Risk and Return on Real Estate: Evidence from Transaction-based Real Estate Returns

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1. Introduction

Real estate is the single largest asset class in the United States, dwarfing both the stock and bond markets. According to the Bureau of Economic Analysis, the value of real estate in 1988 was $10 trillion. Investment properties alone (apartment buildings office buildings, warehouses, hotels, and retail properties) accounted for $3.5 trillion in 1988 according to a report by Stephen Roulac and Equitable Insurance. Furthermore, real estate (in the form of owner-occupied housing) is the dominant asset in the majority of household portfolios.

Despite the enormous size of national real estate holdings, relatively little is known about the risk and return characteristics of real estate. Prior research on appraisal-based return indices found that real estate earned substantial risk-adjusted returns (e.g., Hartzell, Hekman and Miles (1987). Other studies have examined the risk and return characteristics of real estate investment trusts (e.g., Titman and Warga (1986) and Chan, Hendershott and Sanders (1990). The advantage of using real estate investment trusts (REITs) is that REITs represent a transaction-based rather than appraisal-based return. Using equity REITs as a proxy for real estate returns, Chan, Hendershott, and Sanders (1990), for example, find little or no evidence that real estate earns risk-adjusted returns. Furthermore, they find support for the earlier studies that find that real estate is less risky than stocks (although the estimates of CHS are dramatically higher than previous studies). One potential problem with the study is that it can be argued that REIT returns are not representative of the behavior of the actual assets in the REIT's portfolio. Although this potential problem is the subject of much debate, it would be interesting to test a transaction-based real estate index based on actual properties rather than market prices of the aggregate security (REITs).

The purpose of this study is to test whether real estate earns risk-adjusted returns when a transaction-based index of actual properties is employed. Like Chan, Hendershott and Sanders (1990), we employ a multifactor arbitrage pricing model. In order to determine how various macroeconomic forces impact real estate returns, we use the factors prespecified in Chen, Roll and Ross (1986). Using quarterly data from 1980 through 1987, we find that retail real estate does not earn risk-adjusted excess returns. In addition, we find that retail real estate returns are driven by changes in both the risk structure of interest rates as well as the term structure of interest rates. Surprisingly, retail real estate appears to be a hedge against expect

inflation. The comparable Frank Russell Index for retail property over the same period is insignificant in all tests.

2. Methodology

Following Chan, Hendershott and Sanders (1990), we employ the arbitrage pricing model to evaluate the risk-adjusted performance of transaction-based real estate indices. The approach we employ requires the regression of excess real estate returns on the excess returns on portfolios whose returns mimic prespecified factors. Our approach is similar to that of Connor and Korajczak (1986) and Titman and Warga (1986). The mimicking portfolios we utilize are those of Huberman, Kandel and Stambaugh (1986).

2..1 The Arbitrage Pricing Model

It is assumed that real estate returns, like returns on any financial assets, are generated by an arbitrage pricing model. In Ross's APT (1976), returns are assumed be generated by a number of factors,

$$r = E + Bf + \epsilon, \tag{1}$$

where r is aN x 1 vector of returns, E is a N x 1 vector of expected returns, f is a K x 1 vector of random factors with means equal to zero, B is a N x K matrix of factor sensitivities (loading), and ϵ is an N x 1 vector of residuals. The covariance matrix of r is given by V, and the covariance matrix of the ϵ is given by Z. The exact pricing condition obtains if

$$E = ir_f + Bu, \tag{2}$$

where r_f is the return on a riskless asset if it exists, i is a vector of one, and u is a K x 1 vector of risk premiums.

The factors f are not identified by the APT. Following Chen, Roll and Ross (1986) and Chan, Chen and Hsieh (1985), we pre-specify them to be a set of macroeconomic innovations that capture the pervasive forces in the economy. Regressing the time series of the real estate returns in excess of the T-bill rate on these macroeconomic innovations can help us determine the sensitivities, B, but this time series regression does not give a measure of excess returns because the risk premiums, u, are not known. In particular, the intercept of the time series regression cannot be interpreted as a Jensen performance measure, as in the Capital Asset Pricing Model. It is, however, possible to obtain this performance measure if we state the pricing relation in terms of a set of mimicking portfolios.

A set of portfolios are known as mimicking portfolios if their payoffs can be used for pricing the N assets in place of the factors, if exact arbitrage pricing holds. Let a_k be a N x 1 vector that represents positions in the N assets that mimicks the

k-th factor. The K x 1 vector of payoffs on the K mimicking positions are given as $R = A'r$, where A is a N x K matrix, whose k-th column is a_k. The pricing equation can be stated in terms of return sensitivities to these mimicking portfolios:

$$E = ir_f + Cv, \tag{3}$$

where $C = Cov(r, R) = VA$, and v is a vector of constants.

Huberman, Kandel and Stambaugh (1986) show that there are numerous sets of mimicking portfolios for a given set of factors. One particular set of mimicking portfolios that is convenient for our tests is given by

$$A = V^{-1}B(B'V^{-1}B)^{-1} = Z^{-1}B(B'Z^{-1}B)^{-1}. \tag{4}$$

These portfolios have minimum residual variance of all other possible positions, subject to the condition that $a_k'B = e_k$ where e_k is a K x 1 vector with the k-th component equal to one and other components equal to zero. Note that the returns to the mimicking portfolios, $R = A'r$, are equivalent to generalized least squares cross sectional regression coefficients of the asset returns on the sensitivity coefficients.

Two properties of these "unit loading" mimicking portfolios are noteworthy. First, the loadings of all assets with respect to these mimicking portfolios are equal to B, which are the loadings with respect to the original factors. Thus, equation (1) can be rewritten as

$$r = E - B\overline{R} + BR + \eta. \tag{5}$$

where $\overline{R}$ is the mean vector of the mimicking portfolios. Second, if the mimicking portfolios are financed by zero investment, their expected returns are equal to the risk premiums associated with the factors, i.e., $\overline{R} = u$. Substituting this relation and equation (2) into (5).

$$r - ir_f = BR + \eta. \tag{6}$$

Thus, given the mimicking portfolios, we can estimate the ability of real estate to hedge inflation, estimate real estate's risk exposures and evaluate its risk-adjusted performance by equation (6). This is accomplished by regressing the real estate return on the mimicking portfolios and a constant. If the constant is indistinguishable from zero, the real estate's expected return is commensurate with its risk. If the intercept is significantly positive, real estate is a superior investment; if it is significantly negative, it is a poor performer. This yardstick of risk adjusted performance is analogous to the Jensen alpha in the single index model.

Five macroeconomic variables are pre-specified to be the factors that affect returns in interval t. These are identical to the ones used by CRR: (1) the annual production growth from t+1 to t+4; (2) the change in expected inflation from t-1 to t; (3) the unexpected inflation in t; (4) the difference of the returns on the low grade corporate bonds (below BAA) and long term Treasury bonds in period t; (5) the difference of the returns of the long term Treasury bonds and the one month T-bill rate in period t (the change in the term structure). The treasury bill and bond rates,

the inflation rate and the low-grade corporate bond return are from the Ibbotson and Sinquefiled files. The industrial production index is from Citibase data.

2..2 Data

The Frank Russell Company (FRC) has created quarterly indices for retail, office and industrial real estate. Unfortunately, the FRC indices contain appraised values which limit the volatility of the indices. Given that the income portion of the total return is extremely large compared to the growth (decline) in value, it is not surprising that these indices often look like Treasury bill or bond indices.

To combat this problem, Bryan Webb of Indiana University has created a transaction-based index for retail, office and industrial real estate as well. The indices are available from January 1980 through December 1987. Like the FRC indices, these indices are quarterly. In order to compare the FRC and transaction-based indices properly, we limit the FRC indices to the same sample period (although the FRC indices are available over a longer period). See Miles, Webb and Guilkey (1990) for a discussion of this series.

3. Empirical Results

The results of the mimicking portfolio regressions for retail properties are found Table 1 (the other properties types are not reported since the results of the tests were insignificant). For both the FRC and transaction-driven index, the constant is insignificant. As a consequence, neither indices indicate that excess risk-adjusted returns are evident for retail real estate. Also of note is that the adjusted coefficients of determination indicate that mimicking portfolios are much better at explaining the transaction-driven index than the FRC index.

The regressions of retail returns on the macro variables provide some interesting insights. First, both the risk and term structures of interest rates are significant in explaining retail returns. This confirms the finding of Chan, Hendershott and Sanders (1990) for equity REITs. Second, retail real estate appears to be a hedge against expected inflation.

Although the other FRC and transaction-driven indices performed poorly in the tests, the strong performance of the retail index is interesting. Once possible explanation for the significant hedge is the indexed nature of long-term leases for retail properties. Retail leases often have percentage clauses relating to sales or inflation indexation.

4. Summary

In this paper we find that the transaction-driven retail property return index indicates that retail properties are sensitive to changes in the risk and term structures of interest

TABLE 1

Impacts of the Mimicking Portfolios on Retail Property Returns

	FRC	Transaction-driven Index
Constant	0.0059 (0.0029)	-0.0052 (0.0034)
Industrial Production	-0.0054 (0.0301)	0.0444 (0.0384)
Expected Inflation	0.1203 (0.5212)	1.0860 (0.6521)
Unexpected Inflation	0.0134 (0.1942)	-0.5577 (0.2430)
Risk Structure	0.0206 (0.0430)	0.1052 (0.0539)
Term Structure	0.0296 (0.0323)	0.0515 (0.0405)
R^2	-0.10	0.18

Standard errors in parenthesis.

TABLE 2

Impacts of the Macro Factors on Retail Property Returns

	FRC	Transaction-driven Index
Constant	0.0032	-0.0124
	(0.0037)	(0.0042)
Industrial Production	-0.0695	0.0858
	(0.0609)	(0.0682)
Expected Inflation	0.1789	4.2897
	(1.4111)	(1.5809)
Unexpected Inflation	-0.7265	-1.3066
	(0.5331)	(0.5982)
Risk Structure	0.0782	0.4316
	(0.1198)	(0.1342)
Term Structure	-0.0025	0.2964
	(0.0626)	(0.0700)
Adjusted R^2	0.05	0.37

Standard errors in parenthesis.

rates. Although retail properties do not earn risk-adjusted excess returns, retail properties appear to be a hedge against expected inflation.

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