Factors Influencing Capitalization Rates

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Abstract. **This study examines the variations in quarterly mean "capitalization rates" for commercial and industrial investment properties. By explaining the variations in the capitalization rate, we hope to expand the research in explaining variations in the overall return to property. This study differs from other research on portfolio capitalization rates because we separately analyze these rates by property type. The results show that using "averaged" capitalization rates across property types eliminates important information. We use the band of investment approach to develop a theoretical model explaining the capitalization rate and test this model using both Seemingly Unrelated Regression (SUR) and cross-sectional/time-series regression (panel data).**

Introduction

The longest run of data available on the return to real property is the average capitalization ratio reported for property on which mortgage commitments have been made by the largest life insurance companies (ACLI). This paper is an attempt to explain the variations in the quarterly mean "cap rate" from the first quarter of 1966 through the fourth quarter of 1988. In particular, this paper separately analyzes "cap rates" by property type.

The capitalization rate is the ratio of stabilized annual net operating income to purchase price. Thus, it measures income after deduction for operating expenses and normal vacancy but before deducting financing charges and income taxes. Abnormally high vacancy during an initial absorption period is not included. The cap rate is related to the overall return to property before financing and income taxes. Therefore explaining variations in the cap rate will go a long way toward explaining variations in the overall return to property.

Literature Review

Sirmans and Webb (1978, 1980) and Ricks (1969) use the same ACLI data source. These writers, however, estimate imputed equity yields on the investments by hypothesizing average holding periods with no price appreciation, and imputing tax rates. They relate the yield and its variance to alternative investments. We avoid making any such assumptions about the investments by using only the cap rate.

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In a study of market segmentation, Liu, Hartzell, Greig and Grissom (1990) use the ACLI data to compute imputed commercial real estate prices. They use these prices to study whether the real estate market is integrated with the stock market. Their findings suggest that some segmentation does occur, depending on which market proxy is chosen and whether real estate returns are computed from appraised or imputed sales data.

Nourse (1987) uses the ACLI data source to estimate the impact of changes in tax laws on capitalization rates for real estate. His model, however, does not take into account the potential variation driven by property types. Only the mean cap rate for all property is used as the dependent variable. In this study we utilize the variation in cap rates across property types. Evans (1990) also uses the ACLI data to estimate the time-series properties for capitalization rates. His study focuses on comparing the stochastic nature of the stock market earnings/price ratio with real estate cap rates.

Froland (1987) uses the ACLI data source to explain variations in the cap rate and the interaction of those rates with the capital market. Froland finds that the cap rate is a function of the mortgage contract rate, the spread between Treasury bills and bonds, and the corporate earnings-price ratio. However, his study has several significant problems. First, Froland does not consider the impact of the variation in property types or time in examining the cap rates. Second, Froland does not clearly specify the relationship between the cap rate and the independent variables. Finally, the interpretation of his correlation coefficients is weakened by autocorrelation present in the dataset.[1]

In a more recent study, Dokko, Edelstein, Pomer and Urdang (1991) examine nonresidential rates of return across property uses and location. Their results indicate that differences among property types may provide additional insight into the analysis of cap rates.

Model of the Cap Rate

Using the band of investment approach, we define the capitalization rate as:

$$R=[LTV*MC]+[(1-LTV)*ROE], \qquad (1)$$

where R is the capitalization rate, LTV is the mortgage loan-to-value ratio, MC is the mortgage constant, and ROE is the return on equity. The band of investment approach in real estate appraisal is based on the weighted average cost of capital (WACC) concept in finance.[2]

One problem with using equation (1) in connection with the cap rate reported in the ACLI bulletin is that the band of investment approach ignores any differences across property type or location. This suggests that the cap rate reported by ACLI is more accurately defined as

$$\tilde{R}_{i,t}=E[\tilde{A}_{i,t}]+\beta_1[LTV_{i,t}*MC_{i,t}]+\beta_2[(1-LTV_{i,t})]+\tilde{\varepsilon}_{i,t}, \qquad (2)$$

where

$\tilde{R}_{i,t}$ = the observed cap rate for property type i at period t,
$E[\tilde{A}_{i,t}]$ = a time and property type varying intercept term,
β_2 = the unobserved return on equity,
$\tilde{\varepsilon}_{i,t}$ = the error term.

Allowing the intercept to vary through time and across property types allows us to capture changes in investor expected holding periods as well as other factors that may impact the capitalization rate. Investor expectations about their holding periods are a function of conditions in the capital market and local real estate market.

In addition to investor expectations, Hartzell, Heckman and Miles (1986), Grissom, Hartzell and Liu (1987) and Dokko et al. (1991) present evidence that regional variation is an important factor in explaining real estate capitalization rates. Thus we also expect that location factors are a function of the intercept term. By combining location factors with cross-sectional analysis of several property types, we provide a natural extension of the work by Grissom, Hartzell and Liu (1987).

As Froland (1987) and Evans (1990) point out, real estate equity yields and mortgage interest rates must be related to other rates in the capital market since investors can substitute across investment types. One would anticipate that yields in the stock market would be related to equity yields in real estate, and that mortgage interest rates would be related to the returns on government and corporate debt. Thus we expect the cap rate to be related to the stock market earnings/price ratio and the risk premium on long-term debt. We use the earnings/price ratio since this measure is directly comparable to a cap rate for common stocks. The spread between long-term and short-term government bonds serves as a proxy for inflation expectations.

Thus, we expect the functional equation explaining the intercept term is as follows:

$$E[\tilde{A}_{i,t}] = \alpha_0 + \alpha_1(location_{i,t}) + \alpha_2(spread_t) + \alpha_3(e/p_t), \tag{3}$$

where $location_{i,t}$, represents the impact of location on property type i in time t, $spread_t$ is the difference between the total return on long-term and short-term government bonds, and e/p_t is the earnings price ratio for the S&P 500. Substituting (3) into (2) we obtain:

$$\begin{aligned}\tilde{R}_{i,t} = {} & \alpha_0 + \alpha_1(location_{i,t}) + \alpha_2(spread_t) + \alpha_3(e/p_t) \\ & + \beta_1(LTV_t{*}MC_t) + \beta_2[(1-LTV_t)] + \tilde{\varepsilon}_{i,t}\,,\end{aligned} \tag{4}$$

which can be rewritten as

$$\tilde{R}_{i,t} = A'X_{i,t} + B'Y_{i,t} + \tilde{\varepsilon}_{i,t}\,, \tag{4'}$$

where $X_{i,t}$ is the matrix of location and market factors and $Y_{i,t}$ is a matrix containing the debt and equity components of the band of investment approach.

Since we believe the error terms to be contemporaneously correlated across property types, equations (2) and (4) are estimated using Zellner's (1962) Seemingly Unrelated Regression (SUR) technique. The SUR method improves the efficiency of the parameter estimates by using the estimates of the covariance of residuals across property type. To further test the specification of the models, we also estimate equations (2) and (4) using a cross-sectional/time-series (panel data) regression. The techniques of panel data (or cross-sectional/time-series data) allow researchers to study both the relationships between variables across individuals (property types), as in normal regression models, as well as across time, as in time-series models. Since panel data combines both cross-sectional and time-series data, the data set contains a larger number of observations than in normal cross-sectional regressions. This effectively reduces the collinearity among the explanatory variables and thus improves the efficiency of the estimates.[3]

Data

The data used in this study were obtained from the American Council of Life Insurance (ACLI) quarterly *Investment Bulletin.* ACLI tracks mortgage data for about two-thirds of the commercial mortgages held by U.S. life insurance companies. The data set for this study begins in the first quarter of 1966 and continues through the fourth quarter of 1988 for a total of ninety-two observations.[4]

Each quarter ACLI reports the number of new loans, the total amount committed, the average contract interest rate (weighted by dollar and number), the mean mortgage constant, the mean loan-to-value ratio, the mean debt coverage ratio and the mean capitalization rate for nine commercial property types.[5] The nine property types include hotels, apartments, retail, office buildings, commercial services, industrial, FHA and NHA apartments, institutional and multiple property complexes. ACLI surveys its member institutions each quarter to determine the number and amount of long-term (over one year) mortgage commitments on commercial properties excluding construction loans, reapprovals, and loans secured by land only. ACLI requests information on the location, amount, term, rates, property type, and other features for each mortgage commitment. ACLI reports weighted averages of the loan terms where the weighted average is the weighted loan amount divided by the relevant total loan amount for each property category. In a study of various equity and cost of capital rates, Guntermann and Smith (1987) test the reliability of the ACLI data. Their study finds that cost of capital rates derived from the ACLI data are consistent with rates derived from other data sources.

Unfortunately, out of the total of nine property types, only two property types (industrial and office buildings) have data observations for the complete time series. Commercial services and commercial retail are each lacking one quarter of data for a complete time series. Apartments and hotels lack four quarters of data respectively for a complete series. Data availability for FHA and NHA apartments, institutional, and multiple property complexes in widely scattered making inclusion in the analysis inappropriate.

The location factors used in this study are obtained by aggregating the data reported by ACLI into five general location variables. These variables represent the North, South, East and West regions of the United States as well as a variable denoting foreign investment. The variables are the percent of total dollars committed for each area for each quarter and property type.

The data used to proxy the returns on alternative investments are developed from Ibbotson and Siegel (1984). In this study we use the earnings price ratio for the

Exhibit 1
Variable Definitions

Variable	Expected sign	Definition
Property Specific:		
AMOUNT		the dollar amount of funds committed in each quarter expressed in 1965 dollars
RATE		the mean contract interest rate by dollar amount in each quarter
LTV		the average loan-to-value ratio
MC		the average property mortgage constant
DEBT	+	defined as *MC*LTV*. Measures the return on debt financing
EQUITY	+	defined as 1-*LTV*. Measures the return on equity
Location:		
NORTH	+	the percentage of funds committed in each quarter for the ACLI regions East North Central and West North Central
SOUTH	+	the percentage of funds committed in each quarter for the ACLI regions South Atlantic, East South Central and West South Central
EAST	+	the percentage of funds committed in each quarter for the ACLI regions New England and Mid-Atlantic
WEST	+	the percentage of funds committed in each quarter for the ACLI regions Mountain and Pacific
OTHER	+	the percentage of funds committed in each quarter for regions outside the continental U.S.
Financial Characteristics:		
EP	+	the quarterly S&P 500 earnings/price ratio
SPREAD	+	the quarterly difference between the long-term government bond return and the government T-bill return

S&P 500 index as a proxy for the stock market, and the spread between the U.S. Treasury bill index and the long-term government bond index to provide a proxy for the expected inflation rate. These indices are calculated from the monthly data in the *Stocks, Bonds, Bills and Inflation 1989 Yearbook* provided by Ibbotson Associates. The monthly returns are compounded to calculate the quarterly return series.

Exhibit 1 describes the variables used in this study, along with their expected sign, and Exhibit 2 presents the descriptive statistics for each property. Apartments and office buildings make up the bulk of the loans originated by the life insurance companies, in terms of total numbers of loans. Yet the greatest dollar amounts are committed to office buildings. The *F*-statistic tests the equality of the means across property types. Interestingly, the means for all the variables except the loan contract rate (*RATE*) are significantly different across property types at the 1% level.[6] This tends to suggest that studies that use aggregate data ignore meaningful differences across property types.[7] Exhibit 2 also reports the pair-wise comparisons for property

Exhibit 2
Descriptive Statistics
Means and Standard Deviations for Each Property Type
Property Type

Variables[a]	Apartments [1]	Commercial Retail [2]	Office Building [3]	Commercial Services [4]	Industrial [5]	Hotels [6]	*F*-test[b]
Property Specific:							
NUMBER	105.977 (100.094)	63.890 (34.056)	110.196 (58.707)	55.725 (44.743)	58.304 (30.774)	15.966 (9.253)	34.64***
LOAN AMOUNT ($)	304873.630 (242856.04)	362409.890 (406911.230)	925172.480 (993058.800)	79548.730 (65143.190)	124213.340 (130165.660)	143377.330 (138937.170)	42.82***
RATE	.099 (.019)	.100 (.021)	.100 (.021)	.101 (.021)	.101 (.023)	.104 (.023)	.68
LTV (ratio)	.722 (.033)	.727 (.028)	.729 (.022)	.722 (.028)	.717 (.024)	.697 (.054)	11.33***
MC	.108 (.016)	.111 (.017)	.110 (.016)	.114 (.015)	.114 (.016)	.118 (.017)	4.05***
CAP	.099 (.010)	.102 (.013)	.101 (.012)	.102 (.013)	.102 (.012)	.119 (.016)	30.25***
Location:							
NORTH	.177 (.106)	.182 (.096)	.168 (.092)	.224 (.144)	.191 (.142)	.164 (.145)	2.76**
SOUTH	.506 (.153)	.371 (.152)	.323 (.116)	.317 (.153)	.215 (.119)	.441 (.210)	40.12***
EAST	.161 (.098)	.171 (.102)	.245 (.119)	.149 (.108)	.216 (.114)	.155 (.150)	10.00***

WEST	.146 (.080)	.214 (.125)	.223 (.103)	.256 (.166)	.338 (.206)	.212 (.174)	16.17***
OTHER	.009 (.019)	.061 (.072)	.041 (.054)	.055 (.070)	.040 (.090)	.028 (.098)	6.11***
N	88.0	91.0	92.0	91.0	92.0	87.0	

[a]The variables definitions are:

NUMBER	mean number of loans per property type between 1966 and 1988
AMOUNT	mean dollar ($) amount committed for each property type
RATE	average mortgage interest rate for each property weighted by the dollar amount of each loan
LTV	average loan-to-value ratio for each property
MC	average mortgage constant for each property
CAP	average capitalization rate for each property
NORTH	percentage of the total dollar amount committed in the North-Central U.S.
SOUTH	percentage of the total dollar amount committed in the South U.S.
EAST	percentage of the total dollar amount committed in the East U.S.
WEST	percentage of the total dollar amount committed in the West U.S.
OTHER	percentage of the total dollar amount committed in areas outside the U.S.
N	number of observations for each property type

[b]The *F*-test statistics tests the hypothesis that the means for each variable are equal across property types.

***significantly different from 0 at the 1% level
**significantly different from 0 at the 5% level

Exhibit 3
Pearson Correlation Statistics

Variable	*CAP*	*OTHER*	*NORTH*	*EAST*	*SOUTH*	*SPREAD*	*EP*	*DEBT*	*EQUITY*	VIF[1]	Cond. Numb.[2]
CAP	1.000	−.050	−.195	−.064	.104	.042	.500	.747	.245	—	1.000
OTHER		1.000	−.018	−.097	−.203	−.017	−.101	−.100	−.126	1.145	2.515
NORTH			1.000	−.183	−.295	.049	−.153	−.220	−.205	1.390	2.844
EAST				1.000	−.371	.008	−.077	−.007	.055	1.398	4.175
SOUTH					1.000	−.067	.084	.039	.097	1.528	4.319
SPREAD						1.000	−.082	.087	.110	1.061	7.743
EP							1.000	.595	.061	1.617	12.731
DEBT[3]								1.000	.060	1.657	23.735
EQUITY[4]									1.000	1.081	41.555

[1]Variance Inflation Factors (VIF) provide an indication of the severity of multicollinearity. A VIF greater than 10 is considered to indicate a problem with multicollinearity. *CAP* is the dependent variable. Since the location variables sum to unity for all property types, *WEST* is not included in the analysis to control for the correlation between the location variables.

[2]Condition Numbers also provide an indication of the severity of multicollinearity in the data.

[3]*DEBT*=*MC***LTV*.

[4]*EQUITY*=1-*LTV*.

type by location. The South clearly dominates the other regions in terms of the percentage of dollars committed to projects. This is not surprising given the rapid economic expansion that occurred in the Sunbelt during this time period. Only for industrial properties does the South fail to dominate the other regions.

Exhibit 3 presents the Pearson correlation statistics, the Variance Inflation Factors (VIF) and the condition numbers for the variables used in the study. A VIF greater than 10 is considered to indicate the presence of severe multicollinearity. Since the largest VIF is 1.657, multicollinearity does not appear to be a problem with the data used in the study. The condition numbers also provide an indication of multicollinearity. Although a condition number above 30 is generally a sign that multicollinearity exists in the data, an analysis of the variance proportion for the variable eigenvalues indicates that the multicollinearity is not severe.

Results

Seemingly Unrelated Regression

Exhibit 4 presents the results for the SUR estimation of equation (2), the base band of investment model. The system of equations has a high degree of explanatory power in that the variables explain 81% of the variation in the cap rate across property types. Since the *DEBT* variable is equal to the mortgage constant (*MC*) times the loan-to-value (*LTV*) ratio, the estimated parameter for *DEBT* should be equal to one.[8] For retail, office and industrial properties, we cannot reject the null hypothesis that the parameters are equal to one. The variable *EQUITY* is defined as one minus the *LTV*. Thus the estimated parameter for *EQUITY* is equivalent to estimating the equity return on each property type. Only service and office properties have *EQUITY* parameters significantly different from zero at the 1% and 10% level respectively. One important result evident from Exhibit 4 is that hotels have significantly different parameter estimates than the other property types. This suggests that hotels may be valued differently from other commercial property. Of particular concern are the significantly different from one estimated parameters for *DEBT* for apartments, service and hotel properties. This result suggests that the band of investment model may not fit these property types.

Exhibit 5 presents the results from the SUR estimation of equation (4). As with the base model, the system of equations has a high degree of explanatory power, explaining 85% of the variation in the cap rate. With the exception of commercial services and industrial property types, all property types have intercepts significantly different from zero (at the 5% level). As in the base model, all property types have significantly different from zero parameter estimates for *DEBT*; however retail, office and industrial properties are the only properties with parameter estimates that are not significantly different from one. Only office, service and hotel properties have *EQUITY* parameter estimates significantly different from zero. Since the only model with the expected estimate of one for *DEBT* and a significant positive estimate for *EQUITY* is the office model, this calls into question the validity of the SUR regression in describing the band of investment model of the cap rate.

Exhibit 4
Seemingly Unrelated Regression Estimation of Equation 2

	Apartments	Retail	Office	Service	Industrial	Hotel
INTERCEPT	.0297***	.0178***	.0130***	−.0029	.0136**	.0414**
	(.0039)	(.0045)	(.0037)	(.0062)	(.0068)	(.0202)
DEBT	.8878***	1.0103***	1.0241***	1.1323***	1.0123***	.5773***
	(.0382)	(.0292)	(.0320)	(.0506)	(.0466)	(.1954)
EQUITY	.00009	.0084	.0207*	.0419***	.0175	.1013***
	(.0091)	(.0113)	(.0114)	(.0163)	(.0179)	(.0314)

Standard errors are reported in parentheses.
System Weighted MSE: .93653 with 474 degrees of freedom
System Weighted R^2: .8162

***significantly different from zero at the 1% level
**significantly different from zero at the 5% level
*significantly different from zero at the 10% level

Exhibit 5
Seemingly Unrelated Regression Estimation of Equation 4

	Aparments	Retail	Office	Service	Industrial	Hotel
INTERCEPT	.0263***	.0130**	.0104**	.0031	.0120	.0466**
	(.0051)	(.0055)	(.0046)	(.0071)	(.0087)	(.0239)
OTHER	.0094	.0087**	.0050	−.0009	.0044	.0198
	(.0130)	(.0041)	(.0047)	(.0065)	(.0045)	(.0176)
NORTH	.0060	−.0001	−.0007	−.0016	.0023	−.0029
	(.0046)	(.0037)	(.0032)	(.0034)	(.0030)	(.0147)
EAST	.0079**	.0076**	−.0012	−.0114***	.0036	−.0035
	(.0041)	(.0038)	(.0029)	(.0045)	(.0043)	(.0144)
SOUTH	.0122***	.0052*	.0022	−.0069*	−.0030	−.0114
	(.0033)	(.0026)	(.0026)	(.0036)	(.0037)	(.0103)
SPREAD	−.0099	−.0082	−.0086	.0071	−.0207***	−.0143
	(.0066)	(.0062)	(.0059)	(.0092)	(.0082)	(.0352)
EP	.0444***	.0052	.0277**	.0079	.0322*	.0915
	(.0159)	(.0144)	(.0137)	(.0221)	(.0190)	(.0741)
DEBT	.7724***	1.0397***	1.0006***	1.1465***	1.0149***	.5100**
	(.0493)	(.0387)	(.0404)	(.0612)	(.0606)	(.2379)
EQUITY	.00002	.0016	.0265**	.0294*	.0099	.0938***
	(.0096)	(.0122)	(.0134)	(.0172)	(.0216)	(.0361)

Standard errors are reported in parentheses.
System Weighted MSE: .91255 with 438 degrees of freedom
System Weighted R^2: .8515

***significantly different from zero at the 1% level
**significantly different from zero at the 5% level
*significantly different from zero at the 10% level

Since the five location factors sum to unity, the West region variable is not included in the model to control for the correlation between the variables. Interestingly, the regions South and East in the continental U.S. have significantly positive parameter estimates (at the 10% level) for apartments and retail while South and East are significantly negative (at the 10% level) for commercial services. The variable representing funds committed outside the U.S. has a significantly (at the 5% level) positive impact on the cap rate only for retail property. This suggests that funds committed for retail property outside the U.S. have higher risk and have correspondingly higher cap rates. The significant parameter estimates on the location variables for apartments, retail and service properties are consistent width the results reported by Grissom, Hartzell and Liu (1987) who find that location is an important factor in determining industrial property values. However, our analysis suggests that our broad location definition is not important for office, industrial and hotel properties.

The regression results also indicate that cap rates are not closely tied to other investments in the capital market, which is contrary to expectations. Neither the S&P 500 earnings/price ratio nor the risk premium spread between long-term and short-term government debt are significantly different from zero. The insignificant parameter estimates for the earnings/price ratio (for retail and service properties) tend to confirm the findings of Liu, et al. (1990) which show that the real estate market is segmented from the stock market. This result is consistent with the findings by Ibbotson and Siegel (1984) and Hoag (1980) that stocks and real estate are uncorrelated. The findings are also consistent with Grissom, Hartzell and Liu (1987) who found that general economic factors are not included in the risk attributes of industrial property. Contrary to Froland (1987) the results suggest that commercial real estate markets are not tied to other capital markets.[9] Furthermore, the insignificant parameter estimate for the earnings/price ratio contradicts the findings of Evans (1990). This could be the result of his use of aggregate cap rates that do not allow for property-type variation.

Cross-Sectional/Time-Series Regressions

As noted above, the estimated parameters for the individual properties using the SUR methodology are inconsistent with the expectations from the theoretical development of the band of investment model. Two contradictions with the theoretical expectations arise from using the SUR methodology to analyze the impact of property type on cap rate variation. First, the results from three of the six property models (apartment, service and hotel) contradict the theory that the coefficient for the weighted mortgage constant (*DEBT*) is one. We have no theoretical justification for why the band of investment model does not fit these property types. Second, the insignificant results for the earnings price ratio (*EP*) and interest-rate spread (*SPREAD*) contradict theoretical and empirical findings that real estate markets do respond to changes in other investment markets. This leads us to question the validity of the SUR estimates.

An alternative approach to testing the impact of difference in property type on cap rate variance is to use the cross-sectional time-series (panel data) approach. This approach allows separate tests of the homogeneity of the slope and intercept coefficients instead of mixing the two tests as in the SUR method.

In order to determine the relationship between the dependent and independent variables, we test the following hypotheses:[10]

H_1: $y_{it} = \alpha + \varepsilon_{it}$ (no group effects or regressors),
H_2: $y_{it} = \alpha_i + \varepsilon_{it}$ (group effects only),
H_3: $y_{it} = \alpha + \beta' x_{it} + \varepsilon_{it}$ (regressors only),
H_4: $y_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it}$ (group effects and regressors).

Panel B of Exhibit 6 presents the results from the likelihood ratio tests and *F*-tests for the specification of Hypotheses H_1 through H_4. Rejecting the H_3 test-statistic implies that using a pooled regression model is incorrect. The regression intercepts and coefficients are significantly different by property type. H_4 tests for the full panel data specification in which the intercept varies across the property type. Based on the above tests, we cannot assume that homogeneity exists in the intercepts across property types. Thus significant variation exists in the data due to property type and time effects and H_4 is the correct specification for the model.[11]

Panel A of Exhibit 6 reports the results for the panel data regression for the base model (equation (2)). The coefficient for the weighted cost of debt is significantly different from zero (at the 1% level) but is not significantly different from one, which is consistent with the theoretical development in the second section of this study. Furthermore, the return to equity is 4.85% and significantly different from zero (at the 1% level). The different fixed-effects intercept estimates for each property type suggest that controlling for property type is an important factor in explaining the variation in the cap rate.

One disadvantage with using the panel data technique is that the explanatory power of the model is lower than the SUR system of equations. The panel data model explains 71% of the variation in the cap rate versus the 81% explanatory power of the SUR model. This is due to the common parameter estimates rather than allowing the parameter estimates to vary across property types as in the SUR system of equations.

Exhibit 7 reports the results for the panel data regression for the expanded model (equation (4)). Once again the specification tests (Panel B) indicate that the full panel data model (H_4) is the correct specification. Adding the location and capital market variables increases the explanatory power of the model slightly over the base model. However, the full model explains 71% of the variation in the cap rate versus the 85% in the SUR system. Again this is the result of forcing all variation in property types to be reflected in the intercept terms.

As in the base model, the coefficient of the weighted cost of debt is significantly different from zero (at the 1% level) but is not significantly different from one. In addition, the return to equity as well as the coefficient relating the cap rate to the earnings price ratio are significantly different from zero (at the 1% level). The equity parameter indicates that the estimated rate of return on equity for properties is 4.6%. The location coefficients are not significant, but this is not surprising given the crude measure of location used. In contrast to the insignificant parameter estimates from the SUR method, the interest yield spread is significantly positive (at the 10% level) and the earnings price ratio is significantly negative (at the 1% level). Again, these results

Exhibit 6

Panel A
Fixed Effects Estimation of Equation 2
Analysis-of-Covariance Model[1]

Variables	*Beta*	Std Error	*T*-Stat.
Fixed-Effects Intercept:[2]			
Apartment (α_1)	.0091	.0039	—
Commercial Retail (α_2)	.0095	.0039	—
Office Buildings (α_3)	.0087	.0039	—
Commercial Services (α_4)	.0082	.0040	—
Industrial (α_5)	.0119	.0040	—
Hotels (α_6)	.0237	.0042	—
Regression Parameters:			
DEBT	.9795	.0334	29.310***
EQUITY	.0485	.0101	4.799***

$R^2 = .709$
Adj. $R^2 = .705$
$N = 541$

Panel B
Test Statistics for Panel Data Model

Model	Log-Likelihood	Sum of Squares	*R*-squared
(1) Constant term only	1257.22338	.1116670	.0000000
(2) Group effects only	1325.83866	.0866486	.2240451
(3) X—variables only	1504.48233	.0447656	.5991152
(4) X and group effects	1591.45424	.0324571	.7093408

	Hypothesis Tests						
	Likelihood Ratio Test			*F*-Tests			
	Chi-squared	d.f.	Prob.	*F*	Num.	Denom.	Prob.
(2) vs (1)	137.231	5	.00000	30.895	5	534	.00000
(3) vs (1)	494.518	2	.00000	402.016	2	538	.00000
(4) vs (1)	668.462	7	.00000	185.823	7	533	.00000
(4) vs (2)	531.231	2	.00000	444.959	2	533	.00000
(4) vs (3)	173.944	5	.00000	40.426	5	533	.00000

[1]The sample contains six property types observed over ninety-four quarters from 1965 to 1988.
[2]The significance of the fixed-effects intercepts are tested using joint hypothesis tests for restricted and unrestricted models. The *F*-statistic for the restricted model with common intercept (3) and the fixed-effects model (4) is 40.426 [5,533]. Thus we reject the null hypothesis that the individual intercepts are all equal.

***significantly different from zero at the 1% level
**significantly different from zero at the 5% level
*significantly different from zero at the 10% level

Exhibit 7

Panel A
Fixed Effects Estimation of Equation 4
Analysis-of-Covariance Model[1]

Variables	*Beta*	Std Error	*T*-Stat.
Fixed-Effects Intercept:[2]			
Apartments	.0165	.0046	—
Commercial Retail	.0167	.0047	—
Office Buildings	.0196	.0051	—
Commercial Services	.0218	.0056	—
Industrial	.0225	.0051	—
Hotels	.0314	.0049	—
Regression Parameters:			
OTHER	−.0002	.0045	−.048
NORTH	.0008	.0032	.258
EAST	−.0005	.0031	−.146
SOUTH	−.0021	.0023	−.927
SPREAD	.0102	.0058	1.759*
EP	−.0915	.0269	−3.406***
DEBT	.9723	.0334	29.141***
EQUITY	.0466	.0101	4.603***

$R^2 = .718$
Adj. $R^2 = .711$
$N = 541$

Panel B
Test Statistics for Panel Data Model

Model	Log-Likelihood	Sum of Squares	*R*-squared
(1) Constant term only	1257.22338	.1116670	.0000000
(2) Group effects only	1325.83866	.0866486	.2240451
(3) X—variables only	1527.04875	.0411826	.6312019
(4) X and group effects	1599.43205	.0315138	.7177880

	Hypothesis Tests						
	Likelihood Ratio Test			*F*-Tests			
	Chi-squared	d.f.	Prob.	*F*	Num.	Denom.	Prob.
(2) vs (1)	137.231	5	.00000	30.895	5	534	.00000
(3) vs (1)	539.651	8	.00000	113.815	8	532	.00000
(4) vs (1)	684.417	13	.00000	103.107	13	527	.00000
(4) vs (2)	547.187	8	.00000	115.251	8	527	.00000
(4) vs (3)	144.767	5	.00000	32.338	5	527	.00000

[1]The sample contains six property types observed over ninety-four quarters from 1965 to 1988.
[2]The significance of the fixed-effects intercepts are tested using joint hypothesis tests for restricted and unrestricted models. The *F*-statistic for the restricted model with common intercept (3) and the fixed-effects model (4) is 32.338 [5,527]. Thus we reject the null hypothesis that the individual intercepts are all equal.

***significantly different from zero at the 1% level
**significantly different from zero at the 5% level
*significantly different from zero at the 10% level

suggest that the SUR method may not correctly capture the relationship between the cap rate and the returns in other capital markets.

Since the panel data results are more consistent with theory and previous empirical studies, we suggest that it provides a better test indicating that property types are an important factor explaining cap rate variation. Furthermore, the impact of property types is more clearly shown through shifts in the intercept term than in changes in individual coefficients of explanatory terms.

Conclusion

This study has presented and tested an analytical model of commercial capitalization rates. We develop a theory of commercial and industrial capitalization rates from the band of investment technique. In theory, the capitalization rate should be a function of property characteristics and alternative investment returns. Property characteristics will vary across both property types and property location.

The results from this study indicate that differences across property types are important in evaluating cap rates. The rank order for cap rates by property type from highest to lowest was hotels and motels, industrial, commercial services, offices, commercial retail and apartments. The implications for academics and real estate professionals is that failure to account for these differences across property types can lead to biased results.

We test the band of investment model of the cap rate using both Seemingly Unrelated Regression (SUR) and cross-sectional/time-series (panel data) regression methods. The results from both methods indicate the panel data technique estimates a model that better fits with the expectations from the theoretical model of the cap rate.

We further develop the model by incorporating location factors across different property types and returns in other capital markets into the analysis, providing a natural extension of the work by Grissom, Hartzell and Liu (1987). The results from the panel data model indicate that both portfolio variables are significantly related to the real estate cap rate. The model suggests that cap rates are negatively related to stock earnings/price ratios and positively related to expected inflation, proxied by the interest-rate spread. The insignificant results for the location factors may be a result of the crude measure of location used in this study.

Based on the results from this study, future research into commercial property valuation should not ignore the effects of different property classes. The results indicate that failure to control for property classes in aggregate data will lead to biased estimation results.

Notes

[1]Test results using the Froland model with our complete sample show that autocorrelation is present in the data. We calculated a Durbin-Watson statistic for the Froland model of .715 suggesting that autocorrelation is a significant problem.

[2]The theory behind the WACC is that a firm's capital cost is composed of the return on equity and return on debt, each weighted by its proportion to total capital (see Copeland and Weston, 1988).

[3]See p. 2, Hsiao (1986).
[4]We constrain the time series to the period between 1966 and 1988 due to availability of the data at the time of the analysis. Subsequently, ACLI has changed the format of the data reports.
[5]The data are collected from the ACLI quarterly *Investment Bulletin* from Table N (1Q66) and Table O (2Q66–4Q88).
[6]*LOAN AMOUNT* and *RATE* (the dollar weighted contract rate) are provided for descriptive purposes only and are not used in the analysis.
[7]It should be noted that hotels are apparently driving some of the results in Exhibit 2. When hotels are eliminated from the analysis, the significant differences become less significant. This gives greater weight to the caution to avoid using aggregate data to extrapolate to specific property types.
[8]Alternatively, one could also constrain β_1 to equal one in the estimation of the equation. However, this would potentially bias the parameter estimates for the other variables in the model.
[9]One possible reason for this result may be that capital market data are the same for all property types so they do not explain these variations.
[10]See Ch. 2 in Hsiao (1986).
[11]Depending on the type of research being conducted and the implicit assumptions made by the researcher, the researcher must choose between estimating H_4 using a fixed-effects or a random-effects assumption. Under the fixed-effects assumption, β is known as the covariance estimator and, under the random-effects model, β is estimated using the generalized least squares (GLS) techniques. The choice depends upon the assumption regarding the nature of α_i. Using the random effects form implies that the N property types (or individuals) are randomly drawn from a larger population. Whereas, with the fixed-effect model, the purpose of the analysis is to assess the differences between the property types in the data set. It should also be noted that the choice between the fixed-effect and random-effect model when T tends to infinity becomes moot. For all practical purposes, when T becomes very large the fixed-effects and random-effects models become indistinguishable. Thus we estimate H_4 using the fixed-effects assumption.

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