Interest-Rate Sensitivity of Real Estate Investment Trusts

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Abstract. **This paper addresses the issue of whether REITs are sensitive to changes in short-term and long-term interest rates. REITs were found to be sensitive to changes in the long-term interest rates in 1973–1979, but in 1980–1985, REITs were sensitive to changes in both short-term and long-term rates. The sources of interest-rate sensitivity were also found to be different for equity and mortgage REITs. Equity REITs are sensitive to changes in expected inflation, whereas mortgage REITs are sensitive to both changes in expected inflation and changes in the real rate.**

Introduction

REITs are pooled real estate funds that provide individual investors, as well as institutions, the opportunity to invest in income-producing real estate properties, mortgages, joint ventures, and other hybrid structures. In general, REITs take two forms; equity and mortgage REITs. The equity REITs specialize in the ownership of income-producing real estate properties, whereas the mortgage REITs primarily hold long-term as well as short-term construction loans, and mortgages on commercial properties.

The REIT industry grew slowly until the late 1960s. By the mid-1970s, the economic slowdown and the level of overbuilding sent the real estate industry into a severe recession. Many mortgage REITs went into bankruptcy under the burden of non-earning real estate assets. However, many of the equity-oriented trusts survived the problems of the mid-1970s. This result has been attributed to their adherence to property ownership, rather than mortgage-lending activities, and because they were reluctant to leverage with short-term, floating-rate debt.

Historically, dividend yield has always been a significant component of the return from a REIT share investment. By complying with IRS regulations, REITs are exempt from corporate income taxes if they distribute 95% of net income in the form of dividends to shareholders. By virtue of this pass-through feature, REITs generally have relatively high dividend yields, with 8.6% and 12.1% in 1985 for equity and mortgage REITs, respectively.[1] Consequently, REITs, like other high-dividend-yield stocks such as utilities, may possess a high degree of sensitivity to interest-rate fluctuations.

The objective of this paper is twofold. First, based on Merton's (1973) intertemporal capital

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asset pricing model (ICAPM), we attempt to investigate empirically whether both equity and mortgage REITs are sensitive to changes in interest rates. In the context of the ICAPM, the state variable, measured by the interest rate, describes changes in the investment opportunity set and thus becomes another pricing factor other than the traditional market factor. Second, if REITs are interest-rate sensitive, it is also important to identify the source(s) that causes the sensitivity.

The rest of the paper is organized as follows. The second section reviews the relevant literature. The third presents the regression models derived within the context of Merton's (1973) intertemporal capital asset pricing model and the testable hypotheses. The fourth section describes the data set. Empirical results are reported in section five. Concluding remarks are provided in section six.

Relevant Literature

There has been an abundant number of studies on REITs in recent years. Most of them have focused on evaluating the performance of REITs. Smith and Shulman [1976] used a CAPM framework in comparing the performance of REITs and closed-end investment funds. They found that, in general, REITs did not offer significantly better returns than closed-end funds over the period 1963–1976 when compared with the S&P 500 index. Kuhle and Walther [1986] and Kuhle, Walther and Wurtzebach [1986], however, provided evidence that REIT stocks had been a significantly better investment asset than common stocks over the time period 1977 to 1985. Burns and Epley [1982] found that the mixed-asset efficient frontier containing both REITs and stock returns was superior to both of the single-asset efficient frontiers at every risk and return level during the 1970–1979 period. Miles and Estey [1982] and Miles and McCue [1982] examined the portfolios of the REITs and compared them to those of the commingled real estate funds [CREFs] managed by insurance companies and bank trust departments. Kuhle [1987] showed that equity REIT stocks provided better benefits in portfolio risk reduction than common stocks and mortgage REIT stock over the period 1980–1985. However, the overall performance of mixed portfolios of common stock and REITs was not significantly different from that of portfolios of only common stock.

Recently, Titman and Warga [1986] analyzed the returns of REITs and examined their risk-adjusted performance using both single index (i.e., CAPM) and multiple index (i.e., the arbitrage pricing theory (APT)) models. Their findings indicated that the performance rankings of REITs were not sensitive to the risk-adjustment model, and neither the CAPM nor APT-based techniques were powerful enough to provide reliable evaluations of real estate portfolio managers.

Explicit Model and Testable Hypotheses

The following analysis is based on Merton's [1973] intertemporal capital asset pricing model:

$$E(R_t) - \alpha = \beta_1 [E(R_{mt}) - \alpha] + \beta_2 [E(R_{ht}) - \alpha], \tag{1}$$

where

$E(R_t)$ = expected return on an asset at time t;
$E(R_{mt})$ = expected return on the market portfolio at time t;

Exhibit 1
Regression Results for (3): $R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta I_t + \epsilon_t$

		Equity REITs ($n=32$)			
Sample Period	Interest Rate	β_0	β_1	β_2	R^2
	3MTB	0.0042	1.25	−11.98	0.46
		(0.69)	(7.57)**	(−0.58)	
	6MTB	0.0038	1.26	−7.31	0.46
		(0.62)	(7.44)**	(−0.35)	
1973–1979					
	1YTB	0.0032	1.29	−0.20	0.46
		(0.53)	(7.71)**	(−0.09)	
	20YTB	0.0075	1.16	−88.77	0.49
		(1.23)	(7.35)**	(−2.09)*	
	3MTB	0.0083	0.60	−15.23	0.61
		(2.24)*	(7.85)**	(−4.08)**	
	6MTB	0.0086	0.58	−18.19	0.62
		(2.31)*	(7.52)**	(−4.39)**	
1980–1985					
	1YTB	0.0088	0.57	−21.53	0.62
		(2.36)*	(7.34)**	(−4.42)**	
	20YTB	0.0087	0.63	−19.06	0.56
		(2.36)*	(7.39)**	(−2.43)*	

t–values are in parentheses.
**Significant at 99% level
*Significant at 95% level

$E(R_{ht})$ = expected return on a hedge portfolio constructed to have a covariance with each asset's return that is identical to the covariance between the *changes* in the state variable of interest and the asset's return;

α = the risk-free rate of interest; and

β_1, β_2 = multiple regression coefficients.

Equation (1) states that, in equilibrium, investors receive higher expected return for bearing market (systematic) risk and for bearing the risk of unfavorable shifts in the investment opportunity set. The ICAPM is a more generalized model because it reduces to the traditional CAPM when the investment opportunity set is constant, i.e., $\beta_2 = 0$.

To test Merton's ICAPM, Gibbons [1979; 1982] specified the following market model with the addition of a change in the state variable:

$$R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta S_t + \epsilon_t, \quad (2)$$

where ΔS_t = changes in the state variable, S, at time t and

ϵ_t = error term.

An important empirical issue associated with (2) is the selection of the appropriate state variable. Merton [1973] suggested the use of a long-term interest rate; he argued (p. 873):

The interest rate has always been an important variable in portfolio theory, general capital theory, and to practitioners. It is observable, satisfies the condition of being stochastic over time, and while it is surely not the sole determinant of yields on other assets, it is an important factor. Hence, one should interpret the effects of a changing interest rate . . . . as a single (instrumental) variable representation of shifts in the investment opportunity set.

Adopting Merton's suggestion, equation (2) consequently becomes

$$R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta I_t + \epsilon_t, \qquad (3)$$

where ΔI_t = changes in the interest rate at time t.

Following Irving Fisher [1930], the one-period interest rate, ΔI_t, observed at the end of period t can be broken into an expected inflation rate, $E\pi_t$ and an expected real rate, Er_t for the next period:

$$I_t = E\pi_t + Er_t. \qquad (4)$$

Taking the first difference in variables of (4) and substituting into (3) yields:

$$R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta E\pi_t + \beta_3 \Delta Er_t + \epsilon_t. \qquad (5)$$

The variable, ΔEr_t, deserves special attention here, because the empirical evidence of Fama [1976] and Fama and Gibbons [1982; 1984] suggests that the expected real rate is a random walk. In addition β_2 and β_3 can help detect whether interest-rate sensitivity is attributable to changes in expected inflation, changes in the expected real rate, or both.

Why are REITs likely to be sensitive to changes in expected inflation and changes in the expected real rate, respectively? We provide the following explanations and hope that they can further enhance our understanding of the effect of these variables on REITs' performance. First, higher-than-expected inflation generally results in a lower real present value of existing mortgage loans and would thus reduce the mortgage REIT's stock price. Likewise, higher inflation will also increase the equity REIT's expenses. If regulators do not allow a complete pass-through of expenses, the earnings of those REITs will be reduced.

Secondly, REITs offer higher dividend yields than the average corporation because they must pay out at least 95% of net earnings to shareholders to avoid payment of corporate income taxes. The evidence from previous studies, that REITs have performed well over past years, suggests that REITs' shareholders pay a premium for high dividends. If this premium is based on the present values of dividends, a rise in the real interest rate will reduce the present value of REITs' dividends more than other low-dividend-paying stocks.

Therefore, two testable hypotheses are as follows:

H_1: If both equity and mortgage REITs are not sensitive to changes in short-term and long-term interest rates, then β_2 in (3) is zero.

H_2: If both equity and mortgage REITs are not sensitive to changes in expected inflation and changes in the expected real rate, then β_2 and β_3 in (5) are zero.

Data

This study includes both equity and mortgage REITs listed on the NYSE and AMEX for the period of 1983–1985. The sample period is later divided into two subperiods, 1973–1979 and 1980–1985. The rationale for this division rests on the fact that the Federal Reserve

Exhibit 2
Regression Results for (3): $R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta I_t + \epsilon_t$

Mortgage REITs ($n = 22$)					
Sample Period	Interest Rate	β_0	β_1	β_2	R^2
1973–1979	3MTB	−0.0017 (−0.23)	1.40 (6.91)**	−23.78 (−0.94)	0.41
	6MTB	−0.0021 (−0.28)	1.40 (6.77)**	−19.56 (−0.76)	0.41
	1YTB	−0.0027 (−0.36)	1.43 (7.00)**	−14.13 (−0.53)	0.41
	20YTB	0.0075 (0.18)	1.33 (6.88)**	−105.93 (−2.04)*	0.43
1980–1985	3MTB	0.0073 (1.85)	0.73 (7.77)**	−20.71 (−4.76)**	0.61
	6MTB	0.0076 (1.95)	0.70 (7.40)**	−24.41 (−5.06)**	0.62
	1YTB	0.0081 (2.08)*	0.66 (7.15)**	−31.30 (−5.62)**	0.64
	20YTB	0.0094 (2.29)*	0.65 (6.70)**	−44.03 (−4.98)**	0.62

t-values are in parentheses.
**Significant at 99% level
*Significant at 95% level

changed its operating procedures in October 1979, shifting from interest-rate targeting toward money-supply targeting.

To be included in the sample, REITs must satisfy the following requirements: (1) They can be classified as either equity or mortgage REITs.[2] Company annual reports, Moody's *Bank and Finance Manual* and *Value Line Investment Survey*, are used to aid classifications; and (2) they must have a sufficiently large number of monthly returns during the same period. The sample consists of thrity-two equity REITs and twenty-two mortgage REITs. Monthly returns are obtained from the CRSP Monthly Return File. We then construct an equally weighted portfolio of equity and mortgage REITs, respectively.

For the state variable, four measures of the interest rate are used. The first measure is an index of yields on twenty-year U.S. government bonds (20YTB), because Merton [1973] suggested the use of a long-term interest rate for the state variable. In addition, we also use three short-term interest rates: Indexes of yields on three-month (3MTB), six-month (6MTB), and one-year (1YTB) U.S. T-bills, respectively. All four indexes were obtained from the database of Data Resources Incorporated (DRI).[3]

In regard to both expected inflation rates and expected real rates of interest, estimates are derived in the same manner of Fama and Gibbons [1982; 1984]. The ex post inflation rate (π_t) is the change from month t-1 to month t in the natural log of the U.S. Consumer Price Index (CPI) compiled by the Bureau of Labor Statistics. The ex post real rate (r_t) is then measured as the difference between the interest-rate measure and the ex post inflation rate. Since the differences in the expected real rates follow a first-order moving average process, Fama and

Exhibit 3
Chow Test Results for (3)

Interest Rate	Equity REITs	Mortgage REITs
3MTB	3.24*	2.79*
6MTB	2.93*	2.65*
1YTB	3.87*	2.51⁺
20YTB	5.10**	4.79**

The above F-statistics have degrees of freedom of 3 and 156.
**Significant at 99% level
*Significant at 95% level
⁺Significant at 90% level

Gibbons [1984] suggested that the expected real rate be estimated as the average of the most recent *twelve* months of ex post real rates. The expected inflation rate, thus, equals the difference between the interest-rate measure and the expected real rate.

Empirical Findings

A multiple regression analysis of equation (3) constitutes the test of the first null hypothesis. The Cochrane-Orcutt procedure is used to correct for the autocorrelation problem when necessary. Exhibits 1 and 2 report the regression results for equity and mortgage REITs, respectively, both using four interest-rate measures for two subperiods 1973–1979 and 1980–1985. As shown, β_1's are statistically significant in both panels, which indicates that the market factor is still an important factor in explaining the return-generating process of REITs. The results also suggest that, on average, the mortgage REITs are marginally riskier than the equity REITs in both subperiods. This finding is consistent with Titman and Warga [1986]. In addition, the coefficients of the market factor are generally larger in the first subperiod than those in the second subperiod for both equity and mortgage REITs. In other words, REITs, in general, had lower market risk in 1980–1985 than in 1973–1979.

The second factor, changes in the interest rate, seems to be an additional factor in explaining the return-generating process of REITs in 1980–1985. The coefficients on ΔI are negative and statistically significant, with t-statistics greater than 4.0 for both equity and mortgage REITs portfolios. Therefore, the null hypothesis, that the coefficient of ΔI is zero, can be rejected. Both equity and mortgage REITs were shown to be interest-rate sensitive, and provided a poor hedge against both unfavorable short-term and long-term interest-rate movements in 1980–1985. For the subperiod 1973–1979, however, the coefficients on ΔI were statistically insignificant except for the long-term interest-rate measure. This finding implies that REITs, in general, were sensitive only to unfavorable *long-term* interest-rate movements in 1973–1979. The differences in finding between the two subperiods may be attributed to the fact that the Federal Reserve changed its policy orientation toward reserves and the monetary aggregates in 1979. Some observers believed that the Federal Reserve policy, targeting monetary aggregates instead of interest rates, was the most probable reason for increased volatility in all types of economic behavior since 1980.[4]

In addition, the absolute magnitudes of β_2's for the equity REIT portfolio are generally smaller than its mortgage counterpart. This finding is consistent with the fundamental characteristics of REITs in that the equity REITs, in general, are less sensitive to changes in

Exhibit 4
Regression Results for (5): $R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta E\pi_t + \beta_3 \Delta Er_t + \epsilon_t$

Equity Reits ($n = 32$)						
Sample Period	Interest Rate	β_0	β_1	β_2	β_3	R^2
	3MTB	0.0037	1.26	−12.02	−9.49	0.46
		(0.62)	(7.59)**	(−0.58)	(−0.45)	
	6MTB	0.0033	1.27	(−7.60	−5.08	0.46
		(0.54)	(7.46)**	(−0.36)	(−0.24)	
1973–1979						
	1YTB	0.0028	1.29	−1.15	−1.34	0.46
		(0.46)	(7.73)**	(−0.53)	(−0.62)	
	20YTB	0.0071	1.17	−91.74	−88.66	0.49
		(1.16)	(7.39)**	(−2.15)*	(−2.09)*	
	3MTB	0.0084	0.60	−15.31	−16.06	0.61
		(2.18)*	(7.73)**	(−4.02)**	(−1.42)	
	6MTB	0.0086	0.58	18.21	−18.42	0.62
		(2.24)*	(7.43)**	(−4.33)**	(−1.63)	
1980–1985						
	1YTB	0.0086	0.57	−21.35	−19.37	0.62
		(2.24)*	(7.30)**	(−4.35)**	(−1.72)	
	20YTB	0.0079	0.64	−18.87	13.15	0.56
		(2.06)*	(7.42)**	(−2.41)*	(−1.06)	

t-values are in parentheses.
**Significant at 99% level
*Significant at 95% level

interest rates than the mortgage REITs are.[5] To better explain the differing sensitivities, we adopt the concept of effective duration. In fact, duration is a measure of the reaction of asset value to changes in interest rates. It is a function of the value and timing of future cash flows. A longer duration implies a higher degree of sensitivity to changes in interest rates. According to Hartzell et al. [1987], the effective duration of real estate is a function of lease structures. For most equity REITs, lease terms, extending from three to five years, are reset every few years to reflect prevailing market conditions. Accordingly, new adjustments are expected to reflect changes in inflation and interest rates. On the contrary, mortgage REITs tend to have a *longer* duration than the equity counterparts do. With the underlying mortgage terms having maturities of ten years or more, the response of the income streams of the mortgage REITs, to changing interest rates, is heavily dampened.

Overall, the results from Exhibits 1 and 2 seem to imply that there is a structural change in equation (3) between the two subperiods 1973–1979 and 1980–1985. For confirmation, we use a Chow test. Exhibit 3 confirms our conjecture that the model structure of equation (3) has shifted between the two subperiods. This finding was not a surprise, because we have detected, from Exhibits 1 and 2, that the coefficients on R_m declined significantly from subperiod 1 to subperiod 2 and the coefficients on ΔI turned significant in subperiod 2.

The preceding findings indicate that the REITs were interest-rate sensitive in 1980–1985. The following analysis is aimed to identify the source(s) of interest-rate sensitivity. Tests of equation (5) constitute the test of the second null hypothesis. The regression results are presented in Exhibits 4 and 5.

Exhibit 5
Regression Results for (5): $R_t = \beta_0 + \beta_1 R_{mt} + \beta_2 \Delta E\pi_t + \beta_3 \Delta Er_t + \epsilon_t$

		Mortgage REITs ($n=22$)				
Sample Period	Interest Rate	β_0	β_1	β_2	β_3	R^2
	3MTB	−0.0020	1.40	− 23.71	− 22.48	0.41
		(−0.26)	(6.87)**	(−0.93)	(−0.87)	
	6MTB	−0.0024	1.41	− 19.64	− 18.34	0.41
		(−0.31)	(6.74)**	(−0.76)	(−0.69)	
1973–1979	1YTB	−0.0030	1.44	− 14.61	− 13.17	0.41
		(−0.39)	(6.97)**	(−0.54)	(−0.49)	
	20YTB	0.0010	1.34	−107.97	−105.91	0.43
		(1.14)	(6.88)**	(−2.05)*	(−2.02)*	
	3MTB	0.0078	0.72	− 21.02	− 26.13	0.61
		(1.87)	(7.54)**	(−4.73)**	(−2.00)*	
	6MTB	0.0079	0.69	− 24.60	− 27.82	0.62
		(1.93)	(7.23)**	(−5.02)**	(−2.14)*	
1980–1985	1YTB	0.0081	0.66	− 31.31	− 31.38	0.64
		(2.00)*	(7.06)**	(−5.57)**	(−2.46)**	
	20YTB	0.0090	0.65	− 43.95	− 40.68	0.62
		(2.08)*	(6.67)**	(−4.96)**	(−2.92)**	

t-values are in parentheses.
** Significant at 99% level
* Significant at 95% level

For the equity REIT portfolio, the coefficients on $\Delta E\pi$ are negative and statistically significant across all interest-rate measures; whereas the coefficients on ΔEr were statistically insignificant for all but the long-term interest-rate measure in 1973–1979. The results in Exhibit 4 provide two implications. First, the sensitivity of the equity REIT portfolio to unfavorable long-term interest-rate movements in 1973–1979 was due to changes in expected inflation and changes in the expected real rate. Second, the source of the interest-rate sensitivity in 1980–1985 originated primarily from changes in expected inflation. This can be construed to mean that the equity REITs, in general, provided a poor hedge against changes in expected inflation in 1980–1985.[6]

In regard to the mortgage REIT portfolio, similar results were found in Exhibit 5 for the 1973–1979 subperiod. But, for the 1980–1985 subperiod, the interest-rate sensitivity of the mortgage REITs emerged from two sources: Changes in expected inflation and changes in the expected real rate. This latter finding also characterizes differences in mortgage REITs and equity REITs.

We also use the Chow test to investigate whether there is any structural change in equation (5) between 1973–1979 and 1980–1985. The *F*-statistics are reported in Exhibit 6. Not surprisingly, significant structural changes are detected for both REIT portfolios.

Conclusion

In this study, return data on equity and mortgage REITs are used to investigate the effect of changes in short-term and long-term interest rates on the return-generating process of REITs. Merton's [1973] intertemporal capital asset pricing model is used as the base model. The results show that both equity and mortgage REITs were sensitive to changes in the *long-*

Exhibit 6
Chow Test Results for (5)

Interest Rate	Equity REITs	Mortgage REITs
3MTB	2.45*	2.10⁺
6MTB	2.52*	2.17⁺
1YTB	2.66*	2.43*
20YTB	3.62**	3.96**

The above F-statistics have degrees of freedom of 4 and 156.
** Significant at 99% level
* Significant at 95% level
⁺ Significant at 90% level

term interest rates and changes in expected inflation in 1973–1979. For the subperiod 1980–1985, both equity and mortgage REITs were sensitive to changing short–term as well as long–term interest rates. The sources, however, differ. The equity REITs are sensitive only to changes in expected inflation; whereas the mortgage REITs are sensitive to both changes in expected inflation and changes in the real rate. Our results also indicate that the model structure for REITs, in general, shifts between the two subperiods 1973–1979 and 1980–1985.

Notes

[1]See *REIT Fact Book*, 1986, p. 37.
[2]According to the National Association of Real Estate Investment Trusts (NAREIT), equity REITs hold at least 75% of their invested assets in the ownership of real estate or other equity interest, whereas mortgage REITs hold at least 75% of their invested assets in mortgages secured by real estate.
[3]Given the definitions of the state variable, the first difference of each interest–rate series must be white noise to be consistent with the assumptions of Merton [1973], i.e., $E(\Delta I_t) = 0$ and $E(\Delta I_t \cdot \Delta I_{t-j}) = 0$ for all $j \neq 0$. ARIMA models of four measures for the period 1980–1985 support these restrictions.
[4]See, for example, Palash and Radecki [1985].
[5]Recently, Mengden [1988] also found that Mortgage REIT dividend yields were much more positively related to movements in interest rates than the dividend yields on equity REITs were in 1980–1987.
[6]We also add changes in unexpected inflation as an additional independent variable, but the regression coefficients are insignificantly negative for both REITs.

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