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WORKING PAPER NO. 90-174

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DETERMINANTS OF THE RATE OF RETURN FOR COMMERCIAL REAL ESTATE: INFLATION EXPECTATIONS AND MARKET ADJUSTMENT LAGS*

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January 1990

*An earlier version of this paper has been presented at a joint session of the American Economic Association and the American Real Estate and Urban Economics Association Meetings in Atlanta, Georgia, December 28–30, 1989. We thank Peter Colwell and David Dale–Johnson for their comments and suggestions on an earlier draft, and Young–Seop Rhee for his research assistance.

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I INTRODUCTION

The objective of this paper is to analyze economic forces that determine the rate of return for commercial real estate. Our statistical model decomposes the determinants for the rate of return for commercial real estate into three major components: (i) the property land use, (ii) the regional locale of the parcel, and (iii) the macro–environment. For the 1975–1984 time period, changing inflationary conditions are the key macro–economic variables. Since all three economic components may operate simultaneously and their impacts may change differentially over time, one of our principal tasks is separating the economic effects of each type of variable over time and across properties.

Our empirical model allows and tests for the possibility that real estate markets may be in disequilibrium. In this way, we segregate real estate equilibrium rates of return from disequilibrium effects (i.e., dynamic market adjustments). While the dynamics of market adjustments for real estate are not especially well understood, they, also, may be important and may differ from marketplace to marketplace and from time to time within a marketplace.

Our data set consists of 102 commercial real estate properties, which are one–hundred percent equity–owned and managed for large pension funds for 1975–1984. For each parcel, there is annual cash flow–income and market value appraisal information. The sample is dominated by industrial properties with a substantial portion located in California and Illinois.

A generation of real estate research has found that real estate rates of return outperform expected and unexpected inflation.[1] Our analysis casts doubt upon the universal validity of these earlier findings. In brief, we find that real estate need *not* outperform expected inflation. Proper analysis of real estate performance must take into account the interplay of local, regional and macroeconomic forces (e.g., inflation).

Our paper proceeds with a brief review of the literature about the interplay of disequilibrium adjustments, inflation and real estate market rates of return. Section III outlines our empirical model and presents our statistical findings. The last section provides a perspective for our findings.

II REAL ESTATE RATE OF RETURN LITERATURE

Two common features of earlier studies that have important consequences for this study, and, therefore, require special attention are: (*a*) real estate markets implicitly are assumed to be in equilibrium and (*b*) inflation is presumed to affect directly real estate values and rates of returns.

II.A Equilibrium Adjustment Mechanism in Real Estate Markets

Commercial real estate markets, especially office buildings and certain geographic areas, are frequently in a state of disequilibrium. Following Arrow and Capron's (1959) model of "shortages," Rosen and Smith (1983) and Smith (1987) show that the vacancy rate (quantity) adjustment is not a

[1]Zerbst and Cambon (1984), Sirmans and Sirmans (1987), and Miles (1989) provide summaries of the burgeoning literature about the real estate rates of return and inflation.

symptom of unusual irrationality or market failure in the real estate market, but is a part of the normal market adjustment process. The fundamental notion is that there is a natural vacancy rate such that at this rate there is no pressure for real estate values or rents to change. In a similar fashion, we subsume that there is a long–run equilibrium rate of return for real estate that is not necessarily achieved instantaneously. There are a variety of factors that may affect the natural vacancy rate and, therefore, the rate of return. These include the turnover rate of tenants, the notice time required to be given by tenants before vacating, the shape of the demand function for rental space, the operating costs function of landlords, the expected future changes in rent, and the rate of new construction relative to the existing stock. Because these factors vary from city to city and over time, it follows that the equilibrium rate of return might vary across cities and over time.

A parcel's *actual* vacancy rate or rate of return will not always be equal to the corresponding equilibrium rates, but may deviate from them for some time, primarily because of response lags in both demand and supply. Supply lags can be very lengthy and obvious. They arise for a variety of reasons, the most important of which include the time required to assemble land, receive government approvals, obtain financing and construct a project. Since in the short run new construction usually adds only a small percentage of the existing stock, shortages are likely to persist for a considerable period of time before they are recognized and overcome by new construction. Similarly, in the case of excess supply, deterioration or conversion is likely to occur at a very slow rate, causing the excess supply to persist for a lengthy period of time unless offset by demand growth.

Demand lags also arise in markets because shifts in demand usually occur in response to changes in economic fundamentals. Because the elasticity of demand with respect to price changes may be relatively low for physical space, substantial rental price changes are required for demand to adjust solely from price response.

Consequently, once a market is dislodged from equilibrium, excess demand or supply conditions may prevail for some time. Neither demand nor supply will adjust rapidly in the absence of price adjustments to alter this imbalance; furthermore, a low price elasticity would imply that very large price adjustments are necessary to equilibrate the market. A further implication is that the difference in vacancy rates between cities may reflect both differences in both current market conditions and natural vacancy rates. This, in turn, implies that rates of return may be out of equilibrium for a substantial period of time, until quantities of space adjust and prices–rentals are brought back into line.

II.B Inflation and Real Estate Performance

It is folklore that real estate outperforms expected inflation as well as unanticipated inflation. Hartzell, Heckman and Miles (1987) find that their "results ... provide strong evidence that diversified portfolios of commercial real estate have been a complete hedge against both expected and unexpected inflation over the period of 1973–1983." Gyourko and Linneman (1988) aver that "real estate is not homogenous in its inflation hedging traits. ... Some real estate particularly the total and appreciation returns on a broad set of income producing properties ... are strongly positively correlated with inflation in general and with unexpected inflation in particular."

Between 1977 and 1981, the Frank Russell Company Index for institutional properties earned a compound annual rate of return of 18 percent, well above the 11 percent increase in consumer prices over the same period. On *a priori* grounds, however, real estate does not necessarily have to outperform inflation. The implied 7 percent real return to real estate for 1977–1981 might be explained by other contemporaneous factors (perhaps in combination with inflation). During this period of time, office vacancy rates were negligible and shopping center properties had yet to feel the brunt of the 1981–1982 recession. Furthermore, there was a recovery in real estate values from the Real Estate Investment Trust debacle of the early 1970's.

As a further illustration of this issue, during the 1970's, real estate in the west and southwest did especially well. Much of the belief that real estate outperforms inflation is generated from this experience. As a counter point, real estate in the northeast did not do nearly as well. Conversely, in the early 1980's when disinflation prevailed, the northeast real estate markets, particularly in Boston and New York, surged, while the southwest markets commenced a spiralling decline.

In order to understand the relationship between inflation and rates of return for real estate, we examine two interrelated elements: (i) relationships among interest rates, leverage and real estate economics; and (ii) the relative effects of inflation on new construction and existing real estate.

Interest Rates and Leverage. The impact of changing inflation on real estate relates to rising interest rates. Changes in money and capital market expectations appear to lag movements in the expectations of inflation rates.

Consequently, changes in interest rates lag both increases and decreases in expected inflation rates.[2] Because real estate ownership is in general highly levered, small changes in financing conditions and loan terms have substantial impacts on project returns and risks. These impacts include

- Higher interest costs tend to reduce the amount of loan that a particular real estate project can support. This will tend to increase the amount of equity required to finance a real estate project in a business where leverage is "king."

- The debt service for many real estate projects is more sensitive to interest rate changes than will the revenue cash flow stream. More debt service means less expected net spendable income and a smaller margin for error (i.e., higher risk for the investor).

- Operating costs in the long run should keep pace with inflation; but an immediate change in inflation increases costs, with rents tending to lag due to fixed lease contracts (or *ex post* delayed passthrough clauses). Hence, costs immediately increase while rents lag, creating a profit squeeze.

- When inflation rates are rising rapidly, construction loan costs soar as prime rates increase dramatically and raise the costs of construction. Simultaneously, high mortgage interest rates reduce the "effective" demand for real estate and tend to depress the prices investors can

[2]Typically, *real* interest rates are low when inflation expectations are high; and, conversely, *real* interest rates are relatively high when expected inflation rates are declining. See Taylor (1982) and Dokko and Edelstein (1987).

afford (or are willing) to pay for real estate as well, causing slower absorption rates for real estate in general.

The Effects on New Construction Versus Existing Real Estate. Rising inflation will cause land holding costs, construction costs, interest rates and discount rates to rise (sometimes rapidly). These changes will cause the difference between project sales prices and total development costs to become intolerably small; and new development will cease or be curtailed significantly. Even though higher construction and land cost may *eventually* be covered by higher sale prices and rental incomes, market prices do not respond immediately. Thus, developers may have to survive an adjustment period until the market recovers and their products can be sold at a higher price.

While high interest rates and decreasing new construction harm builders and developers, the fates of owners of existing real estate will depend upon overall economic strength of their marketplace. Given growing demand for space resulting from population and income growth, decreasing construction reduces the potential supply of new competing products, engendering a real excess demand for real estate with decreased vacancies and increased rents. In this situation, rent increases should keep up with and often exceed the inflation rate. Subsequently, as long as expenses increase at the same rate or slower than inflation, project net income and the property value will increase (assuming a constant or falling market capitalization rate which is likely). In contrast, during periods of rising inflation, in locales where the economy is weak or stagnant, increases in income streams and market values are neither automatic nor do they accrue to owners of existing properties. If the economy is weak and the real estate market is characterized by over-building and an excess supply of available space, there will be no pressure for rents or property values to rise.

In summary, the relationship between the rate of return for real estate and inflation depends upon several interacting forces. Unanticipated inflation may cause uncertainty about the future as well as revisions of expected inflation. The real estate market will adjust to these changes in expectations; the adjustment process, among other things, will depend upon the strength of the local real estate market and the regional economy. Attributing real estate market performance to inflation may *not* be appropriate; instead market performance may relate to a disequilibrium adjustment process and/or idiosyncratic conditions of a particular real estate market that are neither long run nor certain.

III EMPIRICAL ANALYSIS

III.A Data

The real estate data set consists of 102 commercial properties, which are one-hundred percent equity-owned and managed for large pension funds between 1975 and 1984. Table 1 describes the geographic and land use composition of our sample parcels. The properties are dominated by industrial parcels, with a substantial portion located in California and Illinois.

(Please insert Table 1 about here.)

The principal dependent variable used in our analysis is the overall annual rate of return for each parcel between 1975 and 1984, R:

$$R_t = \frac{\Delta V_t + Y_t - C_t}{V_{t-1} + \frac{1}{2}C_t} - \pi_t$$

where V_t is the market value of the parcel in year t, Y_t is net operating income (annual cash flow) for year t, C_t is capital expenditure for year t, and π_t is the inflation rate for year t. Table 2 describes the nominal mean overall rates of return by property use, by location (state), and by time period.

(Please insert Table 2 here.)

The data base for inflation is the Livingston surveys. For each survey conducted in late November or early December in each year, the survey participants generated forward forecasts for the Consumer Price Index, from which we obtain annual expected inflation rates.[3] We compute unexpected inflation by taking the difference between the realized and expected inflation rates.

III.B Empirical Model

For a number of reasons, including the lag adjustment described above, the actual real estate rate of return may deviate from the expected equilibrium rate of return. Such deviations represent market disequilibria requiring rent and real estate quantity adjustments. The expected equilibrium rate of return should depend upon such variables as expected absorption rates, expected rental rates, operating costs, construction costs and real estate

[3]We follow Carlson's (1977) algorithm for computing expected inflation rates.

market risks. Because these variables are likely to differ across real estate sub–markets, so might the respective equilibrium rates of return. We employ a cross–section time–series errors component model (see Maddala (1971) and Nerlove (1971)) to estimate the equilibrium rate of return for each commercial real estate land use and geographic location as well as the persistence of disequilibrium. The basic model consists of two equations.

$$R_{ijt} = \alpha_i + \beta_j + \epsilon_{ijt}, \quad (1)$$

$$\epsilon_{ijt} = \lambda_j \epsilon_{ijt-1} + \gamma_t + \mu_{ijt} \quad (2)$$

where i, j, and t denote parcel land–use, location of parcel (geographic state), and time period, respectively; R_{ijt} is the real rate of return for parcel type i in location j at time period t; α_i is property–type specific equilibrium rate of return in time period 1 (holding locale as given); β_j is locale (state of parcel) specific equilibrium rate of return in time period 1 (holding property type as given); γ_t is the temporal–specific component of the rate of return; $\alpha_i + \beta_j + \gamma_t$ is the property type i locale j rate of return in time period t (note that $\gamma_t = 0$ for $t = 1$); ϵ_{ijt} is the deviation from the equilibrium rate of return; μ_{ijt} is white noise; and λ_j is a measure of the rate of return autocorrelation.

Combining equations (1) and (2) yields equation (3):

$$R_{ijt} = \lambda_j R_{ijt-1} + \alpha_i(1 - \lambda_j) + \beta_j(1 - \lambda_j) + \gamma_t + \mu_{ijt} \quad (3)$$

Equation (4) is the empirical form for estimating the parameters in equation (3):

$$R_{ijt} = \sum_{j=1}^{m}\sum_{i=1}^{n}\lambda_j R_{ijt-1} d_{ij} + \sum_{j=1}^{m}\sum_{i=1}^{n}\alpha_i(1-\lambda_j)d_{ij} + \sum_{j=1}^{m}\beta_j(1-\lambda_j)d_j + \sum_{t=2}^{T}\gamma_t\theta_t \quad (4)$$

where d_j, d_{ij} and θ_t are dichotomous dummy variables.

This model is a decomposition of variance into geographic market specific, time trend specific, property use specific, and pure random components. The model allows specific shocks to have impacts over more than one time period through the autocorrelated error structure. The estimated parameters of equation (4) can be interpreted as the market specific rate of return equilibria and the speed of adjustment to equilibrium rates of return. This model permits statistical testing of the following hypotheses:

1. Is there a significant lagged adjustment that differs across locales? The null hypothesis is $\lambda_1 = \lambda_2 = \cdots = \lambda_m \neq 0$.

2. Do rates of return differ statistically across locales? The null hypothesis is $\beta_1 = \beta_2 = \cdots = \beta_m \neq 0$.

3. Do rates of return differ statistically across property uses? The null hypothesis is $\alpha_1 = \alpha_2 = \cdots = \alpha_n \neq 0$.

4. Do rates of return differ statistically over time? The null hypothesis is $\gamma_2 = \gamma_3 = \cdots = \gamma_T \neq 0$.

III.C Empirical Findings

Table 3 contains our findings for several variants of equation (4). From these regression results, we draw several important insights about the determinants of the rate of return for commercial real estate. First, when lagged rates of return are used as the sole independent variables (see equation (a), Table 3), their coefficients are statistically significantly positive for parcels located in California, New York and Washington D.C. We reject the null hypothesis that the coefficients of the lagged rate of return are identical across geographical areas. This finding suggests that the market disequilibrium adjustment process may operate differently across real estate markets. Second, the results in equation (a), Table 3 do not necessarily imply that real estate markets in these geographic areas are inefficient, even though real estate rates of return are "predictable." Once parcel location and land use are added as explanatory variables for the current rate of return, the coefficients of the lagged rate of return are not statistically significantly positive.

(Please insert Table 3 here.)

Third, from equations (b), (c) and (d) in Table 3, the rate of return is systematically related to the parcel's locale. The coefficients for location specific dummy variables are statistically significant for properties in California, New York and Washington D.C. Similarly, though less systematic, the coefficients for the industrial parcel (by locale) dummy variables are statistically significant.[4]

[4]The effects of location and property type on the observed rate of return may be the consequences of the market disequilibrium speed of adjustment as well as relative property

Fourth, equations (e), (f) and (g) in Table 3 introduce time specific dummy variables to our analysis. The coefficients of the time specific dummy variables are statistically significant for the years 1979, 1980, 1982, 1983 and 1984. Apparently, changing economic conditions over time have a discernible impact on the rate of return for commercial real estate.

(Please insert Table 4 here.)

In order to explore more fully the potential impacts of the changing economic environment on the rate of return, equations (d) through (h) in Table 4 parallel equations (e) through (g) in Table 3 by substituting expected and unanticipated inflation for the time dummy variables. As before, locale and property type are significant determinants of the rate of return; while the lagged rate of return is not statistically significantly positive.

In equations (a), (b) and (c), Table 4, as found in other studies, both expected and unanticipated inflation are positively correlated with the rate of return. However, the effect of expected inflation on the rate of return becomes statistically insignificant when property locale and unanticipated inflation are included as explanatory variables (see equations (f) and (h) in Table 4); in contrast, unanticipated inflation is statistically important.

In principle, expected inflation should be incorporated into the expected rate of return. Our findings are consistent with the premise that real estate per se does not necessarily outperform expected inflation.

Because unanticipated inflation is associated with revisions in expectations about inflation and changing risks, its interplay with the local real

risk, an issue beyond the scope of the current study.

estate market is likely to be an important determinant of the rate of return. This explanation must be viewed cautiously because during our sample period expected inflation and unanticipated inflation are correlated.

Finally, the F tests (Tables 3 and 4) reject all of the joint coefficient null hypotheses for all of the sets of locale, property type, and time specific dummy variables. These results signify that the rates of return in real estate markets differ over time and from each other. Even though the characteristic–attributes for our parcel data are admittedly "crude," we conclude that the observed rates of return for commercial real estate can be decomposed into location specific, property use specific, and economic state/time specific components.

IV SUMMARY AND PERSPECTIVE

Our statistical model of the real estate market is predicated upon the notions that market disequilibrium adjustments and rates of return may vary from market to market. Our analysis has attempted to determine if the inter-market variation in the natural rate of return is significant; and the evidence suggests that it is. In the process of testing this hypothesis, we have demonstrated that the rate of return differs by land use and market area, as well as over time in response to changes in macroeconomic conditions. Finally, we also measured the persistence of shocks on the rate of return. Our empirical evidence suggests that the effects of a given shock dissipate rather quickly in most markets, and do not statistically appear to affect the rate of return after we take into account locational and property use differences.

We use inflation variables as surrogates for changes in macroeconomic conditions over time. Earlier studies find that real estate outperforms expected inflation. Our analysis casts doubt upon this claim. We find that commercial real estate may not outperform expected inflation. We believe that the impact of expected inflation (and other macroeconomic variables) on real estate rates of return depend upon the interaction of the macro environment and specific local real estate market conditions. In "hot markets," as characterized by general excess demand for real estate, increases in expected inflation will lead to "unanticipated" increases in real estate rates of return; and in "cool markets," this may not occur.

Future research should refine the analysis of how real estate markets respond to changes in economic conditions and the disequilibrium adjustment. In order to examine these effects statistically, the next step is to utilize detailed parcel data sets, containing a full range of refined measures of local and regional economic markets, specific property features, and the macroeconomy.

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Table 1

Sample Stratification By State and By Land Use

State	Number of Parcels	Land Use	Number of Parcels
California	23	Industrial,	
		Warehouse,	
Illinois	36	Distribution &	
		R & D	80
New York*	7		
		Office Building	9
Texas	9		
		Hotel/Motel	6
Washington, D.C.*	9		
		Retail	6
Georgia	4		
		Other	1
Arizona,		total	102
Colorado,			
Florida,			
Kentucky,			
Minnesota,			
Missouri,			
N. Carolina,			
Oregon,			
Tenessee, &			
Wisconsin	14		
total	102		

*: includes metropolitan area.

Table 3–A: Commercial Real Estate Real Rate of Return Regressions

$$
\begin{aligned}
R_t = {} & a_1(R_{t-1} \times \mathrm{CA}) + a_2(R_{t-1} \times \mathrm{NY}) + a_3(R_{t-1} \times \mathrm{DC}) + a_4(R_{t-1} \times \mathrm{IL}) + a_5(R_{t-1} \times \mathrm{TX}) \\
& + b_1\mathrm{CA} + b_2\mathrm{NY} + b_3\mathrm{DC} + b_4\mathrm{IL} + b_5\mathrm{TX} \\
& + c_1(\mathrm{CA} \times \mathrm{IN}) + c_2(\mathrm{NY} \times \mathrm{IN}) + c_3(\mathrm{DC} \times \mathrm{IN}) + c_4(\mathrm{IL} \times \mathrm{IN}) + c_5(\mathrm{TX} \times \mathrm{IN}) \\
& + d_1\mathrm{T77} + d_2\mathrm{T78} + d_3\mathrm{T79} + d_4\mathrm{T80} + d_5\mathrm{T81} + d_6\mathrm{T82} + d_7\mathrm{T83} + d_8\mathrm{T84}
\end{aligned}
$$

		Regressions			
coef.	var.	(a)	(b)	(c)	(d)
a_1	$R_{t-1}\times$ CA	0.279(5.23)	0.023(0.41)	0.029(0.53)	0.010(0.18)
a_2	$R_{t-1}\times$ NY	0.205(2.01)	0.062(0.63)	0.193(2.05)	0.058(0.59)
a_3	$R_{t-1}\times$ DC	0.212(1.73)	0.081(0.68)	0.178(1.56)	0.043(0.36)
a_4	$R_{t-1}\times$ IL	−0.017(−0.24)	−0.250(−3.54)	−0.251(−3.51)	−0.252(−3.59)
a_5	$R_{t-1}\times$ TX	0.098(0.76)	−0.032(−0.25)	−0.166(−1.24)	−0.196(−1.46)
b_1	CA		0.105(9.69)		0.065(2.86)
b_2	NY		0.093(4.30)		0.065(2.86)
b_3	DC		0.051(3.11)		0.089(3.19)
b_4	IL		0.065(7.82)		0.031(0.68)
b_5	TX		0.050(3.11)		−0.041(−1.27)
c_1	CA × IN			0.113(9.38)	0.049(1.98)
c_2	NY × IN			0.070(1.52)	−0.022(−0.43)
c_3	DC × IN			0.030(1.56)	−0.055(−1.68)
c_4	IL × IN			0.066(7.76)	0.036(0.78)
c_5	TX × IN			0.083(4.24)	0.127(3.23)
d_1	T77				
d_2	T78				
d_3	T79				
d_4	T80				
d_5	T81				
d_6	T82				
d_7	T83				
d_8	T84				
	Adj. R^2	0.04	0.20	0.19	0.22
	F for $a_1 = \cdots = a_5 = 0$	7.00	2.72	4.14	3.11
	F for $a_1 = \cdots = a_5$	2.93	2.72	5.12	3.01
	F for $b_1 = \cdots = b_5$		3.55		3.42
	F for $c_1 = \cdots = c_5$			4.12	3.63
	F for $d_1 = \cdots = d_8$				

t statistics are in parentheses next to coefficient estimates. List of dichotomy variables: CA = 1 if the parcel is located in California and 0 otherwise, NY = 1 if in New York and 0 otherwise, DC = 1 if in Washington D.C. metropolitan area and 0 otherwise, IL = 1 if in Illinois and 0 otherwise, TX = 1 if in Texas and 0 otherwise, IN = 1 if the parcel is industrial and 0 otherwise, and Txx = 1 if the observation occurs in year xx and 0 otherwise (xx is between 77 and 84). All F statistics are statistically significant at least at the 5% level.

Table 2 Sample Stratification for

Nominal Mean Annual Rate of Return (%)

By Year, By Location, and By Land Use

Year	All Parcels	Parcels in Illinois	Parcels in California	Industrial Properties
1975	7.8	9.9	8.5	7.1
	(7.9)*	(6.8)	(7.0)	(8.3)
1976	9.4	10.2	9.7	9.3
	(8.3)	(7.8)	(6.4)	(6.3)
1977	10.8	8.6	13.8	14.6
	(8.4)	(4.5)	(8.2)	(7.7)
1978	11.9	7.7	14.7	14.8
	(11.6)	(6.6)	(9.9)	(8.7)
1979	25.6	27.5	37.2	29.3
	(19.7)	(19.7)	(24.1)	(23.2)
1980	21.4	19.0	27.9	24.8
	(18.3)	(10.2)	(26.6)	(22.8)
1981	15.2	14.2	17.8	17.6
	(12.5)	(7.2)	(17.5)	(17.8)
1982	6.4	6.3	11.1	6.4
	(12.4)	(4.9)	(16.2)	(15.2)
1983	11.6	15.0	17.2	15.3
	(13.3)	(8.7)	(12.8)	(11.4)
1984	10.5	7.8	15.6	14.3
	(13.0)	(11.7)	(9.1)	(12.9)

*: numbers in parentheses are standard deviations.

Table 3–B: Commercial Real Estate Real Rate of Return Regressions

$$\begin{aligned} R_t = \; & a_1(R_{t-1} \times \mathrm{CA}) + a_2(R_{t-1} \times \mathrm{NY}) + a_3(R_{t-1} \times \mathrm{DC}) + a_4(R_{t-1} \times \mathrm{IL}) + a_5(R_{t-1} \times \mathrm{TX}) \\ & + b_1\mathrm{CA} + b_2\mathrm{NY} + b_3\mathrm{DC} + b_4\mathrm{IL} + b_5\mathrm{TX} \\ & + c_1(\mathrm{CA} \times \mathrm{IN}) + c_2(\mathrm{NY} \times \mathrm{IN}) + c_3(\mathrm{DC} \times \mathrm{IN}) + c_4(\mathrm{IL} \times \mathrm{IN}) + c_5(\mathrm{TX} \times \mathrm{IN}) \\ & + d_1\mathrm{T77} + d_2\mathrm{T78} + d_3\mathrm{T79} + d_4\mathrm{T80} + d_5\mathrm{T81} + d_6\mathrm{T82} + d_7\mathrm{T83} + d_8\mathrm{T84} \end{aligned}$$

		Regressions		
coef.	var.	(e)	(f)	(g)
a_1	$R_{t-1}\times$ CA	−0.016(−0.29)	−0.002(−0.03)	−0.001(−0.18)
a_2	$R_{t-1}\times$ NY	−0.018(−0.19)	−0.014(−0.15)	0.077(0.84)
a_3	$R_{t-1}\times$ DC	0.045(0.39)	0.084(0.73)	0.122(1.11)
a_4	$R_{t-1}\times$ IL	−0.264(−3.73)	−0.261(−3.66)	−0.269(−3.76)
a_5	$R_{t-1}\times$ TX	−0.132(−1.01)	0.027(0.22)	−0.086(−0.66)
b_1	CA	0.044(1.88)	0.085(6.63)	
b_2	NY	0.081(3.34)	0.077(3.45)	
b_3	DC	0.066(2.37)	0.028(1.63)	
b_4	IL	0.008(0.19)	0.044(3.96)	
b_5	TX	−0.061(−1.89)	0.026(1.48)	
c_1	CA × IN	0.051(2.10)		0.083(6.35)
c_2	NY × IN	−0.025(−0.51)		0.041(0.92)
c_3	DC × IN	−0.055(−1.74)		−0.002(−0.12)
c_4	IL × IN	0.036(0.82)		0.034(3.22)
c_5	TX × IN	0.119(3.15)		0.044(2.21)
d_1	T77	0.005(0.30)	0.004(0.30)	0.017(1.22)
d_2	T78	0.001(0.03)	0.001(0.01)	0.013(0.92)
d_3	T79	0.101(6.74)	0.100(6.67)	0.112(7.79)
d_4	T80	0.051(3.29)	0.050(3.22)	0.063(4.21)
d_5	T81	0.012(0.80)	0.010(0.68)	0.024(1.65)
d_6	T82	−0.035(−2.34)	−0.037(−2.48)	−0.022(−1.56)
d_7	T83	0.041(2.75)	0.042(2.77)	0.055(3.82)
d_8	T84	0.031(2.04)	0.029(1.94)	0.043(2.99)
	Adj. R^2	0.28	0.27	0.26
	F for $a_1 = \cdots = a_5 = 0$	3.03	2.80	3.34
	F for $a_1 = \cdots = a_5$	2.57	2.93	3.67
	F for $b_1 = \cdots = b_5$	3.77	4.38	
	F for $c_1 = \cdots = c_5$	3.72		4.83
	F for $d_1 = \cdots = d_8$	9.60	9.67	9.30

t statistics are in parentheses next to coefficient estimates. List of dichotomy variables: CA = 1 if the parcel is located in California and 0 otherwise, NY = 1 if in New York and 0 otherwise, DC = 1 if in Washington D.C. metropolitan area and 0 otherwise, IL = 1 if in Illinois and 0 otherwise, TX = 1 if in Texas and 0 otherwise, IN = 1 if the parcel is industrial and 0 otherwise, and Txx = 1 if the observation occurs in year xx and 0 otherwise (xx is between 77 and 84). All F statistics are statistically significant at least at the 5% level.

Table 4–A: Commercial Real Estate Real Rate of Return Regressions

$$\begin{aligned} R_t \; = \; & a_1(R_{t-1} \times \text{CA}) + a_2(R_{t-1} \times \text{NY}) + a_3(R_{t-1} \times \text{DC}) + a_4(R_{t-1} \times \text{IL}) + a_5(R_{t-1} \times \text{TX}) \\ & + b_1\text{CA} + b_2\text{NY} + b_3\text{DC} + b_4\text{IL} + b_5\text{TX} \\ & + c_1(\text{CA} \times \text{IN}) + c_2(\text{NY} \times \text{IN}) + c_3(\text{DC} \times \text{IN}) + c_4(\text{IL} \times \text{IN}) + c_5(\text{TX} \times \text{IN}) \\ & + e_1\text{EXINF} + e_2\text{UNXINF} \end{aligned}$$

		Regressions			
coef.	var.	(a)	(b)	(c)	(d)
a_1	$R_{t-1}\times$ CA				−0.004(−0.74)
a_2	$R_{t-1}\times$ NY				0.041(0.42)
a_3	$R_{t-1}\times$ DC				0.040(0.33)
a_4	$R_{t-1}\times$ IL				−0.269(−3.84)
a_5	$R_{t-1}\times$ TX				−0.203(−1.52)
b_1	CA				0.040(1.64)
b_2	NY				0.073(2.89)
b_3	DC				0.063(2.16)
b_4	IL				0.005(0.11)
b_5	TX				−0.068(−2.03)
c_1	CA × IN				0.050(2.01)
c_2	NY × IN				−0.023(−0.45)
c_3	DC × IN				−0.055(−1.70)
c_4	IL × IN				0.036(0.79)
c_5	TX × IN				0.127(3.26)
e_1	EXINF	0.879(13.18)		0.787(8.73)	0.395(3.01)
e_2	UNXINF		2.495(9.62)	0.516(1.53)	
	Adj. R^2	0.16	0.09	0.16	0.23
	F for $a_1 = \cdots = a_5 = 0$				3.47
	F for $a_1 = \cdots = a_5$				3.16
	F for $b_1 = \cdots = b_5$				3.53
	F for $c_1 = \cdots = c_5$				3.72

t statistics are in parentheses next to coefficient estimates. EXINF is the expected inflation rate; and UNXINF is the unexpected inflation rate. List of dichotomy variables: CA = 1 if the parcel is located in California and 0 otherwise, NY = 1 if in New York and 0 otherwise, DC = 1 if in Washington D.C. metropolitan area and 0 otherwise, IL = 1 if in Illinois and 0 otherwise, TX = 1 if in Texas and 0 otherwise, and IN = 1 if the parcel is industrial and 0 otherwise. All F statistics are statistically significant at least at the 5% level.

Table 4–B: Commercial Real Estate Real Rate of Return Regressions

$$R_t = a_1(R_{t-1} \times \text{CA}) + a_2(R_{t-1} \times \text{NY}) + a_3(R_{t-1} \times \text{DC}) + a_4(R_{t-1} \times \text{IL}) + a_5(R_{t-1} \times \text{TX})$$
$$+ b_1\text{CA} + b_2\text{NY} + b_3\text{DC} + b_4\text{IL} + b_5\text{TX}$$
$$+ c_1(\text{CA} \times \text{IN}) + c_2(\text{NY} \times \text{IN}) + c_3(\text{DC} \times \text{IN}) + c_4(\text{IL} \times \text{IN}) + c_5(\text{TX} \times \text{IN})$$
$$+ e_1\text{EXINF} + e_2\text{UNXINF}$$

coef.	var.	Regressions (e)	(f)	(g)	(h)
a_1	$R_{t-1}\times$ CA	−0.008(−0.15)	−0.010(−0.18)	−0.006(−0.10)	0.003(0.05)
a_2	$R_{t-1}\times$ NY	0.022(0.23)	0.022(0.23)	0.112(1.20)	0.026(0.26)
a_3	$R_{t-1}\times$ DC	0.016(0.14)	0.018(0.15)	0.110(0.97)	0.057(0.48)
a_4	$R_{t-1}\times$ IL	−0.268(−3.85)	−0.271(−3.88)	−0.279(−3.96)	−0.268 (−3.82)
a_5	$R_{t-1}\times$ TX	−0.184(−1.39)	−0.188(−1.41)	−0.140(−1.06)	−0.024 (−0.19)
b_1	CA	0.055(2.40)	0.049(2.02)		0.090(6.51)
b_2	NY	0.089(3.74)	0.084(3.30)		0.090(6.51)
b_3	DC	0.080(2.87)	0.074(2.53)		0.035(1.89)
b_4	IL	0.020(0.44)	0.014(0.31)		0.050(4.10)
b_5	TX	−0.052(−1.62)	−0.058(−1.73)		0.033(1.81)
c_1	CA × IN	0.050(2.03)	0.050(2.04)	0.084(6.14)	
c_2	NY × IN	−0.023(−0.47)	−0.023(−0.47)	0.041(0.90)	
c_3	DC × IN	−0.056(−1.74)	−0.057(−1.74)	−0.001(−0.02)	
c_4	IL × IN	0.036(0.80)	0.036(0.80)	0.036(3.22)	
c_5	TX × IN	0.125(3.21)	0.126(3.23)	0.049(2.37)	
e_1	EXINF		0.105(0.66)	0.367(2.77)	0.097(0.61)
e_2	UNXINF	1.183(4.32)	1.049(3.08)	0.821(2.44)	1.055(3.07)
	Adj. R^2	0.24	0.23	0.22	0.22
	F for $a_1 = \cdots = a_5 = 0$	3.37	3.42	3.87	2.98
	F for $a_1 = \cdots = a_5$	2.84	2.88	4.17	2.99
	F for $b_1 = \cdots = b_5$	3.61	3.61		3.83
	F for $c_1 = \cdots = c_5$	3.75	3.75	4.47	

t statistics are in parentheses next to coefficient estimates. EXINF is the expected inflation rate; and UNXINF is the unexpected inflation rate. List of dichotomy variables: CA = 1 if the parcel is located in California and 0 otherwise, NY = 1 if in New York and 0 otherwise, DC = 1 if in Washington D.C. metropolitan area and 0 otherwise, IL = 1 if in Illinois and 0 otherwise, TX = 1 if in Texas and 0 otherwise, and IN = 1 if the parcel is industrial and 0 otherwise. All F statistics are statistically significant at least at the 5% level.