to improved quality and amenity mix. As a result, this sub-segment has experienced smaller turnover and capital expenditure, reduced management supervision and superior performance. In fact, manufactured homes have the second highest Sharpe-Ratio of all real estate sectors and sub-

Table 6. REITs returns and economic variables.

	c	Term	Default	GDP		c	Fed	UINF	GDP
Apartments REITs:	Break Date 1995M01 – 2001(M08)					Break Date 1995 M(01) – 2020(M04)			
	1.507	0.030	0.258	−2.864		0.756**	3.429*	0.435	2.336***
	(0.59)	(0.04)	(0.26)	(−1.30)		(2.18)	(1.71)	(0.40)	(2.78)
	Break Date 2001M09 – 2009(M02)								
	4.863**	0.657	−2.692***	6.345*					
	(1.96)	(1.01)	(−2.59)	(1.89)					
	Break Date 2009M03 – 2020(M04)								
	−4.382**	0.568	1.735**	2.330**					
	(−1.97)	(1.00)	(1.95)	(2.41)					
Adj. R2	0.139				**Adj. R2**	0.045			
F	5.47***				**F**	5.75***			
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15				
0 vs 1	6.26	25.03	16.19						
1 vs 2	5.26	21.04	18.11						
2 vs 3	2.34	9.47	18.93						
Manufactured	Break Date 1995M01 – 2008(M11)					Break Date 1995 M(01) – 2002(M06)			
Homes REITs:	1.573	−0.063	−0.848	3.994**		2.210***	−3.578*	1.803	−2.439
	(0.97)	(−0.17)	(−1.24)	(2.15)		(2.62)	(−1.76)	(0.86)	(−1.16)
	Break Date 2008M12 – 2020(M04)					Break Date 2002 M(07) – 2008(M06)			
	−0.457	−0.179	0.933	2.152**		−1.976**	−6.26**	−3.229**	14.13***
	(−0.25)	(−0.33)	(1.32)	(2.28)		(−2.24)	(−2.19)	(−1.92)	(4.27)
						Break Date 2008(M07) – 2020(M04)			
						2.713***	6.932	−1.528*	−0.311
						(4.73)	(1.45)	(−1.65)	(−0.27)
Adj. R2	0.056				**Adj. R2**		0.130		
F	3.55***				**F**		4.79***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	4.17	16.69	16.19			5.25	21.01	16.19	
1 vs 2	4.36	17.45	18.11			4.83	19.34	18.11	
2 vs 3						2.81	11.24	18.83	
Health-Care REITs:	Break Date 1995M01 – 2000(M02)					Break Date 1995 M(01) – 2008(M09)			
	7.542**	−0.147	−3.180**	−4.827		1.891***	−3.588*	−0.459	−2.230
	(2.19)	(−0.13)	(−2.02)	(−1.49)		(3.09)	(−1.67)	(−0.32)	(−1.12)
	Break Date 2000M03 – 2020(M04)					Break Date 2008 M(10) – 2020(M04)			
	0.656	−0.355	0.299	3.831***		1.715***	5.646*	−3.620*	−0.411
	(0.40)	(−0.83)	(0.44)	(3.63)		(2.62)	(1.83)	(−1.72)	(−0.27)
Adj. R2	0.045				**Adj. R2**		0.116		
F	3.02**				**F**		5.90***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	5.44	21.76	16.19			5.55	22.19	16.19	
1 vs 2	1.87	7.47	18.11			2.46	9.84	18.11	

The trimming value is defined as the shortest time that a break needs to be eligible to be included as structural. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively. 't' values are in parentheses and critical values are from Bai and Perron. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

sectors. As Table 6 reports, GDP has a significant positive impact on this sub-sector. However, the change in federal funds rate has a negative effect on the returns of manufactured home REITs in the first period, but there is a reversal of sign for the monetary policy variable after the GFC. This may reflect, shifting demographics along with their improved reputation.

In contrast to REITs in other sectors, health care REITs generally operate on a net lease basis, which shifts the operating risk of the property to the lessee. Hence, these REITs have less risky structures with minimal operating costs. Table 6 indicates that health care REITs are adversely impacted by the default risk premium until February 2000. However, they display resilience to the default spread during the GFC. The effect of unanticipated inflation after October 2008 is negative, indicating a lack of a hedge against inflation. However, the monetary policy variable proxied by change in the federal funds rate is positive. As expected, these REITs perform better than S&P 500 index after adjustment for risk.

Brady and Conlin (2004) suggest that hotels are affected by economic cycles resulting in greater volatility in this sector. As shown in Table 1, hotel REITs are characterized by high standard deviation and low average returns resulting in a Sharpe Ratio substantially below that of the S&P 500 index. The results presented in Table 7 show the significant negative effects of GDP until June of 2001. The coefficient for the constant is negative and significant after March 2009. The change in federal funds is positive and significant, implying favourable monetary policy effects.

Storage REITs are one of the best performing sectors. As reported in Table 7, there is a negative effect of GDP until June 2001 but after this timespan, storage REITs display superior performance relative to most sectors of real estate. Even in terms of the Sharpe Ratio, storage REITs significantly outperform the S&P 500 index.

REITs display stock and bond-like features implying that they may be impacted by market factors while retaining distinct features embedded in idiosyncratic risk. Thus, researchers have

Table 7. REITs returns and economic variables.

	c	Term	Default	GDP		c	Fed	UINF	GDP
Hotels REITs:		Break Date 1995M01 – 2001(M06)					Break Date 1995 M(01) – 2001(M05)		
	7.042	0.715	−1.899	−11.43***		6.354***	1.716	7.137*	−13.091***
	(1.59)	(0.55)	(−1.09)	(−3.11)		(3.44)	(0.45)	(1.64)	(−3.35)
		Break Date 2001M07 – 2009(M02)					Break Date 2001 M(06) – 2020(M04)		
	7.132**	1.206	−5.454***	17.382***		0.458	8.979**	−2.238	3.906**
	(2.13)	(1.41)	(−3.57)	(3.65)		(0.57)	(2.10)	(−1.06)	(1.95)
		Break Date 2009M03 – 2020(M04)							
	−8.837**	0.428	2.597*	6.359***					
	(−2.27)	(0.47)	(1.81)	(3.83)					
Adj. R2	0.205					**Adj. R2**	0.068		
F	7.51***					**F**	3.75***		
Break Test:	F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	9.45	37.80	16.19			6.08	24.33	16.19	
1 vs 2	6.96	27.85	18.11			4.13	16.54	18.11	
2 vs 3	3.26	13.02	18.93						
Storage REITs:		Break Date 1995M01 – 2020(M04)					Break Date 1995 M(01) – 2001(M06)		
	1.399	0.509*	−0.483	1.786***		2.804*	−1.224	1.525	−5.536**
	(0.87)	(1.86)	(−0.66)	(5.13)		(1.75)	(−0.41)	(0.47)	(−1.95)
							Break Date 2001 M(07) – 2020(M04)		
						0.643	1.450	−0.461	3.804***
						(1.09)	(0.55)	(−0.34)	(2.54)
Adj. R2	0.021				**Adj. R2**		0.034		
F	3.14**				**F**		2.37**		
					Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1							4.06	16.24	16.19
1 vs 2							1.85	7.40	18.11

The trimming value is defined as the shortest time that a break needs to be eligible to be included as structural. *, **, *** represent significance at 10%, 5%, and 1% levels, respectively. Critical values are from Bai and Perron. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

pointed out their potential diversification benefits. Chui, Titman, and Wei (2003) and Hung and Glascock (2010) find that the momentum factor results in higher returns for REITs relative to non-REIT companies.[8] However, Hung and Glascock (2010) suggest that earnings momentum tends to encompass price momentum. To gain additional insight into the performance characteristics of REITs, we employ the Carhart (1997) four-factor regression model which includes Fama and French's three-factor model. This approach decomposes and captures risk-adjusted performance attributes, such as 'alpha' and factor exposure components measured by coefficients associated with each factor to obtain the corresponding risk premia.

The equation for the Fama-French and Carhart four-factor model with momentum is:

$$r_{it} - r_{ft} = \alpha_i + \beta_i(r_{mt} - r_{ft}) + \omega_i SMB_t + \theta_i HML_t + \lambda i PRIYR_t + \varepsilon_{it} \quad (5)$$

where $r_{it} - r_f$ is the excess return for REITs, r_{ft} is the risk-free rate, r_{mt} is the return on value weighted market portfolio, SMB_t is the return on diversified portfolios of small stocks minus large stocks, HML_t is the difference between diversified portfolio of high and low Book/Market-Value stocks and PRIYRt are the returns on value weighted zero investment factor showing similarity with the portfolio for size, book to market equity and one-year momentum in stock returns and ε_{it} is a zero-mean residual.

Fama and French (1993) infer that SMB_t and HML_t relate to size and growth premiums, which supplement the market risk premium, while the fourth factor signifies momentum of returns arising from the recent performance. As suggested by Jegadeesh and Titman (1993) this factor also explains asset returns. An economic rationale for inclusion of SMB_t and HML_t is provided by Liew and Vassalou (2000) who advocate that these variables reflect the current and future states of the economy. Similarly, Petkova (2006) argues that any variation in SMB and HML is related to current investment opportunities, consumption preferences and the future state of the economy. Due to the linkages between these variables and the economy, their relationships with REITs may provide insights into the temporal variability of excess return determinants. For instance, Petersen and Hsieh (1997) find that EREIT's variability in excess returns can be explained by Fama-French's three factors. However, after the 1990s the influx of institutional investors providing inexpensive capital produces a 'leverage effect' accelerating REIT growth and price inflation (Kawaguchi and Shilling 2012). This dramatic increase in leverage alters the risk-return profile of REITs.[9] As displayed in Table 8, regressing excess REIT returns on the four-factor model results in an adjusted *R*-square of 63.6% signifying good fit for the model. For the first and the second period, market risk-premium, SMB and HML are significant, but momentum is negative and significant for the period that covered the GFC, suggesting shocks to the economic system adversely impact excess REIT returns. The market beta of 0.398 increases to 0.997 in the second period before declining to 0.776 in the final period, reflecting the variability of the risk of these REITs. In contrast, the beta for equity REITs increases from 0.417 prior to the first breakpoint to 1.160 in the second period that includes the GFC but declines to 0.785 in the final period. Like all REITs, equity REITs display negative momentum effects in the second period. Their variation in beta likely reflects an increase in their size and utilization of leverage prior to the GFC and a subsequent deleveraging effect.[10] This fluctuation in beta and the increase in leverage may have resulted in equity REITs being more susceptible to market shocks (Bai, Chang, and Glascock 2011).

Interestingly, SMB and HML are significant for equity REITs during the first two time periods but insignificant in the final period. As suggested by Bai, Chang, and Glascock (2011), mortgage REITs

[8]Johnson (2002) has pointed out that infrequent but persistent shocks to business conditions arising from innovations, technological changes and other structural variations may lead to higher growth rate of the companies which can, in turn, increase dividend yields. This higher dividend yield can cause price momentum of returns. Since REITs distribute most of their earnings as dividends, there is some likelihood of finding price momentum for real estate sectors.

[9]Ling and Naranjo (2003) suggest that this transformation of the REITs structurally changed their beta attributes as new REITs were relatively larger with significant amount of debt in their capital structure. However, deleveraging occurred after GFC.

[10]Sing, Tsai, and Chan (2016) also suggest time varying beta attributes of equity REITs in the 90's and 2000s as these companies used more external debt to acquire other REITs and/or develop more properties which may have resulted in structural shift of these companies.

Table 8. Excess REIT returns and Carhart-Fama-French four-factor model with momentum.

REITs	4-Factors					REITs	4-Factors				
Sector or Sub-Sector	α	Mkt	SMB	HML	Mom	Secto or Sub-Sector	α	Mkt	SMB	HML	Mom
			1995(M01) – 2004(M03)						1995(M01) – 2005(M05)		
All	0.665**	0.398***	0.378***	0.639***	−0.090**	**Equity**	0.273	0.417***	0.376***	0.650***	−0.077
	(2.42)	(6.13)	(5.74)	(7.09)	(−1.97)		(0.83)	(5.17)	(4.54)	(5.80)	(−1.33)
			2004(M04) – 2010(M04)						2005(M06) – 2010(M04)		
	0.783	0.997***	0.583***	0.687***	−0.315***		−0.050	1.160***	0.709***	0.769***	−0.219***
	(1.47)	(7.00)	(2.59)	(3.69)	(−2.92)		(−0.11)	(10.1)	(3.43)	(4.62)	(−2.61)
			2010(M05) – 2020(M04)						2010(M05) – 2020(M04)		
	0.146	0.776***	0.021	0.048	0.133		−0.013	0.785***	0.005	0.056	0.173
	(0.45)	(9.30)	(0.14)	(0.36)	(1.21)		(−0.04)	(9.02)	(0.03)	(0.40)	(1.51)
Adj R2		0.636				**Adj R2**	0.595				
F		36.29***				**F**	30.68***				
Break Test:	F	Scaled F	Critical Values (5%)				Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1	12.33	61.66	18.23					8.22	41.10	18.23	
1 vs 2	8.67	43.35	19.91					6.29	31.43	19.91	
2 vs 3	1.31	6.53	20.99					1.70	8.51	20.99	
			1995(M01) – 2020(M04)						1995(M01) – 2005(M05)		
Mortgage	0.024	0.634***	0.636***	0.321***	−0.035	**Office**	0.802**	0.518***	0.329***	0.682***	−0.010
	(0.07)	(8.09)	(5.99)	(3.21)	(−0.50)		(2.09)	(5.55)	(3.43)	(5.26)	(−0.16)
									2005(M06) – 2009(M12)		
							1.100	0.974***	1.041***	0.694***	−0.423***
							(1.51)	(5.22)	(3.48)	(2.86)	(−2.74)
									2010(M01) – 2020(M04)		
							−0.026	0.861***	0.182	0.115	0.082
							(−0.08)	(9.92)	(1.20)	(0.85)	(0.75)
Adj R2		0.296				**Adj R2**	0.587				
F		32.80***				**F**	31.78***				
Break Test:							Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1							7.20	36.00	16.19	18.23	
1 vs 2							7.77	38.86	18.11	19.91	
2 vs 3							1.63	8.13	18.93	20.99	
			1995(M01) – 2005(M06)						1995(M01) – 2000(M06)		
Industrials	0.931***	0.374***	0.222**	0.469***	−0.001	**Retail**	0.610*	0.399***	0.360***	0.677***	−0.188**
	(2.52)	(4.14)	(2.41)	(3.76)	(−0.01)		(1.79)	(4.79)	(4.44)	(4.27)	(−2.18)
			2005(M07) – 2008(M08)						2000(M07) – 2004(M03)		
	0.801	1.230***	−0.240	−0.689	−0.095		1.755***	0.047	0.611***	0.256**	−0.093
	(1.04)	(4.50)	(−0.62)	(−1.42)	(−0.37)		(4.17)	(0.50)	(5.03)	(2.29)	(−1.36)
			2008(M09) – 2013(M04)						2004(M04) – 2009(M04)		
	3.058*	0.941***	1.741***	0.768	−1.232***		1.013	1.096***	0.832**	0.674**	−0.669***
	(1.90)	(2.80)	(2.57)	(1.57)	(−3.91)		(1.16)	(4.39)	(1.97)	(2.06)	(−3.31)
			2013(M05) – 2020(M04)						2009M05 – 2020M04		
	0.521	0.820***	0.084	−0.289	0.138		0.144	0.891***	0.093	0.582***	0.191
	(1.08)	(6.41)	(0.43)	(−1.52)	(0.83)		(0.31)	(7.54)	(0.47)	(3.22)	(1.38)
Adj R2		0.564				**Adj R2**	0.570				
F		20.59***				**F**	21.06***				
Break Test:		F	Scaled F	Critical Values (5%)		Trimming = 0.15	F	Scaled F		Critical Values (5%)	
0 vs 1		9.07	45.38	18.23			10.09	50.47		18.23	
1 vs 2		5.31	26.54	19.91			6.14	30.72		19.91	
2 vs 3		5.14	25.68	20.99			4.56	22.78		20.99	
3 vs 4		0.87	4.36	21.71			2.66	13.31		21.71	

*, **, *** represent significance at 10%, 5%, and 1% levels, respectively. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

have become more insulated from the stock market. The results presented in Table 8 indicate a lower R-square of 0.296 for mortgage REITs but the market risk premium, SMB and HML are significant. However, the beta for mortgage REITs is 0.634, and there are no breakpoints even during the GFC implying insulation from market shocks. The results for the office REITs presented in Table 8 are similar to those of equity REITs. While the market risk premium is significant in all three periods, SMB and HML are significant and positive for the first two periods but insignificant in the final period. As observed with equity REITs, market beta displays rising variability prior to the GFC and declining afterwards. Finally, momentum has a significant inverse effect during the GFC indicating increased susceptibility to market shocks.

The behaviour of industrials is similar to that of other REITs in the first period but in the second period, the coefficient of SMB is significant and positive, implying smaller firms are riskier than larger firms. Counter cyclicality of the value premium is noted by Chen, Petkova, and Zhang (2008) who suggest that value firms are riskier than growth firms during weak economic conditions. Following the financial crisis, the market risk premium and size premium (SMB) remain significant until April of 2013, while the value premium (HML) is insignificant.

In retail REITs, a close relationship is observed between excess returns and the market, size and value premiums. Momentum is significant and negative in the first and third periods suggesting accelerated inverse momentum arising from a structural shift due to the leverage effect. In the final period, only the market and size premiums remain significant. The betas reflect fluctuation in market risk across time with values of 0.399, 1.096 and 0.891 reflecting the leveraging and deleveraging effect across the three periods. As reported in Table 9, Shopping centre REITs display comparable variability in beta to the retail sector, absent the leveraging and deleveraging effect, increasing from an initial level of 0.485 to 0.864 and 0.903. In contrast, the relationship for mall REITs demonstrates a different configuration with positive and significant alpha in the initial period and significant negative momentum in the second period. Unlike other retail REIT sub-sectors, alpha is negative and significant in the final period, reflecting the challenging market conditions experienced by malls during this time. As expected, free standing stores experience positive and significant alpha in the first period and positive momentum in the subsequent period. The defensive nature of the sub-sector is reflected by the relatively low beta of 0.454 prior to the first breakpoint and 0.642 in the second period. Referring to Table 1 and Figure 1 (b), the GFC had a minimal effect on free standing retail. The results for residential REITs reveal their changing composition over time. The substantial impact of the GFC is likely the result of the structural changes arising from the 'leveraging effect' within the sector. Following the final breakpoint, momentum is significant and positive, reflecting improving performance in the sector. The market index and the two Fama-French factors are significant and positive for the manufactured home sub-sector prior to the first and second breakpoints. During the second period, which includes the GFC, the momentum is negative and significant. After the second breakpoint alpha and momentum are significant and positive, reflecting favourable market conditions for manufactured homes.

Table 10 reports the results for health care REITs. Initially, the market, size and value premiums are significant and positive, while momentum is significant and negative. In the subsequent period, only the market premium remains significant and positive. Additionally, beta increases slightly from 0.532 prior to the breakpoint to 0.655 suggesting minimal structural changes in these REITs over a twenty-five-year timespan. As expected, hotel REITs display significant negative momentum effects for the first two periods reflecting the sector's challenging market conditions. The market, size and value premiums are significant across all three periods, while alpha is consistently negative but insignificant. Beta displays a pattern seen in other REIT sectors, rising from 0.823 to 1.491 before declining to 1.253 across the three periods. The adjusted R-square for hotel REITs of 72% is the highest in the study. Finally, storage REITs are the best performing sector with alpha and all three Fama-French factors significant and positive in the first period. Following the breakpoint, the market risk premium remains significant and positive, and momentum becomes positive and significantly reflecting favourable market conditions. Additionally, the beta values for storage REITs decline from an initial value of 0.506 to 0.301 in the most recent period reflecting the sector's defensive nature and market insulation.

V. Robustness tests

To check the stability of the results and ensure that the relationships within sub-periods are not spurious, all the regressions are re-run using

Table 9. Excess REIT returns and Carhart-Fama-French four-factor model with momentum.

REITs	4-Factors					REITs	4-Factors				
Sector or Sub-Sector	α	Mkt	SMB	HML	Mom	Sector or Sub-Sector	α	Mkt	SMB	HML	Mom
			1995(M01) – 2000(M04)						1995(M01) – 2005(M06)		
Shopping Centers	0.448	0.485***	0.302***	0.756***	−0.159*	**Mall**	1.315***	0.225*	0.602***	0.451***	−0.208**
	(1.26)	(5.64)	(3.66)	(4.64)	(−1.70)		(2.66)	(1.86)	(3.59)	(3.64)	(−2.39)
			2000(M05) – 2004(M03)						2005(M07) – 2010(M04)		
	1.704***	0.004	0.389***	0.207**	−0.097**		−0.191	1.460***	0.583**	0.978***	−0.581***
	(4.80)	(0.05)	(4.10)	(2.24)	(−1.98)		(−0.28)	(8.44)	(2.31)	(3.12)	(−4.59)
			2004(M04) – 2009(M03)						2010(M05) – 2016(M06)		
	1.320	0.864***	1.034***	0.755**	−0.715***		0.364	0.908***	−0.109	−0.431	0.347
	(1.52)	(3.48)	(2.45)	(2.29)	(−3.53)		(0.57)	(5.27)	(−0.32)	(−1.39)	(1.61)
			2009M05–2020 M(04)						2016(M07) – 2020(M04)		
	0.039	0.903***	0.163	0.535***	0.142		−1.831**	1.033***	0.745***	0.511	−0.262
	(0.08)	(7.57)	(0.83)	(2.92)	(1.01)		(−2.23)	(5.06)	(2.71)	(1.47)	(−0.85)
Adj R2		0.567				**Adj R2**	0.585				
F		20.86***				**F**	23.52***				
Break Test:		F	Scaled F	Critical Values (5%)			Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1		10.14	50.74	18.23				7.72	38.58	18.23	
1 vs 2		6.49	32.44	19.91				7.95	39.73	19.91	
2 vs 3		4.75	23.74	20.99				4.53	22.65	20.99	
3 vs 4		3.01	15.07	21.71				1.07	5.33	21.71	
			1995(M01) – 2010(M04)						1995(M01) – 2004(M03)		
Free-Standing	1.107***	0.454***	0.535***	0.731***	−0.135**	**Residential**	0.532*	0.398***	0.272***	0.613***	−0.029
	(3.12)	(6.29)	(6.23)	(7.65)	(−2.26)		(1.73)	(5.46)	(4.62)	(6.05)	(−0.58)
			2010(M05) – 2020(M04)						2004(M04) – 2010(M04)		
	0.326	0.642***	−0.130	0.151	0.247*		1.338**	0.881***	0.544**	0.921***	−0.287**
	(0.61)	(4.72)	(−0.55)	(0.70)	(1.69)		(2.24)	(5.69)	(2.18)	(4.45)	(−2.39)
									2010(M05) – 2020(M04)		
							0.405	0.663***	0.105	0.114	0.312**
							(0.99)	(6.29)	(0.57)	(0.68)	(2.25)
Adj R2		0.311				**Adj R2**	0.528				
F		14.69***				**F**	23.60***				
Break Test:		F	Scaled F	Critical Values (5%)			Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1		4.47	22.37	18.23				10.67	53.35	18.23	
1 vs 2		3.54	17.71	19.91				6.73	33.67	19.91	
2 vs 3								0.79	3.98	20.99	
			1995(M01) – 2005(M06)						1995(M01) – 2003(M03)		
Apartments	0.518*	0.410***	0.275***	0.628***	−0.028	**Manufactured Homes**	0.519	0.251**	0.419***	0.191*	0.009
	(1.65)	(5.46)	(3.62)	(6.02)	(−0.53)		(1.17)	(2.37)	(2.87)	(1.79)	(0.12)
			2005(M07) – 2008(M08)						2003(M04) – 2009(M03)		
	1.398**	0.884***	0.542**	0.947***	−0.302**		0.036	0.634***	0.466**	0.868***	−0.512***
	(2.27)	(5.54)	(2.11)	(4.42)	(−2.16)		(0.07)	(4.43)	(2.28)	(3.53)	(−3.72)
			2008(M09) – 2020(M04)						2009(M04) – 2020(M04)		
	0.344	0.665***	0.125	0.152	0.306**		1.092***	0.655***	−0.056	−0.319	0.190**
	(0.82)	(6.18)	(0.66)	(0.89)	(2.16)		(2.85)	(6.49)	(−0.37)	(−0.19)	(2.07)
Adj R2		0.523				**Adj R2**	0.363				
F		23.16***				**F**	13.34***				
Break Test:		F	Scaled F	Critical Values (5%)			Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1		9.78	48.91	18.23				10.37	51.93	18.23	
1 vs 2		6.47	32.37	19.91				4.07	20.36	19.91	
2 vs 3		0.89	4.45	20.99				1.10	5.49	20.99	

*, **, *** represent significance at 10%, 5%, and 1% levels, respectively. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

Ramsey's Regression Equation Specification Error Test (RESET).[11] This test determines if the linear fitted values are appropriate in explaining the response variable or if a correction for non-linearity is needed. For model 1 with term, default and GDP as independent variables, the null hypothesis of linearity is rejected for mortgage, hotels, office, storage, manufactured homes, and health care REITs. The linearity hypothesis is rejected for

[11]The authors would like to thank the reviewers for this suggestion. The stability tests improved the results and enabled us to find regression coefficients with greater power and stability.

Table 10. Excess REIT returns and Carhart-Fama-French four-factor model with momentum.

REITs	4-Factors					REITs	4-Factors				
Sector or Sub-Sector	α	Mkt	SMB	HML	Mom	Sector or Sub-Sector	α	Mkt	SMB	HML	Mom
			1995(M01) – 2009(M08)						1995(M01) – 2004(M09)		
Health	1.115***	0.532***	0.457***	0.929***	−0.240***	**Hotels**	−0.297	0.823***	0.775***	1.266***	−0.316***
	(2.58)	(5.85)	(4.28)	(7.75)	(−3.21)		(−0.58)	(6.75)	(6.24)	(7.50)	(−3.66)
			2009(M09) – 2020(M04)						2004(M10) – 2009(M11)		
	0.192	0.655***	−0.061	0.101	0.180		−0.533	1.491***	0.558*	0.519**	−0.811***
	(0.38)	(4.97)	(−0.28)	(0.49)	(1.08)		(−0.79)	(8.30)	(1.78)	(2.16)	(−5.05)
									2009(M12) – 2020(M04)		
							−0.540	1.253***	0.790***	0.749***	0.176
							(−1.34)	(12.2)	(4.53)	(4.60)	(1.36)
Adj R2		0.335				**Adj R2**	0.722				
F		16.24***				**F**	53.53***				
Break Test:		F	Scaled F	Critical Values (5%)			Trimming = 0.15	F	Scaled F	Critical Values (5%)	
0 vs 1		5.85	29.24	18.23				9.06	45.31	18.23	
1 vs 2		2.76	13.79	19.91				7.55	37.73	19.91	
2 vs 3								3.38	16.92	20.99	
			1995(M01) – 2012(M06)								
Storage	0.959***	0.506***	0.746***	0.490***	−0.066						
	(2.83)	(6.57)	(6.88)	(4.94)	(−1.04)						
			2012(M07) – 2020(M04)								
	0.502	0.301**	0.149	−0.008	0.578***						
	(0.95)	(2.05)	(0.70)	(−0.04)	(3.04)						
Adj R2		0.282									
F		14.24***									
Break Test:		F	Scaled F	Critical Values (5%)			Trimming = 0.15				
0 vs 1		10.18	50.89	18.23							
1 vs 2		2.24	11.21	19.91							

*, **, *** represent significance at 10%, 5%, and 1% levels, respectively. To check the stability of the coefficients Ramsey's regression equation specification error test (RESET) are run for each break date. If the RESET test displays rejection of the null hypothesis, tests are re-run that allow heterogenous error distributions across breaks. Since, Durbin-Watson statistic values are close to 2 for all linear regression models, no autocorrelation correction in the residuals is needed.

industrial, hotel, residential, and manufactured-home REITs for Model 2 with fed-funds, unanticipated inflation, and GDP as independent variables. For the model with the three Fama-French factors and momentum as independent variables, linearity is rejected for equity, office, industrial, retail, shopping centre, free-standing store, residential, apartment, hotel, and health-care REITs. Checking the Durbin–Watson statistics for all models reveals values that are close to 2 indicating no auto-correlations in the residuals. Hence, tests are re-run allowing heterogenous error distributions across breaks, and these results are reported in the tables for non-linear coefficients indicated above. Interestingly, the regression results with heterogenous error distributions are only marginally different for most of the coefficients when compared to the least square model. Thus, these results provide evidence of robustness of our analysis.

VI. Conclusions

We examine the impact of variability in economic and financial variables on REIT returns with the goal of understanding how these relationships have changed over time. The results of this study will benefit both individual and institutional investors as they seek to make informed portfolio decisions across REIT sectors under changing market conditions. The observed variations in REIT sector performance reflect potential return enhancing opportunities arising from changes in economic conditions and monetary policy.

A multi-factor methodology is applied to various fundamental economic variables against REITs to better understand their changing risk-return attributes. Examination of REIT Sharpe-Ratios (SR) reveals that mortgages, shopping centres, malls and hotels underperform small, mid, and large capitalization stock indices. In contrast, equity, office, industrials, free standing stores, residential, apartments, manufactured homes, healthcare, and self-storage REITs outperformed the three stock indices. REITs display higher volatility than equity indices, signifying changing risk characteristics of these companies. The observed REIT returns include outsized gains followed by large losses, suggesting the existence of profit opportunities if the underlying relationships and trends could be correctly identified.

Standard multi-factor models in which typical economic variables are included to explain return predictability are analysed. Furthermore, the dynamic evolution of these changing economic factors is considered using an endogenous breakpoint methodology. The results indicate that the default risk premium has a significant but inverse effect during periods encompassing the global financial crisis (GFC). Similarly, GDP has a significant positive influence on REIT returns in most periods. Following the GFC, the default premium narrows, positively impacting REIT returns. Likewise, changes in federal funds have a significant positive impact on several REIT sectors, implying the appropriateness of monetary policy for these entities. Unanticipated inflation has a significant negative effect on time periods that include the GFC, signalling its importance during periods of extreme market stress.

The Fama-French-Carhart four-factor regression model is employed to decompose and capture risk-adjusted performance attributes, such as 'alpha' and factor exposure components to obtain corresponding risk-premium variability over time. As a result of their linkages to the macroeconomy, the association of these factors with REITs provides insights with respect to the temporal variability of the determinants of risk-premia and excess returns. For REITs where at least two breakpoints are identified, the market, size and value premiums are significant for time periods encompassing GFC. In general, momentum effects are negative and significant when there is a shock to the economic system. For REITs where multiple breakpoints are identified, beta coefficients are significant and variable, providing support for the 'leveraging' followed by 'deleveraging' effect suggested in the literature. A subset of REITs, including mortgages, industrials, free standing stores, manufactured homes and storage, are minimally impacted by market shocks reflecting their insularity and defensive nature. Finally, although the correlation of REITs with the broader market has increased over time, they continue to provide significant diversification benefits for equity investors.

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Appendix

Following Bai and Perron (2003) and Roine and Waldenstrom (2011), breaks that are common to all REITs as well as specific to a REIT are identified. To calculate the breaks, a multiple linear regression model is run which is shown in matrix form by Bai and Perron (2003) as:

$$Y = X\beta + \lambda + \varepsilon \quad \text{(A1)}$$

where $Y=(y_1, \ldots \ldots, y_T)'$; $X=(x_1, \ldots \ldots, x_T)'$; $\varepsilon=(\varepsilon_1, \ldots \ldots, \varepsilon_T)'$; and $\Lambda=(\lambda_1', \ldots \ldots, \lambda_{m+1}')$. In equation (A1), Z is the matrix with diagonal division of data at break-points $(T_1, \ldots \ldots \ldots, T_m)$ with corresponding least square estimates of β and λ_j. The minimum value of the observed sum of squared residuals can be computed from the following:

$$(Y - X\beta - \lambda)'(Y - X\beta - \lambda) =]^2 \quad \text{(A2)}$$

Constrain breakpoints by bounded values so that trimming value is E =, where K is the minimum length of time the break needs to last to be called structural and define $\gamma_i = T_i/T$ $(i=1, \ldots \ldots, m)$,

$$\gamma_E = \{(\gamma_1, \ldots \ldots, \gamma_m); \geq E, \gamma_1 \geq E \quad \text{(A3)}$$

Including $\{T_j\}$ and $\{T_j\}$ and estimating coefficients for m subdivisions $(T_1, \ldots \ldots \ldots, T_m)$ for all T_j, sum of squared residuals is given by $S_T(T_1, \ldots \ldots \ldots, T_m)$ for breakpoints $(T_1, \ldots \ldots \ldots, T_m)$ as follows:

$$(T_1, \ldots \ldots \ldots, T_m) = \operatorname{argmin}(\gamma_1, \ldots \ldots, \gamma_m) \in \gamma_E S_T(T_1, \ldots \ldots \ldots, T_m) \quad \text{(A4)}$$

To test for no break versus fixed number of breaks, following F tests are computed with m=0 being no structural breaks versus m = k breaks. Thus, matrix R is given by (eq., Bai and Perron 2003):

$$(R\lambda) = (\lambda_1 - \lambda_2, \ldots \ldots \ldots, \lambda_k - \lambda_{k+1}) \quad \text{(A5)}$$

$$(R\lambda) = (\lambda_1 - \lambda_2, \ldots \ldots \ldots, \lambda_k - \lambda_{k+1}) \quad \text{(A6)}$$

In equation (A6) as shown by Bai and Perron (2003), the F-test includes () as the estimation of covariance matrix of which is consistent with serial correlations and heteroskedasticity as:

$$V() = \operatorname{plim}_{T\to 0}\left(\check{Z}' M_x \check{Z}\right)^{-1} \check{Z} M_x \Omega M_x \check{Z} \left(\check{Z} M_x \check{Z}\right)^{-1} \quad \text{(A7)}$$

where $M_x=1 - X(X'X)^{-1}X'$.

However, in the absence of autocorrelations and holding variance constant, the statistics is:

$$V() = \operatorname{plim}_{T\to\infty} T\left(\check{Z}' MxX \check{Z}\right)^{-1} \quad \text{(A8)}$$

In that case, the test is

$$\operatorname{Sup}F_T(k; q) = F_T(\gamma_1, \ldots \ldots, \gamma_k : q) \quad \text{(A9)}$$

where $(\gamma_1, \ldots \ldots, \gamma_k)$ would enable minimization of the sum of squared residuals for a given trimming value.