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The Inflation-Hedging Properties of Risk Assets: The Case of REITs

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Abstract. **This study examines the inflation-hedging abilities of REITs over the period 1972:2-1992:12 to determine whether REITs act as a hedge against expected and/or unexpected inflation. The time period used in this study is substantially longer than in earlier studies. A model of real estate returns is derived that has components for expected and unexpected returns and allows for variation in the real return on risky assets. The results indicate that REITs provide some hedging capability against expected inflation, but act as perverse hedges against unexpected inflation. These results are robust with respect to time period studied, measure of expected inflation and proxy for the market portfolio, indicating that the apparent perverse hedging property of real estate investments is not due to methodological problems.**

Introduction

One objective of investors holding investments is to protect wealth against inflation. Considerable work has been done examining the ability of both financial and real assets to act as hedges against inflation. During periods of high inflation, it has been observed that certain financial instruments not only do not protect the investor against changes in the price level, but actually perform as perverse hedges. That is, they decrease in value as inflation increases.

Many studies have noted the existence of a perverse hedging property for domestic common stock (see Nelson, 1976 and Stulz ,1986, among others) and foreign equities (for example, Gultekin, 1983 and Mandelker and Tandon, 1985). On the other hand, real estate has been found to be a partial hedge against some inflation measures (Fama and Schwert, 1977; Fogler, Granito and Smith, 1985; Hartzell, Heckman and Miles, 1987; Rubens, Bond and Webb, 1989).

Since the findings for some real estate studies have been criticized due to an appraisal smoothing bias (Gyourko and Linneman, 1988) in the data, a logical progression would be to use market data from publicly traded Real Estate Investment Trusts (REITs) instead of appraised values. Publicly traded REIT returns reflect the value of the income and price appreciation components of the underlying assets, determined in a market that adjusts rapidly to changes in information or expectations. A number of studies have analyzed the hedging effectiveness of REITs (including Murphy and Kleiman, 1989 and Park, Mullineaux and Chew, 1990), but the most recent (by Goebel and Kim, 1989) only goes through 1987, one year after the passage of the Tax Reform Act of 1986, which severely restricted the deductibility of real estate losses and had a major impact on real

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estate markets. This study updates Goebel and Kim through 1992 and, more significantly, allows the *real* return of the market portfolio to vary.

The purpose of this study is to determine the inflation-hedging abilities of REITs over the period 1972:2 through 1992:12 for expected inflation and/or unexpected inflation. The time extension takes on great importance considering the significant changes in the stock market and interest rates over the 1988 – 1992 period. In addition, previous studies suffer from either too narrow a focus or from other methodological problems.

Review of the Literature

Until the latter half of the 1970s, it was assumed that common stock returns would vary directly with increases in inflation. This argument stems from the pioneering work of Fisher (1930) and Williams (1938). Fisher noted that the nominal rate of interest equalled the real rate of interest plus an expected inflation premium. Thus, it was expected that the nominal rate would incorporate the best possible estimate of future inflation. Fisher's work, along with that of Williams (1938), which sorted out some of the effects of anticipated and unanticipated inflation upon the market value of common stocks, led early researchers to conclude that stock prices adjusted for inflation.

This conclusion was initially challenged in a series of empirical papers by Bodie (1976), Jaffe and Mandelker (1976) and Nelson (1976). All three papers concluded that both nominal and real holding period returns for corporate equities were negatively and significantly related to the inflation rate. The time frame analyzed in these studies was from 1953:1 through 1974:6.

Fama and Schwert (1977) tested the effectiveness of Treasury bills, government bonds, real estate, corporate bonds, labor income and common stocks as hedges against both expected and unexpected inflation. They concluded only residential real estate is a complete hedge against both expected and unexpected inflation. However, of particular interest to this study are the articles by Hasbrouck (1983) and Gultekin (1983), since they are representative of the small number of research efforts that have used the Livingston data as a proxy for expected inflation (which will be one of the measures of expected inflation used in this study). Gultekin used the Livingston data to examine the Fisher effect on common stock returns from 1952:06 to 1979:12. His emphasis, however, was on the value of the Livingston data in predicting expected levels of inflation and stock returns while this study uses the survey data to estimate hedging effectiveness of REITs. Hasbrouck examined the relationship of inflation and common stock returns from 1953:05 to 1979:05 and agreed with Gultekin that unexpected inflation, not expected inflation, explained the negative relationship between the two measures.

Studies involving the use of real estate as an inflation hedge are more encouraging. Fogler et al. (1985) examined two possible explanations for the positive relationship between real estate and inflation. The first was that it is the result of a true high positive correlation between the two factors. Second was that it was the result of changing investor expectations concerning the effectiveness of real estate as an inflation hedge. They found limited support for the first explanation, but not enough to reject the second. Their data was the Census Bureau quarterly price index of new single-family homes sold, which is of questionable value since it only considers gains in appreciation and new home sales. Thus, it omits income returns and the existing stock of residential real estate.

Hartzell et al. (1987) perform two tests to examine the hedging effectiveness of a

commingled real estate fund (CREF) using data from 1973 through 1983. Both tests involve using Treasury bill rates as the basis for expected inflation. One test is based upon Fama and Schwert (1977), while the other involves using a non-constant real rate which moves according to an integrated moving average process. Further, they construct portfolios consisting of real estate and government bonds to examine the benefits of including real estate in inflation-hedging portfolios. They find that commercial real estate acts as a complete hedge against both expected and unexpected inflation.

Rubens et al. (1989) examine the inflation-hedging effectiveness of three types of real estate (residential, commercial, farmland) and four financial instruments as both individual assets and parts of portfolios. They found that all three types of real estate provide at least partial hedges and improve the hedging effectiveness of portfolios in which real estate is included. This perceived inflation–hedging effectiveness of real estate has been attributed to appraisal–smoothed biases in the data. Such biases have been thoroughly discussed by others including Geltner (1991) and Giaccotto and Clapp (1992). Geltner (1991) notes that only when such returns are corrected for smoothing bias can the risk characteristics of commercial real estate be examined with a considerable degree of confidence in the results.

Evidence on the ability of REITs to hedge against inflation is mixed. Chen and Tzang (1988) find that both equity and mortgage REITs show some hedging ability against expected inflation. Murphy and Kleiman (1989) examine REIT returns and find that, over short periods of time, equity REITs act as a perverse hedge against both expected and unexpected inflation. Chan et al. (1990) note this perverse relationship only against unexpected inflation. Gyourko and Linneman (1988) find REIT returns do provide a "moderate hedge " against actual inflation (adjusted by subtracting out the Home Purchase Price component of the CPI) and expected inflation, but a perverse hedge against unexpected inflation.

Park et al. (1990) use two measures of expected inflation, a generalized Fisher equation from Fama (1975) and another from the Livingston Price Expectations (LPE) series. They find that REITs generally exhibit the same perverse hedging characteristics as common stock, although REITs appeared to be a partial hedge against anticipated inflation when using the LPE series. Like earlier work however, their model assumed that the real return earned by an asset was constant.

Development of the Model and Sources of the Data

Fisher (1930) noted that the nominal rate of interest is comprised of an appropriate equilibrium real interest rate and an expected inflation premium. For example, consider a nominally risk–free asset. Formally:

$$E(R_{f,t}|\phi_{t-1}) = E(r_{f,t}|\phi_{t-1}) + E(\pi_t|\phi_{t-1}) \,, \tag{1}$$

where

$E(R_{f,t}|\phi_{t-1})$ = the expected nominal return from t–1 to t given the information available at time t–1 for the risk–free asset,

$E(r_{f,t}|\phi_{t-1})$ = the expected real return from t–1 to t given the information available at time t–1 for the risk–free asset, and

$E(\pi_t|\phi_{t-1})$ = the expected rate of inflation between period t–1 and period t.

Fama and Schwert (1977) and others extend the Fisher relationship to risk assets. In their approach,

$$E(R_{i,t}|\phi_{t-1}) = E(r_{i,t}|\phi_{t-1}) + E(\pi_t|\phi_{t-1}) , \tag{2}$$

where

$E(R_{i,t}|\phi_{t-1})$ = the expected nominal return from t–1 to t given the information available at time t–1 for risk asset i,
$E(r_{i,t}|\phi_{t-1})$ = the expected real return from t–1 to t given the information available at time t–1 for risk asset i, and
$E(\pi_t|\phi_{t-1})$ = the expected rate of inflation between period t–1 and period t.

Implicit in this model is the notion that the real return on the risk asset (which compensates the investor for risk) is *independent* of the level of expected inflation. But intuition tells us that this is likely not the case. The notion of "flight to quality" in investments is a reflection that investors shift to less risky assets during volatile economic times. During periods of high inflation or disinflation, investors may become more risk averse, and expect higher real returns on risk assets. For example, suppose the expected real return to the market portfolio (a bundle of risky assets) is conditional on inflationary expectations, i.e.,

$$E(R_{m,t}|\phi_{t-1}) = E[r_{m,t}|E(\pi_t|\phi_{t-1})] + E(\pi_t|\phi_{t-1}) , \tag{3}$$

where

$E(R_{m,t}|\phi_{t-1})$ = the expected nominal return from t–1 to t given the information available at time t–1 for the market portfolio,
$E[r_{m,t}|E(\pi_t|\phi_{t-1})]$ = the expected real return from t–1 to t conditional on expected inflation given the information available at time t–1 for the market portfolio.

The Sharpe/Lintner Capital Asset Pricing Model is a basic risk/return model in finance. In this model, the return (ex ante) to an asset is a linear combination of the risk–free rate of interest and the market risk premium, adjusted for the systematic risk of the asset. That is,

$$E(R_i|\phi_{t-1}) = E[R_{f,t}|\phi_{t-1})] + \beta_i[E(R_m|\phi_{t-1}) - E(R_{f,t}|\phi_{t-1})] , \tag{4}$$

where

$E(R_{m,t}|\phi_{t-1})$ = the expected return to the market portfolio,
$E(R_{f,t}|\phi_{t-1})$ = the nominal expected return to the risk–free asset, and
β_i = a measure of systematic risk of asset i.

Suppose that the return to the nominally risk–free asset is determined according to equation (1) and the expected return to the market is determined according to equation (3). Then,

$$E(R_{i,t}|\phi_{t-1}) = E(r_f|\phi_{t-1}) + E(\pi_t|\phi_{t-1}) + \beta_i[E[r_{m,t}|E(\pi_t|\phi_{t-1})] + E(\pi_t|\phi_{t-1}) - E(r_{f,t}|\phi_{t-1}) - E(\pi_t|\phi_{t-1})] . \quad (5)$$

Collecting terms,

$$E(R_i|\phi_{t-1}) = (1-\beta_i)E(r_{f,t}|\phi_{t-1}) + E(\pi_t|\phi_{t-1}) + \beta_i[E[r_{m,t}|E(\pi_t|\phi_{t-1})]] . \quad (6)$$

Note that equation (6) is identical to equation (1) if $\beta = 0$. Under the assumption that the expected real return to the market is, on average, realized, equation (6) can be tested (as in Fama and Schwert) in the following form:

$$R_{i,t} = \gamma_o + \beta_{E(INFL)}\pi_t^e + \beta_{U(INFL)}(\pi_t - \pi_t^e) + \beta_{MKT}r_{m,t} + \epsilon_t , \quad (7)$$

where

π_t^e = expected inflation for time period t,
π_t = actual inflation in time period t,
$r_{m,t}$ = realized real return to the market portfolio ($R_{m,t}-\pi_t$), and
ϵ_t = a white noise error term.

If $\beta_{E(INFL)} = 1$, the asset is a perfect hedge against expected inflation. If $\beta_{U(INFL)}= 1$, the asset is a perfect hedge against unexpected inflation, and if $\beta_{E(INFL)} = \beta_{U(INFL)} = 1$, the asset is a perfect hedge against all inflation. The model presented here expands on that of Park et al. (1990) by allowing the real return to the market portfolio to vary. Failure to account for potential variability in the real return on risky assets may account for the apparent perverse hedging properties of real estate. If, for example, investors become *more* risk averse during periods of high inflation or disinflation and demand correspondingly higher real returns on risky assets, the correlation between expected inflation and the real market rate of return that is unaccounted for in Park et al. (1990) may result in biased coefficients for inflation. This bias may be sufficiently large to suggest perverse hedging properties for real estate, even though none exist!

There does not appear to be a consensus on the best method to estimate inflationary expectations. Both survey-based data (such as the Livingston data) and data generated from time–series models appear to be acceptable proxies for the expected inflation rate. The merits of each approach have been well developed in studies by Menil and Bhalla (1975), Carlson and Parkin (1975), Carlson (1977), and Mullineaux (1980). In addition, Fama and Schwert (1977) provide a useful framework for testing the hedging effectiveness of various financial assets against both expected and unexpected inflation. Assuming that Treasury bills are perfectly liquid, they use the rate on bills as a proxy for the expected rate of inflation. Their measure of unexpected inflation is merely the difference between actual inflation and the bill rate, as calculated on an ex post basis.

This study analyzes the hedging effectiveness of REITS against expected inflation and/or unexpected inflation over the 1972:02 to 1992:12 period. In addition, two subperiods are also examined to assess the sensitivity of the results to inflation levels. During the 1972:02 through 1981:12 subperiod, inflation rates were relatively high compared to those in the 1982:01 through 1992:12 subperiod. The CPI is used as the

measure of actual inflation. Several different series are used as measures of expected inflation, including Livingston forecasts, time-series predictions, and short-term interest-rate forecasts.

The time-series predictions are generated using an AR(1) model. Residuals from this model are relatively well behaved. Each forecast is based on a model estimated from the entire preceding time series of CPI rates. For example, the 1972.02 forecast is based on the previous eighty months of CPI data, the 1972.03 forecast on a model estimated with the previous eighty-one months of data, and so on.

Monthly inflation rates and short-term interest rates were taken from the CRSP SBBI file. The holding period return on the Treasury bills was used as the measure of short-term interest rates. Monthly returns on both the value-weighted and the equally weighted NYSE and AMEX were taken from the CRSP indices file, adjusted for inflation using the CPI, and used as measures of the realized real return on the market portfolio.

The Livingston data are available with both six-month and one-year forecasts of CPI levels. This study used both the six-month and the one-year forecasts to generate two series of implied monthly inflation rates. Monthly inflation rates from the Livingston series were calculated by deannualizing the six-month and one-year inflation rates to reflect the one-month time interval used for calculating returns.

REIT returns were generated from the NAREIT Share Price index. Index levels are reported for all REITS, as well as for equity REITS, mortgage REITS and hybrid REITS. The hedging properties of each of these indices is explored in this study.

Results

Exhibit 1 shows the descriptive statistics for all variables analyzed. Reflecting the bull market in the 1980s, both market indices reveal impressive gains only in the latter time period. The abysmal performance of REITs, with the exception of equity REITs, is immediately apparent. Also noteworthy is the differing performance levels of REIT types

Exhibit 1
Monthly Means and Standard Deviation

	1972–1992		1972–1981		1982–1992	
Variable	Mean	σ	Mean	σ	Mean	σ
All REITS	–.007%	4.72%	–.051%	5.98%	.033%	3.21%
Equity REITS	.353	4.02	.281	4.73	.419	3.27
Mortgage REITS	–.511	5.66	–.486	7.18	–.534	3.83
Hybrid REITS	–.063	5.91	.169	7.50	–.271	3.99
Real Value–Weighted Market Index	.524	4.73	–.021	4.86	1.015	4.58
Real Equal–Weighted Market Index	.727	6.07	.498	6.98	.934	5.15
CPI	.496	.35	.697	.34	.314	.25
AR(1) Forecast	.470	.20	.570	.20	.380	.16
Livingston six-month	.578	.21	.700	.24	.468	.09
Livingston one-year	.522	.17	.618	.19	.437	.08
Treasury bills	.607	.23	.629	.27	.587	.18

between the two subperiods. Equity REITs performed better in the more recent ("low inflation") subperiod while mortgage and hybrid REITs performed better in the first ("high inflation") subperiod, thus obfuscating REIT performance against actual inflation.

As investors make decisions based upon estimates of future economic conditions, it is appropriate to examine REIT return performance given an information set containing estimates of expected inflation. As noted above, four estimates for expected inflation are

Exhibit 2
Summary of Results for Equation 7

	All REITs		Equity REITs		Mortgage REITs		Hybrid REITs	
	E(INF)	U(INF)	E(INF)	U(INF)	E(INF)	U(INF)	E(INF)	U(INF)
				Market Value Index				
AR(1) model with MV index								
1972:02 – 1992:12	P	N*	N	N*	P	N*	P	N*
1972:02 – 1981:12	P	N*	N	N	P	P	P	N
1982:01 – 1992:12	N*	N*	N*	N*	N*	N*	N	N*
6 months LIV with MV index								
1972:02 – 1992:12	P	N*	P	N*	P	N*	P	N*
1972:02 – 1981:12	P	N	N	N	P	N	P	N
1982:01 – 1992:12	P	N*	N	N*	P	N*	N	N*
12 months LIV with MV index								
1972:02 – 1992:12	P	N*	P	N*	P	N*	P*	N*
1972:02 – 1981:12	P	N*	P	N	P	N	P	N
1982:01 – 1992:12	P	N*	P	N*	P	N*	N	N*
T–bills proxy with MV index								
1972:02 – 1992:12	N	N*	N*	N*	P	N*	P	N
1972:02 – 1981:12	N	N	N	N	P	N	P	N
1982:01 – 1992:12	N*	N*	N*	N*	N	N*	N*	N*
				Equal-Weighted Index				
AR(1) model with EW index								
1972:02 – 1992:12	P	N*	N*	N*	P	N*	P	N*
1972:02 – 1981:12	P	N*	N	N	P	N	P	N
1982:01 – 1992:12	N*	N*	N*	N*	N*	N*	N	N*
6 months LIV with EW index								
1972:02 – 1992:12	P	P	N*	N*	P	N*	P	N*
1972:02 – 1981:12	N	N	N	N	N	N	N	N
1982:01 – 1992:12	P	N*	P	N*	P	N*	N	N*
12 months LIV with EW index								
1972:02 – 1992:12	P	N*	N	N*	P	N*	P	N*
1972:02 – 1981:12	N	N	N	N	N	N	N	N
1982:01 – 1992:12	P	N*	P	N*	P	N*	N	N*
T–bills proxy with EW index								
1972:02 – 1992:12	P	N*	N*	N*	P	N*	P	N
1972:02 – 1981:12	N	N	N*	N	P	N	P	N
1982:01 – 1992:12	N	N*	N	N*	P	N*	N	N*

Note: P = Positive but statistically insignificant
P* = Positive significant
N = Negative but statistically insignificant
N* = Negative significant

used, six- and twelve-month Livingston forecasts, time–series predictions using an AR(1) model, and short–term interest-rate (in this case, Treasury bill) forecasts. The inflation-hedging effectiveness of REIT returns is analyzed using each measure of expected inflation (equation (7)) and with both the market–value and equal–weighted index. The results are summarized in Exhibit 2 with detailed results contained in Exhibits 3 through 10.

Several salient relationships are revealed in Exhibit 2. First, as noted by Gyourko and Linneman (1988), REITs tend to mirror equity results against expected and unexpected inflation. Hedging effectiveness was mixed for both inflation components, but performance was markedly worse against unexpected inflation, the same conclusion as Gultekin (1983). Second, in nearly all instances, REIT returns acted as a perverse hedge against unexpected inflation, as noted by Park et al. (1990). The only positive *beta* estimates were associated with expected inflation.

Exhibits 3 through 10 report the estimates of equation 7 using each of the four measures of expected inflation and the real return for two market indices (the CRSP market value-weighted index and the CRSP equally weighted index). In all cases, β_{MKT}, which estimates systematic risk relative to changes in the real market return, is positive and highly significant. Regressions using the CRSP equally weighted index as a market proxy have slightly higher adjusted R^2s. However, the performance of this index is skewed toward smaller firms and the higher R^2 may reflect a "small firm" effect for REITs (see McIntosh et al., 1991).

Generally, the coefficients on expected inflation are positive and near 1, especially in the case of mortgage REITs. This indicates that REITs offered some hedging potential against expected inflation. However, the coefficients of unexpected inflation are negative, and most are significantly different from 1. The results are strikingly different between the two time periods studied. In the high inflation period (1972:02–1981:12), the hypotheses that the coefficients on unexpected inflation were equal to 1 (indicating perfect hedging capability) could not be rejected for equity, mortgage, or hybrid REITs, primarily because of the large standard errors. In the low inflation period, the hypothesis that REITs were a perfect hedge against unexpected inflation was rejected in *all* cases. The consistent negative signs in both subperiods indicate that real estate values fell as unexpected inflation increased.

The results were remarkably robust irrespective of the type of REIT returns or the measure of expected inflation utilized. The twenty-one-year time period analyzed encompasses a wide range of economic scenarios (with respect to growth in GNP and inflation levels), but little variation is found in the direction or significance of the estimators. With the exception of the Treasury bill proxy for expected inflation, the other expected inflation measures yielded nearly identical results. This may be due to the inadequacy of Treasury bills as a measure of expected inflation. Although differences exist between the Treasury bill and other measures of expected inflation, the results were not substantially different. As noted by Nelson and Schwert (1977), Fama (1975) failed to adequately account for the variability in expected real rates when performing his analysis.

Exhibit 3
Results for Expected and Unexpected Inflation Measures with AR(1) Model Forecasts as Proxy for Expected Inflation and Market Value–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
		1972:02 – 1992:12			
All REITs	–.0084	1.1025	–1.1718	.6608	.45
Std Error	.0057	1.0996	.8295	.0486	
t (β = 1)	–.0932	–2.6182***			
Equity REITs	.0031	–.5181	–.2114	.5531	.43
Std Error	.0049	.9601	.7243	.0424	
t (β = 1)	–1.5812	–1.6725*			
Mortgage REITs	–.0145	1.3086	–1.2354	.6732	.33
Std Error	.0075	1.4662	1.1060	.0648	
t (β = 1)	.2105	–2.0212**			
Hybrid REITs	–.0192	3.2224	–1.6779	.7319	.36
Std Error	.0077	1.4905	1.1244	.0658	
t (β = 1)	1.4910	–2.3816***			
		1972:02 – 1981:12			
All REITs	–.0054	1.2614	–1.6473	.8343	.49
Std Error	.0122	1.9725	1.4546	.0856	
t (β = 1)	.1325	–1.8200*			
Equity REITs	.0063	–.4341	–.6741	.6205	.41
Std Error	.0104	1.6820	1.2404	.0731	
t (β = 1)	–.8526	–1.3496			
Mortgage REITs	–.0111	1.5322	1.8491	.8975	.39
Std Error	.0159	2.5931	1.9123	.0731	
t (β = 1)	.2052	.4440			
Hybrid REITs	–.0086	2.3226	–2.1304	.9643	.42
Std Error	.0163	2.9399	1.9468	.1146	
t (β = 1)	.5010	–1.6080			
		1982:01 – 1992:12			
All REITs	.0055	–2.8204	–1.3247	.4601	.49
Std Error	.0055	1.3452	.9111	.0454	
t (β = 1)	–2.8400***	–2.5515***			
Equity REITs	.0125	–3.5618	–.7429	.4636	.49
Std Error	.0056	1.3706	.9282	.0463	
t (β = 1)	–3.3283***	–1.8777*			
Mortgage REITs	.0029	–3.4914	–1.2728	.4151	.29
Std Error	.0077	1.8967	1.2845	.0641	
t (β = 1)	–2.3680***	–1.7694*			
Hybrid REITs	–.0063	–.6967	–2.0951	.4779	.32
Std Error	.0079	1.9309	1.3076	.0652	
t (β = 1)	–.8787	–2.3670			

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 4
Results for Expected and Unexpected Inflation Measures with AR(1) Model Forecasts as Proxy for Expected Inflation and Equal–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
		1972:02 – 1992:12			
All REITs	.0089	1.0125	–1.2256	.6142	.64
Std Error	.0046	.8855	.6624	.0301	
t (β = 1)		.0141	–3.3599***		
Equity REITs	.0033	–.6733	–.3905	.4847	.55
Std Error	.0044	.8522	.6375	.0289	
t (β = 1)		–1.9635*	–2.1812**		
Mortgage REITs	–.0158	1.3071	–1.1387	.6589	.51
Std Error	.0064	1.2468	.9327	.0424	
t (β = 1)		.2468	–2.2930**		
Hybrid REITs	–.0199	3.1392	–1.7096	.6864	.52
Std Error	.0066	1.2911	.9658	.0439	
t (β = 1)		1.6569	–2.8055***		
		1972:02 – 1981:12			
All REITs	–.0087	1.1073	–1.2411	.6894	.67
Std Error	.0097	1.5784	1.1524	.0473	
t (β = 1)		.0680	–1.9447*		
Equity REITs	.0042	–.5461	–.5435	.4897	.52
Std Error	.0093	1.5097	1.1022	.0452	
t (β = 1)		–1.0241	–1.4004		
Mortgage REITs	–.0149	1.3635	–1.2149	.7681	.57
Std Error	.0134	2.1717	1.5856	.0650	
t (β = 1)		.1674	–1.3969		
Hybrid REITs	–.0124	2.1443	–1.6476	.7986	.58
Std Error	.0139	2.2521	1.6443	.0664	
t (β = 1)		.5081	–1.6102		
		1982:01 – 1992:12			
All REITs	.0004	–1.4258	–1.4442	.4696	.61
Std Error	.0049	1.2008	.7955	.0359	
t (β = 1)		–2.0202**	–3.0725***		
Equity REITs	.0081	–2.2911	–.9065	.4601	.58
Std Error	.0052	1.2706	.8417	.0379	
t (β = 1)		–2.5902***	–2.2651**		
Mortgage REITs	–.0029	–1.9593	–1.2928	.4505	.40
Std Error	.0072	1.7791	1.1785	.0532	
t (β = 1)		–1.6634*	–1.9455*		
Hybrid REITs	–.0114	.7173	–2.2304	.4845	.40
Std Error	.0075	1.8495	1.2252	.0553	
t (β = 1)		–.1529	–2.6366***		

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 5
Results for Expected and Unexpected Inflation Measures with Six-Month Livingston Forecast as Proxy for Expected Inflation and Market Value–Weighted index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
		1972:02 – 1992:12			
All REITs	–.0139	1.6259	–1.3612	.6449	.46
Std Error	.0064	1.0481	.7785	.0489	
t (β = 1)		.5972	–3.0330***		
Equity REITs	–.0036	.6233	–.8145	.5427	.43
Std Error	.0056	.9177	.6816	.0428	
t (β = 1)		–.4105	–2.6621***		
Mortgage REITs	–.0211	1.9501	–1.4764	.6549	.33
Std Error	.0086	1.3994	1.0395	.0653	
t (β = 1)		.6789	–2.3823***		
Hybrid REITs	–.0222	2.8884	–1.3279	.7129	.36
Std Error	.0088	1.4311	1.0631	.0668	
t (β = 1)		1.3195	–2.1897**		
		1972:02 – 1981:12			
All REITs	–.0039	.4983	–1.1804	.8355	.49
Std Error	.0129	1.7591	1.3451	.0869	
t (β = 1)		–.2852	–1.6210		
Equity REITs	.0054	–.3588	–.6996	.6182	.41
Std Error	.0109	1.4954	1.1433	.0739	
t (β = 1)		–.9087	–1.4866		
Mortgage REITs	–.0065	.2616	–1.1286	.9056	.39
Std Error	.0169	2.3143	1.7694	.1144	
t (β = 1)		–.3191	–1.2030		
Hybrid REITs	–.0062	1.1488	–1.4129	.9663	.42
Std Error	.0173	2.3567	1.8018	.1165	
t (β = 1)		.0631	–1.3392		
		1982:01 – 1992:12			
All REITs	–.0074	.0559	–1.8061	.4657	.49
Std Error	.0106	2.2540	.8512	.0451	
t (β = 1)		–.4189	–3.2966***		
Equity REITs	–.0023	–.1536	–1.5285	.4746	.48
Std Error	.0109	2.3241	.8776	.0465	
t (β = 1)		–.4964	–2.8812***		
Mortgage REITs	–.0223	2.0389	–2.0633	.4232	.29
Std Error	.0148	3.1668	1.1959	.0634	
t (β = 1)		.3281	–2.5615***		
Hybrid REITs	–.0071	–.6821	–1.8084	.4723	.32
Std Error	.0151	3.2343	1.2213	.0648	
t (β = 1)		–.5201	–2.2995**		

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 6
Results for Expected and Unexpected Inflation Measures with Six-Month Livingston Forecast as Proxy for Expected Inflation and Equal–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
			1972:02 – 1992:12		
All REITs	–.0069	.3071	.7906	.6094	.64
Std Error	.0052	.8571	.6338	.0311	
t (β = 1)		–.8084	–.3304		
Equity REITs	.0022	–.4449	–.5184	.4838	.55
Std Error	.0051	.8203	.6067	.0298	
t (β = 1)		–1.7614*	–2.5027***		
Mortgage REITs	–.0137	.5615	–.6765	.6534	.51
Std Error	.0074	1.2039	.8904	.0437	
t (β = 1)		–.3642	–1.8829*		
Hybrid REITs	–.0143	1.4243	–.6696	.6779	.50
Std Error	.0077	1.2596	.9315	.0457	
t (β = 1)		.3369	–1.7924*		
			1972:02 – 1981:12		
All REITs	.0002	–.5955	–.3759	.7024	.67
Std Error	.0103	1.4149	1.0777	.0489	
t (β = 1)		–1.1276	–1.2767		
Equity REITs	.0083	–1.1323	–.2696	.4978	.53
Std Error	.0098	1.3425	1.0225	.0464	
t (β = 1)		–1.5883	–1.2417		
Mortgage REITs	–.0021	–.9689	–.0486	.7889	.57
Std Error	.0142	1.9408	1.4782	.0671	
t (β = 1)		–1.0145	–.7094		
Hybrid REITs	–.0016	–.1171	–1.2916	.8129	.57
Std Error	.0148	2.0226	1.5405	.0699	
t (β = 1)		–.5523	–1.4876		
			1982:01 – 1992:12		
All REITs	–.0078	.3012	–1.5449	.4693	.61
Std Error	.0092	1.9683	.7428	.0351	
t (β = 1)		–.3550	–3.4261***		
Equity REITs	–.0024	.0469	–1.3161	.4678	.58
Std Error	.0098	2.0954	.7908	.0373	
t (β = 1)		–.4549	–2.9288***		
Mortgage REITs	–.0233	2.3915	–1.6848	.4538	.41
Std Error	.0136	2.9049	1.0963	.0517	
t (β = 1)		.4790	–2.4490***		
Hybrid REITs	–.0073	–.4736	–1.5872	.4674	.39
Std Error	.0144	3.0687	1.1581	.0546	
t (β = 1)		–.4802	–2.2340**		

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 7
Results for Expected and Unexpected Inflation Measures with Twelve-Month Livingston Forecast as Proxy for Expected Inflation and Market Value–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
		1972:02 – 1992:12			
All REITs	–.0171	2.5442	–1.3961	.6441	.46
Std Error	.0072	1.3101	.7723	.0488	
t (β = 1)		1.1787	–3.1026***		
Equity REITs	–.0058	1.1988	–.8801	.5413	.43
Std Error	.0063	1.1473	.6763	.0428	
t (β = 1)		.1733	–2.7800***		
Mortgage REITs	–.0248	3.0304	–1.5263	.6538	.33
Std Error	.0096	1.7497	1.0315	.0653	
t (β = 1)		1.1604	–2.4492***		
Hybrid REITs	–.0257	4.0238	–1.3183	.7131	.36
Std Error	.0098	1.7907	1.0556	.0667	
t (β = 1)		1.6886*	–2.1962**		
		1972:02 – 1981:12			
All REITs	–.0069	1.2291	–1.2743	.8319	.49
Std Error	.0141	2.1493	1.3435	.0869	
t (β = 1)		.1066	–1.6928*		
Equity REITs	.0032	.0699	–.8119	.6139	.41
Std Error	.0119	1.8283	1.1429	.0739	
t (β = 1)		–.5087	–1.5854		
Mortgage REITs	–.0091	.8621	–1.2049	.9027	.39
Std Error	.0185	2.8298	1.7689	.1144	
t (β = 1)		–.0487	–1.2465		
Hybrid REITs	–.0094	2.0183	–1.4775	.9638	.42
Std Error	.0188	2.8811	1.8009	.1165	
t (β = 1)		.3534	–1.3757		
		1982:01 – 1992:12			
All REITs	–.0079	.2941	–1.7951	.4658	.49
Std Error	.0111	2.5152	.8493	.0451	
t (β = 1)		–.2807	–3.2911***		
Equity REITs	–.0027	.0381	–1.5211	.4746	.48
Std Error	.0114	2.5932	.8756	.0465	
t (β = 1)		–.3709	–2.8793***		
Mortgage REITs	–.0251	2.9678	–2.0583	.4234	.29
Std Error	.0155	3.5291	1.1917	.0633	
t (β = 1)		.5576	–2.5663***		
Hybrid REITs	–.0075	–.5131	–1.8029	.4723	.32
Std Error	.0158	3.6091	1.2186	.0648	
t (β = 1)		–.4192	–2.3001**		

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 8
Results for Expected and Unexpected Inflation Measures with Twelve-Month Livingston Forecast as Proxy for Expected Inflation and Equal–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
			1972:02 – 1992:12		
All REITs	–.0085	.7182	–.8313	.6083	.64
Std Error	.0059	1.0763	.6293	.0311	
t (β = 1)		–.2618	–2.9101***		
Equity REITs	.0011	–.2377	–.5875	.4824	.55
Std Error	.0056	1.0306	.6027	.0297	
t (β = 1)		–1.2010	–2.6340***		
Mortgage REITs	–.0156	1.0599	–.7353	.6519	.51
Std Error	.0083	1.5122	.8842	.0437	
t (β = 1)		.0396	–1.9626*		
Hybrid REITs	–.0161	1.9877	–.6657	.6778	.50
Std Error	.0087	1.5826	.9254	.0457	
t (β = 1)		.6241	–1.8000*		
			1972:02 – 1981:12		
All REITs	–.0004	–.5215	–.4203	.7011	.67
Std Error	.0113	1.7381	1.0792	.0490	
t (β = 1)		–.8754	–1.3161		
Equity REITs	.0076	–1.2729	–.3478	.4956	.53
Std Error	.0107	1.6502	1.0247	.0465	
t (β = 1)		–1.3773	–1.3153		
Mortgage REITs	–.0016	–1.1583	–.0665	.7886	.57
Std Error	.0155	2.3841	1.4804	.0672	
t (β = 1)		–.9053	–.7204		
Hybrid REITs	–.0019	–.0117	–.4822	.8127	.57
Std Error	.0161	2.4843	1.5426	.0701	
t (β = 1)		–.4072	–.9608		
			1982:01 – 1992:12		
All REITs	–.0088	.6612	–1.5391	.4695	.67
Std Error	.0096	2.1961	.7407	.0351	
t (β = 1)		–.1543	–3.4280***		
Equity REITs	–.0033	.3587	–1.3139	.4679	.53
Std Error	.0102	2.3382	.7887	.0373	
t (β = 1)		–.2743	–2.9338***		
Mortgage REITs	–.0267	3.4429	–1.6841	.4543	.57
Std Error	.0142	3.2357	1.0914	.0516	
t (β = 1)		.7550	–2.4593***		
Hybrid REITs	–.0082	–.1844	–1.5871	.4676	.57
Std Error	.0151	3.4249	1.1552	.0546	
t (β = 1)		–.3458	–2.2395**		

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 9
Results for Expected and Unexpected Inflation Measures with Treasury Bill as Proxy for Expected Inflation and Market Value–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
		1972:02 – 1992:12			
All REITs	–.0038	–.0395	–.4386	.6654	.45
Std Error	.0065	1.0388	.7082	.0487	
t (β = 1)		–1.0007	–2.0309***		
Equity REITs	.0061	–.9095	–.1343	.5524	.43
Std Error	.0057	.9013	.6144	.0423	
t (β = 1)		–2.1186**	–1.8462*		
Mortgage REITs	–.0128	.5758	–.5906	.6784	.33
Std Error	.0087	1.3814	.9418	.0648	
t (β = 1)		–.3071	–1.6889 *		
Hybrid REITs	–.0093	.7685	–.0996	.7419	.34
Std Error	.0089	1.4189	.9673	.0666	
t (β = 1)		–.1632	–1.1368		
		1972:02 – 1981:12			
All REITs	.0006	–.0349	–1.0386	.8541	.49
Std Error	.0111	1.5871	1.3741	.0843	
t (β = 1)		–.6521	–1.4836		
Equity REITs	.0098	–1.0609	–.2943	.6231	.41
Std Error	.0094	1.3451	1.1645	.0715	
t (β = 1)		–1.5322	–1.1115		
Mortgage REITs	–.0043	.0681	–1.1686	.9204	.39
Std Error	.0146	2.0838	1.8041	.1107	
t (β = 1)		–.4472	–1.2020		
Hybrid REITs	–.0027	.9093	–1.5607	.9934	.42
Std Error	.0148	2.1204	1.8358	.1126	
t (β = 1)		–.0428	–1.3949		
		1982:01 – 1992:12			
All REITs	.0000	–1.5579	–1.7262	.4662	.49
Std Error	.0071	1.2952	.8632	.0453	
t (β = 1)		–1.9749*	–3.1582***		
Equity REITs	.0062	–1.8002	–1.3855	.4743	.49
Std Error	.0074	1.3331	.8885	.0466	
t (β = 1)		–2.1005**	–2.6849***		
Mortgage REITs	–.0152	–.0573	–2.1565	.4261	.29
Std Error	.0101	1.8154	1.2099	.0634	
t (β = 1)		–.5824	–2.6089***		
Hybrid REITs	.0003	–2.1124	–1.6762	.4719	.32
Std Error	.0102	1.8539	1.2357	.0648	
t (β = 1)		–1.6788*	–2.1657***		

significance level: * = 10%, ** = 5%, *** = 1%

Exhibit 10
Results for Expected and Unexpected Inflation Measures with Treasury Bill as Proxy for Expected Inflation and Equal–Weighted Index

	Intercept	$\beta_{E(INFL)}$	$\beta_{U(INFL)}$	β_{MKT}	R^2
			1972:02 – 1992:12		
All REITs	–.0061	.1424	–.5902	.6177	.64
Std Error	.0053	.8372	.5652	.0303	
t (β = 1)		–1.0244	–2.8135***		
Equity REITs	.0049	–.8839	–.3687	.4839	.55
Std Error	.0051	.8001	.5401	.0289	
t (β = 1)		–2.3546**	–2.5342***		
Mortgage REITs	–.0161	.9071	–.6197	.6632	.51
Std Error	.0074	1.1731	.7919	.0424	
t (β = 1)		–.0792	–2.0453**		
Hybrid REITs	–.0119	.9934	–.2501	.6938	.50
Std Error	.0078	1.2317	.8315	.0446	
t (β = 1)		–.0054	–1.5034		
			1972:02 – 1981:12		
All REITs	–.0029	–.0853	–.6768	.6995	.67
Std Error	.0089	1.2638	1.0958	.0467	
t (β = 1)		–.8588	–1.5302		
Equity REITs	.0042	–1.1811	–.1366	.4912	.53
Std Error	.0093	1.1983	1.0391	.0443	
t (β = 1)		–1.8202*	–1.0938		
Mortgage REITs	–.0149	.1229	–.6394	.7791	.57
Std Error	.0134	1.7349	1.5043	.0641	
t (β = 1)		–.5056	–1.0898		
Hybrid REITs	–.0124	.8501	–1.1407	.8135	.58
Std Error	.0139	1.7997	1.5604	.0665	
t (β = 1)		–.0833	–1.3719		
			1982:01 – 1992:12		
All REITs	–.0049	–.5932	–1.5843	.4724	.61
Std Error	.0063	1.1374	.7493	.0351	
t (β = 1)		–1.4007	–3.4490***		
Equity REITs	.0016	–.9017	–1.2959	.4691	.57
Std Error	.0067	1.2126	.7988	.0375	
t (β = 1)		–1.5683	–2.8742***		
Mortgage REITs	–.0029	1.0481	–1.8794	.4629	.41
Std Error	.0092	1.6673	1.0983	.0515	
t (β = 1)		.0288	–2.6217***		
Hybrid REITs	–.0043	–1.2051	–1.5782	.4686	.39
Std Error	.0098	1.7741	1.1687	.0548	
t (β = 1)		–1.2429	–2.2060**		

significance level: * = 10%, ** = 5%, *** = 1%

Summary and Conclusions

This study examined the inflation–hedging effectiveness of REIT returns using a model that posits real estate returns are a function of expected inflation, unexpected inflation, and the *real* return to a market index. Four types of REIT return measures (equity, mortgage, hybrid, and a composite index) were used, as were four expected inflation forecasts across an extended time period (1972:02 through 1992:12). Results indicate that REITs act as poor hedges against any measure of inflation (actual, expected or unexpected) with the poorest performance relative to unexpected inflation. In this respect, REIT returns mirrored results involving equity returns in general and would seem not to be proxies for direct investment in real estate. Studies that have shown the real estate's ability to act as at least a partial inflation hedge may be the result of the well–documented appraisal basis in such returns, rather than real estate's innate ability to act as an effective hedge. Evidence on REITs indicate that real estate, at best, acts as a partial hedge against expected inflation and a perverse hedge against unexpected inflation.

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