Investor Rationality: An Analysis of NCREIF Commercial Property Data

Authors

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Abstract

National Council of Real Estate Fiduciaries multiple listing service level cash flows and panels of capitalization rates for industrial, office and retail properties over the last two decades are examined in this study. Real NOI 5-year future growth is shown to be negatively related to deviations of current real NOI from trend. Given this trend reversion in real cash flows, investor rationality requires that income multipliers be low (capitalization rates be high) when real cash flows are above trend and visa versa. In the panel estimates, the opposite is seen to be the case. Whether this is due to questionable data or irrational behavior is uncertain.

Introduction

Capitalization rates should be linked to expected real cash flow growth. The higher is expected real growth, the more investors should be willing to pay for a current dollar of cash flow and thus the lower should the capitalization rate be. To illustrate, when real rents are expected to rebound from a cycle bottom, investors should be willing to pay relatively more for a dollar of current cash flow—cap rates should be low—than when only normal growth is expected.

Real property cash flows per unit space have been shown to be mean reverting in the United States (Wheaton and Torto, 1994), as well as in many other countries.[1] As a result, when real cash flows are highest relative to trend, investors should expect negative (or at least below average) real cash flow growth and cap rates should therefore be relatively high.[2] However, based on panel estimation of NCREIF data, both Sivitanides, Southard, Torto and Wheaton (SSTW, 2001) and Chen, Hudson-Wilson and Nordby (CHN, 2004) report negative relationships between cap rates and the ratio of market to long run equilibrium real rents. SSTW conclude that U.S. investors have not built the ''obvious'' mean reversion of real rents into their forecasts of real rental growth and thus have overvalued property at rental cyclical peaks (used too low cap rates) and undervalued it at cyclical troughs.[3]

These results contrast markedly with those of Hendershott and MacGregor (2005), who find that investors in the office and retail markets in the United Kingdom have appropriately built mean reversion into U.K. cap rates. The contrasting results could be due to differences in modeling, in the quality of data, or in differences in U.K. and U.S. investor behavior. Regarding modeling, Hendershott and MacGregor found a strong link between property cap rates and the stock market (both the dividend price ratio and proxies for the expected growth rate in real dividends), a link not explored in the SSTW and CHN studies. As for data, two weaknesses in the U.S. data analyses are noteworthy. First, the NCREIF cap rate series are based, in part, on stale appraisals and, at certain times and places, on very few properties. Second, the real net rental data employed in constructing expected rental growth proxies are based on market rent (new leases) data rather than actual property cash flows.

The present paper takes another look at the NCREIF data, building different data panels and using real NOI cash flows. Stale appraisals are excluded in the computation of cap rates, as are periods and/or MSAs from the panel estimation when there are too few properties to give plausible NOI growth rates. Both underlying NCREIF NOI data and market rents are used to compute proxies for expected real NOI growth. Unfortunately, attempts to establish links to equity market variables similar to those found for the U.K. market have been unsuccessful and thus are not reported.

Section two describes the modeling framework and reviews the SSTW and CHN methodologies and empirical results. Section three describes the NCREIF cap rate and real NOI data used. There are serious concerns with the quality of the data. The capitalization rates are extremely volatile, and numerous outlandishly large (in absolute value) quarterly real NOI growth rates are observed. More specifically, MSA property level data are especially worrisome prior to 1985 (industrial) or 1986 (retail and office), owing largely to limited numbers of properties, and only six retail and office MSAs of plausible data quality even after 1985 can be identified.

The mean reversion proxies employed are shown to be good predictors of future real NOI growth in Section 4. The proxies are significantly negatively correlated with ex post five-year forward real NOI cash-flow growth; the greater is current real cash flow relative to its mean, the lower was ex post future real cash-flow growth. That is, real cash flows have been mean reverting. This result is similar to that obtained with U.K. property data.

Section five reports results for the industrial, office and retail markets. The results are fully consistent with SSTW and CHN, suggesting that U.S. investors do not appear to have built mean reversion into their forecasts of real cash flow growth and thus capitalization rates have been too low at rental peaks and too high at rental troughs. Section 6 summarizes the findings.

Modeling the Capitalization Rate

Value is the sum of all future discounted cash flows. If real cash flows are expected to grow at a constant rate g forever, R is the (constant) required rate of return on property, and leases are for single periods, then the ratio of next period's real cash flow to value, the cap rate is:

$$C = R - g. \tag{1}$$

With the required real return decomposed into the nominal 10-year Treasury rate, *R10*, plus a risk premium, *prem*, less expected 10-year inflation, *E*(*Inf10*), then:

$$C = R10 + prem - E(Inf10) - g. \tag{2}$$

Of course, leases are longer than one period and rarely would one expect future real discount rates and real cash flow growth rates to be constant. Thus Equation (2) is an approximation.

SSTW (2001) consider expectations of real cash flow growth as consisting of both extrapolative and regressive components. They base their expectations proxies on Torto-Wheaton newly-let or market real net rent series on fully-occupied space (see Wheaton and Torto, 1994, for a discussion of the calculation methodology). Their specific proxies are the percentage change in real net market rent during the previous year (%ΔCFM) and the ratio of current (annual average) market real market rent to its trend value (CFM/CFT):

$$g = g(\%\Delta CFM, CFM/CFT). \tag{3}$$

The greater is recent real growth, the higher is expected growth; the higher are real rents relative to trend, the lower should be expected growth.

For office and industrial properties, SSTW (2001) examine data from fourteen metropolitan markets for the 1984–2000 period; for retail, their data are from nine markets for the 1983–2000 period. Annual averages of quarterly data are employed. Variations in the real discount rate are captured by the 10-year Treasury bond rate and the previous year CPI inflation rate, which have positive and negative effects. The log of the cap rate is treated as the dependent variable and its lagged value is included as an independent variable to allow for a sluggish response of the capitalization rate to its determinants.

While the growth in real rent works as expected, the real net rent level variable has a negative coefficient, which is inconsistent with expectations of mean reversion in real rents. This conclusion is tempered by two considerations. First, the rent ratio is entered with a two-year lag. Rational forward-looking expectations require that the current rent ratio, not the lagged ratio, have a positive coefficient. If, to illustrate, the rent cycle were four years, two rising and two falling, forward-looking expectations would *require* that the lagged two-year ratio have a *positive* coefficient. Of course, the cycle is far longer than four years.

Second, it is the expected growth rate in actual real property cash flows, rather than in newly-let lease rates on fully let property, that is relevant to valuation. Thus there are two potential real cash flow adjustments, the movement of contract real cash flow to newly-let or market real cash flow and the movement of real market cash flow to long-run equilibrium. To reflect this, consider:

$$g = g(\overset{+}{\%\Delta CF}, \overset{-}{CF/CFM}, \overset{-}{CFM/CFT}), \tag{4}$$

where both of the level ratios should have negative impacts on the expected growth rate and thus positive impacts on the cap rate.

In a more recent study, CHN (2004) also estimate panels explaining NCREIF capitalization rates.[4] Their estimation differs from SSTW (2001) in important respects. First, they use PPR rather than TW real market rent indexes. Second, they take Equation (2) quite literally, constraining the coefficient on *R10* to unity by subtracting it from the right side, treating *C-R10* as the dependent variable. This greatly increases the importance of an accurate estimate of *E*(*Inf10*), but like SSTW, they simply use the previous year CPI inflation rate. Third, they use current, rather than lagged, values of the rent proxies.

Supporting the SSTW (2001) results, CHN (2004) report a negative relationship between cap rates and the concurrent ratio of real market rent to its mean value. Unfortunately, they interpret this variable as a determinant of the risk premium required on real estate, not of the expected growth rate in real cash flows. They argue that lower premiums are required in ‘‘hot’’ markets (high *CF*/*CFM*) and thus that the negative coefficient is consistent with rationality. The current study finds it implausible that a lower risk premium would rationally be required the greater is the downside risk to real cash flows (equities were less risky at the early 2000 peak than earlier?), much less that the magnitude of the premium impact would be greater than the positive impact on the cap rate through a lower expected real growth rate.

NCREIF Data

The capitalization rates and real net rent or NOI series are both from the NCREIF database and are discussed in detail below. To illustrate the construction of the data, consider the following example. Say that for a particular geographic area and property type there are thirty properties in quarter one and thirty-four in quarter two. For each property there is an NOI and a value estimate. Of the thirty-four properties in quarter two, twenty-eight are the same properties that existed in quarter one; two had been sold and six new properties were added to the database. Finally, say that only half of the properties had appraisals each quarter. Cap rates are calculated as the ratio of the aggregate NOI for the newly appraised properties to their aggregate appraised value. That is, to continue the example, in quarter one the aggregations are over only the fifteen properties with a ‘‘fresh’’ appraisal; in quarter two they are over only eighteen. The NOI index for quarter two is computed by multiplying the beginning period index number, say 100 for the first quarter, by 1 + g2, which is the ratio of the sum of the NOIs in quarter two to the sum in quarter one (and equals one plus the growth rate). Both sums are computed for the twenty-eight common properties in the two quarters. Similarly, 1 + g3 is calculated for quarter three by using the common properties in quarters two and three. The NOI index for quarter three is then the product of the quarter two index and 1 + g3 (in the example it would be 100 (1 + g2) (1 + g3)).

Capitalization Rates

Capitalization rates are computed as the ratio of a four-quarter average of aggregate property NOIs to current appraised value. The NOI average is of current, one future, and two lagged values. The averaging is necessary to smooth out the accounting data, which are highly volatile. However, even cap rates based on the smoothed NOI data are quite volatile, as shown below.

Unlike the SSTW (2001) and CHN (2004) studies, ‘‘stale’’ appraisals (those where there is no change in value and thus cap rates) have been excluded from the database. This deletes about half of the properties in any quarter because properties are appraised only twice a year on average.

The panels are determined in a multi-step process. First, the Investment Property Databank rule that no MSA observation be based on fewer than four properties and requiring that the panel not begin after 1984.1 is imposed. With these two rules, only four cities for were obtained for retail (Atlanta, Baltimore, Chicago and LA) and seven cities for office (Boston, Chicago, Dallas, Washington DC, Los Angeles, Minneapolis and New York City). In order to achieve larger retail and office panels and to get greater numbers of properties generally, some common or close MSAs have been aggregated. The aggregations are:

Baltimore/DC (to get retail)

Kansas City/St. Louis (to get retail)

New York City/Newark

Northern CA: Oakland, San Francisco, San Jose and Vallejo (to get office and retail)

Phoenix/Tucson (to get retail).

Southern CA: Los Angeles, Orange County and Riverside

South Florida: Fort Lauderdale, Miami and West Palm Beach (to get office)

Exhibit 1 lists the resulting fourteen cities (MSAs), the NCREIF codes for each, the year the series begins and the local CPI index used to deflate the nominal series. Industrial properties are most heavily represented in the NCREIF database and there are twelve potential cities beginning in 1980 or 1982. There are nine and eight potential cities for office and retail, beginning in 1981–1983 and 1982–1984, respectively. The term ‘‘potential’’ is used because the questionable quality of the NOI data caused the deletion of some of these series from the panels.

Exhibit 2 lists the average number of properties for each property type in each quarter. Two averages are computed, one for ‘‘early’’ years and one for later years. The breaks for the property types are: end 1985 (office), end 1987 (industrial) and end 1988 (retail). As can be seen, the early samples for office and retail have only nine properties on average, while that for industrial has twenty-two. There are more than twice as many properties in office and retail during the later years, with only one category, KC/St.L retail, averaging less than twelve properties per quarter. SSTW (2001) do not provide information on the number of properties in their MSA level NCREIF data. In personal correspondence, CHN (2004) state that they required a minimum of ten properties per observation when establishing their panels.

The Real NOI or Net Rent Data

The real rental (NOI) growth expectations variables (recent growth and the level of real net NOI relative to trend) require the calculation of real NOI indices. Nominal NOI indices are obtained by moving the initial index forward each quarter by multiplying it by unity plus the nominal growth rate in NOI. As explained above, for each MSA and property type, the NOI on all properties that existed in each pair of adjacent quarters (and whose characteristics did not change between the quarters) is aggregated and then the aggregate value in one quarter is divided by the aggregate value in the previous quarter to obtain unity plus the growth rate. The real net rent or NOI indices is obtained by deflating the nominal series by the area-specific CPI indices (equal to 1 in 1982–1984).

These inflation series are obtained from www.econmagic.com. Series are available for all but three of the areas. For DC/Baltimore, a series is available only after 1996. Prior to that the South Size A series is used, rescaling the city-specific

Exhibit 1 | MSAs or Aggr

City	MSAs	Initial Year			CPI Availability
		Industrial	Office	Retail	
Atlanta	520	80		84	Even months only
Boston	1123	82	83		Odd months only
Chicago	1600	80	81	84	All
Dallas	1920	80	83		Even until 98, then odd
Washington DC / Baltimore	8840+720	80	81	82	Only available 97-03 (odd); use South Size A earlier)*
Kansas City / St. Louis	3760+7040	80	83	84	Use Midwest Size A; even only until 1987
Minneapolis	5120	80	81		Even only until 1986
New York City / Newark	5600+5640		83		All
Northern California	7360+7400+8720+5775	80	82	82	Oakland, SF, SJ & Vallejo; all until 1998, then even only
Philadelphia	6160	82			All
Phoenix / Tucson	6200	80		82	Use West Size A; only even through 1986, then all
Seattle	7600	82			Only odd thru 1997; then only even
Southern California	4480+5945+6780	80	81	82	LA, Orange County, Riverside; all
Southern Florida	5000+8960+2689			84	Fort Lauderdale, Miami, WPB; only odd thru 1997; then only even
MSAs		12	9	8	

Note:
[a]The base for Washington DC in 1996 = 100, while South Size A it is the usual 1982–1984 = 100.

Exhibit 2 | Average Number of Properties Included in Cap Rate Series for Selected Subperiods

	Industrial		Offices		Retail	
	Pre 1988	1989–2002	Pre 1986	1990–2002	Pre 1989	1990–2002
Atlanta	16	26			6	13
Boston	7	17	6	17		
Chicago	43	56	10	27	11	20
Dallas	31	39	15	17		
Washington DC/Baltimore	10	29	12	48	8	18
Kansas City/St. Louis	9	16	7	15	5	8
Minneapolis	17	19	8	12		
New York City/Newark			6	14		
Northern California	47	59	9	31	8	20
Philadelphia	7	15				
Phoenix/Tucson	14	16			7	13
Seattle	10	25				
Southern California	49	110	12	30	14	34
Southern Florida					9	19
Average	22	36	9	23	9	18

Note: Averages computed from start dates of 1982 for industrial, 1983 for office and 1984 for retail.

series to equal the South Size A index in 1996.1. For KC/St.L, the Midwest Size A is used for all quarters, and for Phoenix/Tucson, West Size A is used for all quarters. For some series for some periods, the deflators are available only every other month. The average of all months available is used in the relevant quarter to obtain quarterly indexes.

The price level series rise at different rates, with the aggregate cumulative rise in the price level between 1985.1 and 2003.1 ranging from a low of 65% to 68% for Atlanta, Dallas, DC/Baltimore and KC/St.L to 82% to 84% in New York, Northern CA and Seattle, and to 88% in Boston. That is, Boston experienced a third more inflation than the first set of cities, and New York City, Northern CA and Seattle experienced a quarter more.

The underlying nominal NOI series exhibit extreme volatility, which generated an exploration of the outliers. More specifically, the study examined quarterly nominal NOI growth rates of greater than 25% in absolute value. While individual properties might occasionally experience sharp changes in quarterly NOI owing to the loss or gain of major tenants, averages of NOIs across eight to twenty-five properties would seem unlikely to experience sharp changes. Nonetheless, forty-eight quarters have negative growth rates greater than 25% and 113 quarters have positive growth rates greater than 25%. This is 6.5% of the total sample. As one might expect, there is a negative correlation between these outliers and the following or preceding quarterly observations. This is obvious in the scatter diagram of current nominal NOI growth against next period NOI growth in Exhibit 3, Panel A.

Exhibit 4 lists the number of outliers by city, property and magnitude. The numbers with absolute values between 25% and 33.3%, 33.3% and 50%, 50% and 100% and above 100% are listed. As can be seen in the average-per-MSA row, outliers are 60% and 80% more likely for office and retail than for industrial (even though the industrial data start a year earlier than office and two years earlier than retail). Altogether, the outliers constitute 4% of the total industrial quarters and 8% each of the office and retail quarters. Moreover, 1.5% of the total retail and office quarters have growth rates greater than 50% in absolute value, and all four of the over 100% absolute rental changes and three-quarters of changes between 75% and 100% are in office or retail.

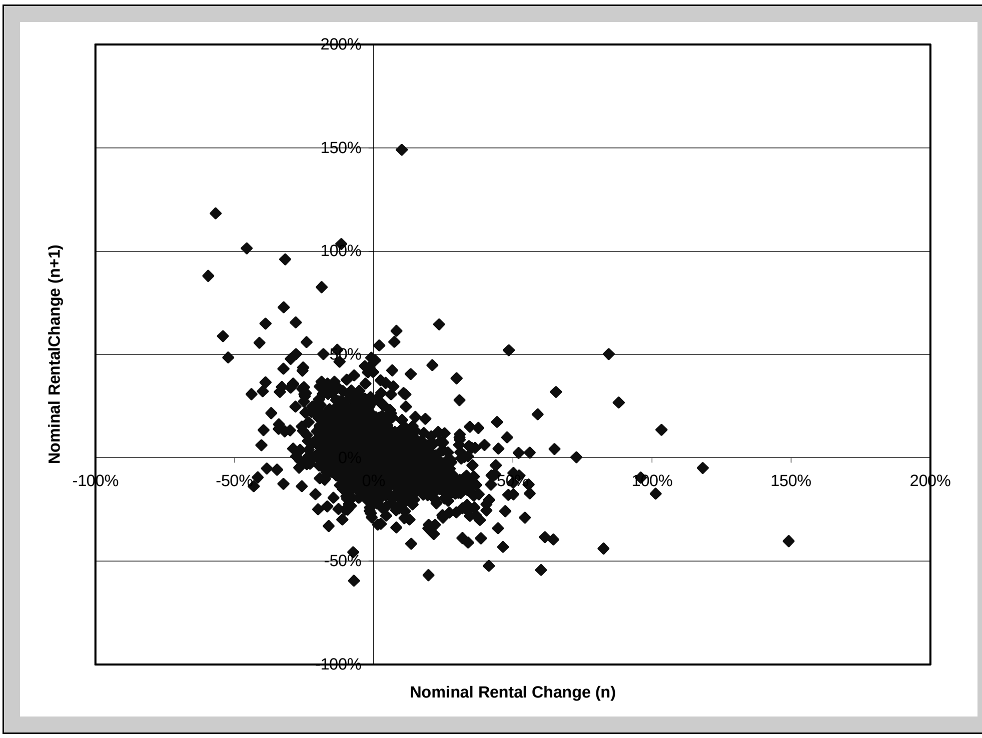
Because the numbers of properties in retail and office are less than half as many as those in industrial, this suggests, as expected, that outliers are concentrated in periods/MSAs where there are relatively fewer properties. To check this, Exhibit 5 shows the cumulative percentage of quarters in the total sample with numbers of properties less than different thresholds, as well as the percentage of outliers of different magnitudes with similar numbers.[5] As can be seen, only 20% of the total sample quarters have fewer properties than ten, while 37% to 75% of the outliers do, with the percentage rising with the size of the outlier. And while 75% of the total sample quarters have less than thirty properties, 95% of the outlier quarters do.

The outliers are also twice as likely to occur in the early years of the sample when the numbers of properties per quarter are relatively fewer. Forty-three percent (20 of 47) of the industrial outliers occur before 1985 or in the first 19% of the sample. Similarly, 44% of office outliers occur in the earliest 18% of the observations, and 26% of retail outliers occur in the earliest 14% of the observations.

This concentration in early quarters suggested that the panels begin later than that dictated by the four-property rule. The industrial panel begins in the first quarter of 1985 and the retail and office panels in the first quarter of 1986. That is, the industrial, office and retail panels begin one, two and three years later than SSTW

Exhibit 3 | Nominal NOI Percentage Change: Current Quarter versus Next Quarter

Panel A: Full Sample



Panel B: Reduced

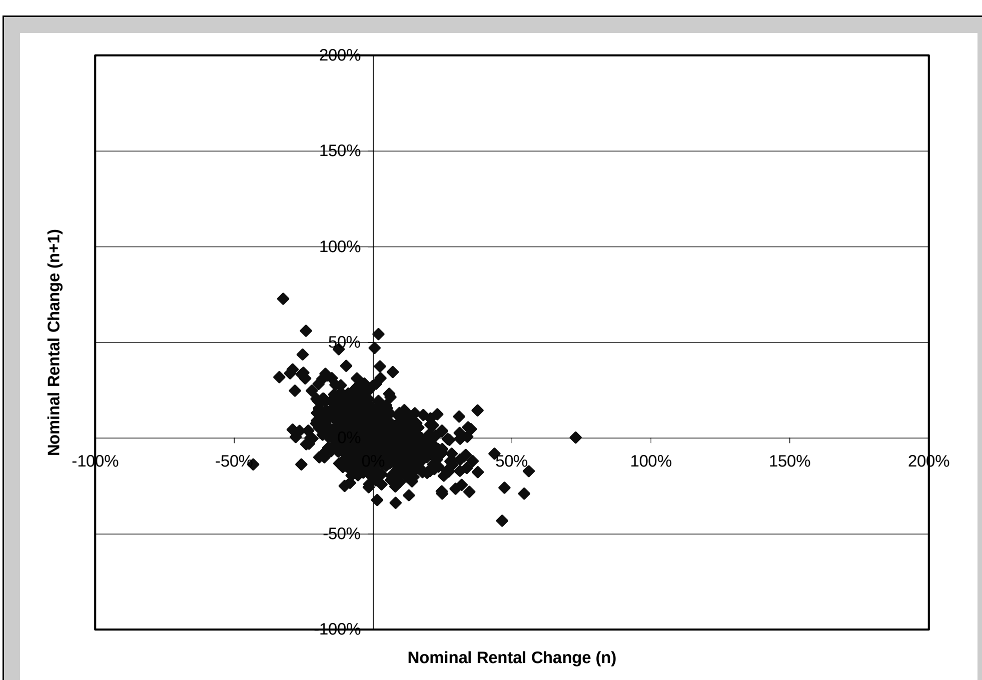


Exhibit 4 | Number of Quarters with Absolute Values of Percentage Change in Nominal NOI Growth within Indicated Ranges

Range		Absolute Values														
		25 to 33			33 to 50			50 to 100			>100			Total		
		I	O	R	I	O	R	I	O	R	I	O	R	I	O	R
Atlanta	520	2		3	1		4	0		1	0		1	3		9
Boston	1123	4	5		2	3		3	0		0	0		9	8	
Chicago	1600	1	4	4	2	3	2	1	2	1	0	1	0	4	10	7
Dallas	1920	0	3		0	4		0	2		0	0		0	9	
Kansas City / St Louis	3760	2	2	2	1	3	2	1	5	0	0	0	0	4	10	4
S. California	4480	0	2	1	0	1	1	0	1	0	0	0	0	0	4	2
S. Florida	5000			3			3			0			0			6
Minneapolis	5120	3	2		2	4		0	2		0	0		5	8	
New York City / Newark	5600		1			2			0			0			3	
Philadelphia	6160	2			1			1			0			4		
Phoenix / Tucson	6200	4		3	3		5	0		0	0		1	7		9
N. California	7360	0	4	6	1	1	1	0	1	1	0	1	0	1	7	8
Seattle	7600	3			0			0			0			3		
Washington DC / Baltimore	8840	3	4	2	4	1	1	0	0	2	0	0	0	7	5	5
Total		24	27	24	17	22	19	6	13	5	0	2	2	47	64	50
Average per MSA														3.9	7.1	6.25

Note: Based on data from the start dates shown in Exhibit 1 until 2003.1.

Exhibit 5 | Cumulative Percentage of Quarterly Nominal NOI Growth in Specified Ranges by Number of Properties Used in Calculation

Number of Properties	<10	<15	<20	<30	<200	Number of Observations
Percentage of total sample	20	40	57	75	100	2511
Observations with absolute value:						
25% to 33.3%	37	67	84	95	100	75
33.3% to 50%	45	84	91	93	100	58
50% to 100%	63	83	92	96	100	24
>100%	75	75	75	100	100	4

Note: Based on Exhibit 1 starting dates.

(2001). Even with this later start, a number of MSAs continue to have outliers (over five). As a result, two or three MSAs have been dropped from each panel. Boston and Phoenix/Tucson have been deleted from the industrial panel, leaving ten MSAs. Dallas, Minneapolis and Northern CA have been deleted from the office panel, leaving six MSAs, and Atlanta and Phoenix/Tucson have been deleted from the retail panel, again leaving six MSAs.

Exhibit 6 shows that dropping a few MSAs and starting the panels a bit later eliminates all the outliers with growth rates over 100% in absolute value, 88% of the outliers between 50% and 100%, 78% of those between 33.3% and 50%, and 61% of those with absolute growth rates between 25% and 33.3%. In Exhibit 3, Panel B is the scatter diagram of current nominal NOI growth against next period NOI growth for the remaining data. A simple correlation of the current and next period changes in nominal NOI growth in these data is −0.42.

The main difference in the final panels from those of SSTW (2001) is that they include Denver and Houston in their office and industrial panels, while in this study, Seattle is included in the industrial panel and South Florida in the retail panel. Further, they include Washington DC, New York City, Oakland, Los Angeles and Orange County separately, while they are aggregated in this study, respectively, with Baltimore, Newark, San Francisco–San Jose–Vallejo (into Northern CA) and Orange County–Riverside (into Southern CA).

The Resulting Data

Exhibit 7 plots the office cap rates. These rates declined modestly throughout most of the 1980s, troughing in 1990 or early 1991. They then rose by two to three percentage points through the middle 1990s (Kansas City through 1999). Nearly

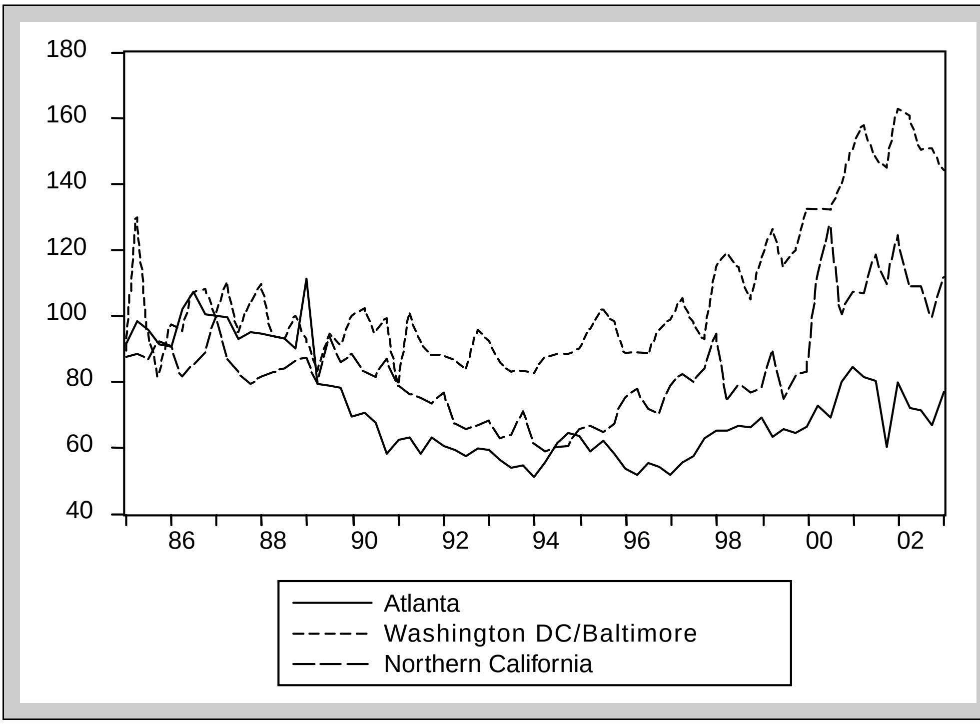
Exhibit 6 | Number of Quarters with Absolute Values of Percentage Change in Nominal NOI within Indicated Ranges–Revised Sample

Range		Absolute Values														
		0.25 to 0.33			0.33 to 0.5			0.5 to 1			>1			Total		
		I	O	R	I	O	R	I	O	R	I	O	R	I	O	R
Atlanta	520	2			1			0			0			3		0
Boston	1123		0			0			0			0			0	
Chicago	1600	1	4	1	0	1	0	0	0	1	0	0	0	1	5	2
Dallas	1920	0			0			0			0			0		
Kansas City / St Louis	3760	2	1	2	1	2	2	1	0	0	0	0	0	4	3	4
S. California	4480	0	1	1	0	0	1	0	0	0	0	0	0	0	1	2
S. Florida	5000			2			2			0			0			4
Minneapolis	5120	0			0			0			0			0		
New York City / Newark	5600		1			1			0			0			2	
Philadelphia	6160	1			0			0			0			1		
Phoenix / Tucson	6200															
N. California	7360	0		4	1		0	0		1	0		0	1		5
Seattle	7600	1			0			0			0			1		
Washington DC / Baltimore	8840	2	1	2	1	0	0	0	0	0	0	0	0	3	1	2
Total		9	8	12	4	4	5	1	0	2	0	0	0	14	12	19

Note: Industrials start in 1985; Office and Retail in 1986.

Exhibit 7 | Office Cap Rates

Panel A



Panel B

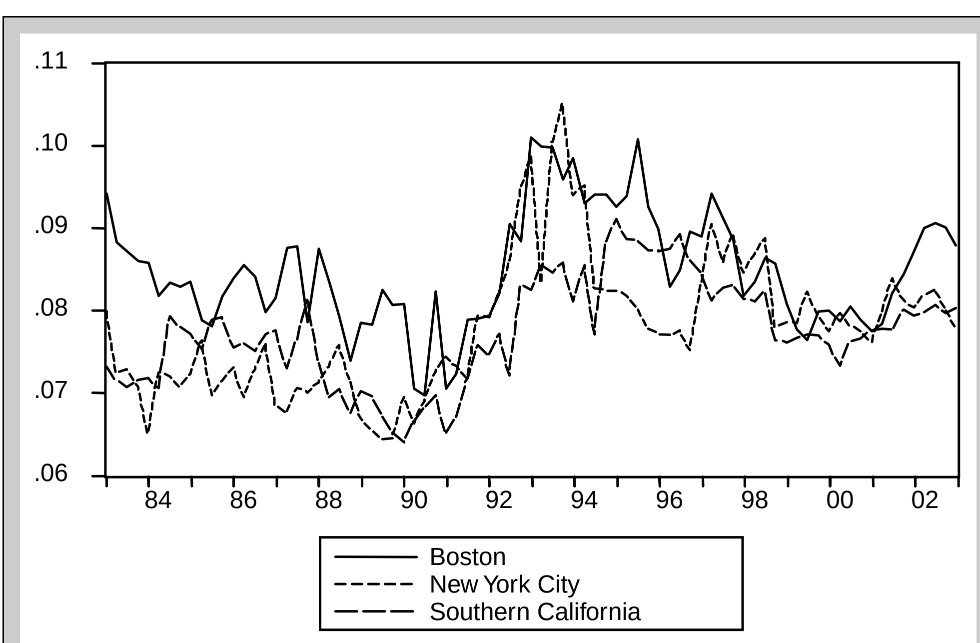
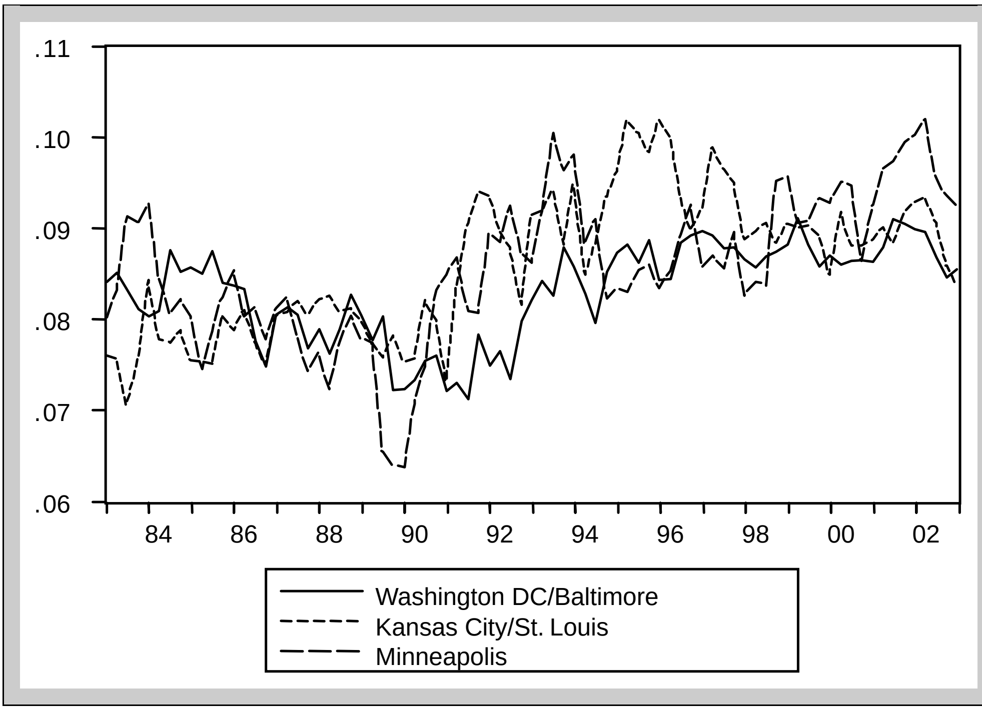


Exhibit 7 | (continued)

Office Cap Rates

Panel C



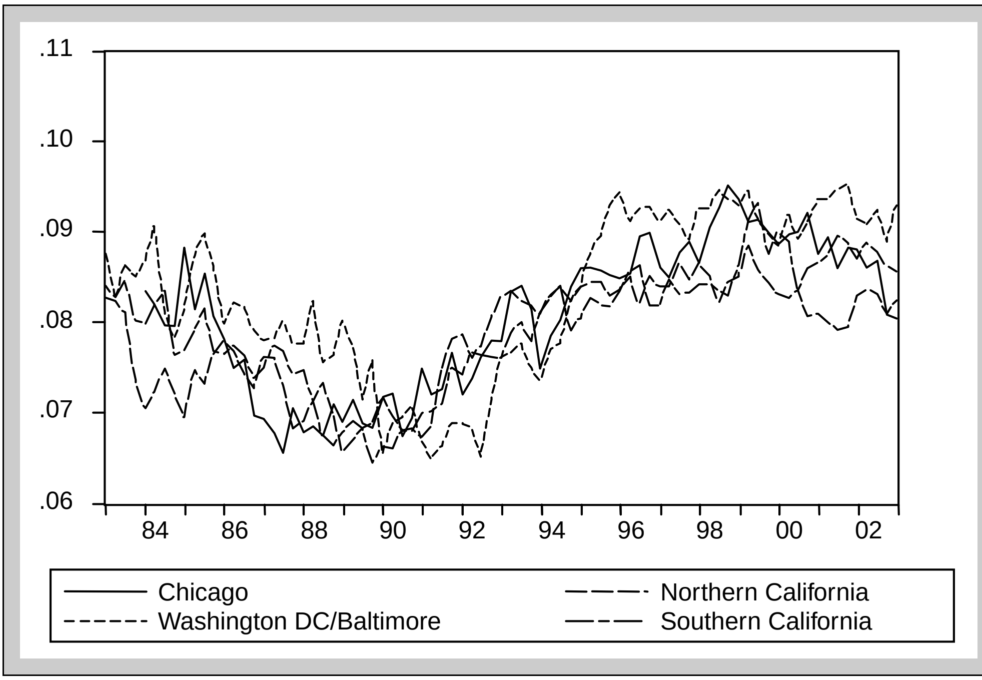
all then declined through 1998 (Washington DC/Baltimore and KC/St.L being the exceptions). After that point most remained roughly flat, although Boston and Chicago rose by a percentage point or two.

The retail cap rates are in Exhibit 8. While volatile, the cap rates for the four cities in Panel A exhibit common movement. Rates declined by one to two percentage points in the 1980s, and then rose by two to three percentage points in the 1990s, with most of the rise occurring in the first half of the decade. Cap rates are even more volatile in the four cities in Panel B, with little evidence of a trend decline in the 1980s. There is a common sharp rise in the first half of the 1990s, but a roughly two percentage point decline in the late 1990s. Cap rates in KC/St.L and South Florida reversed sharply in 1999–2000.

The industrial cap rates are in Exhibit 9. The rates for most cities—those in Panel A—are roughly flat from 1981 to 1991 at 7.5% to 8%, jump in the next two years, and are then flat for the 1993–2002 period at 9% to 9.5%. The exceptions are Chicago, Washington DC/Baltimore and Seattle, where the rates are relatively stable throughout the entire twenty-year period.

Exhibit 8 | Retail Cap Rates

Panel A



Panel B

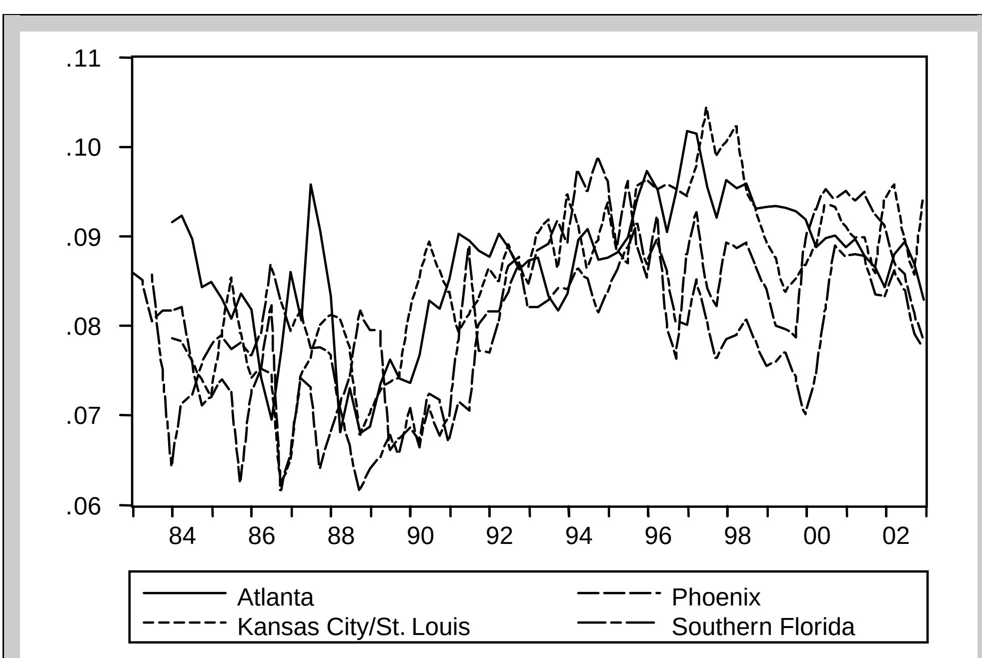
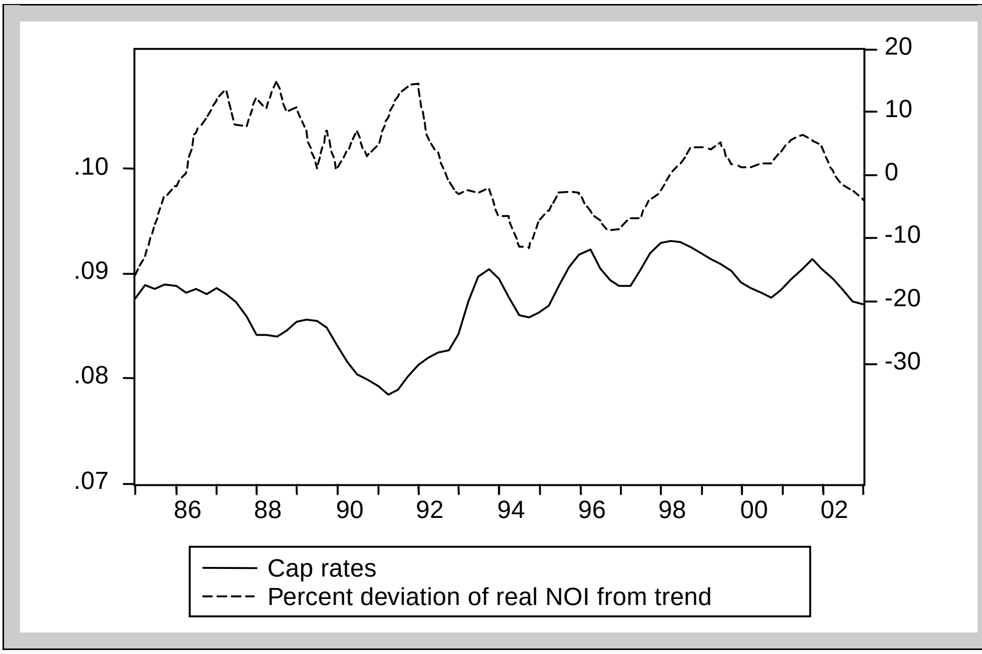
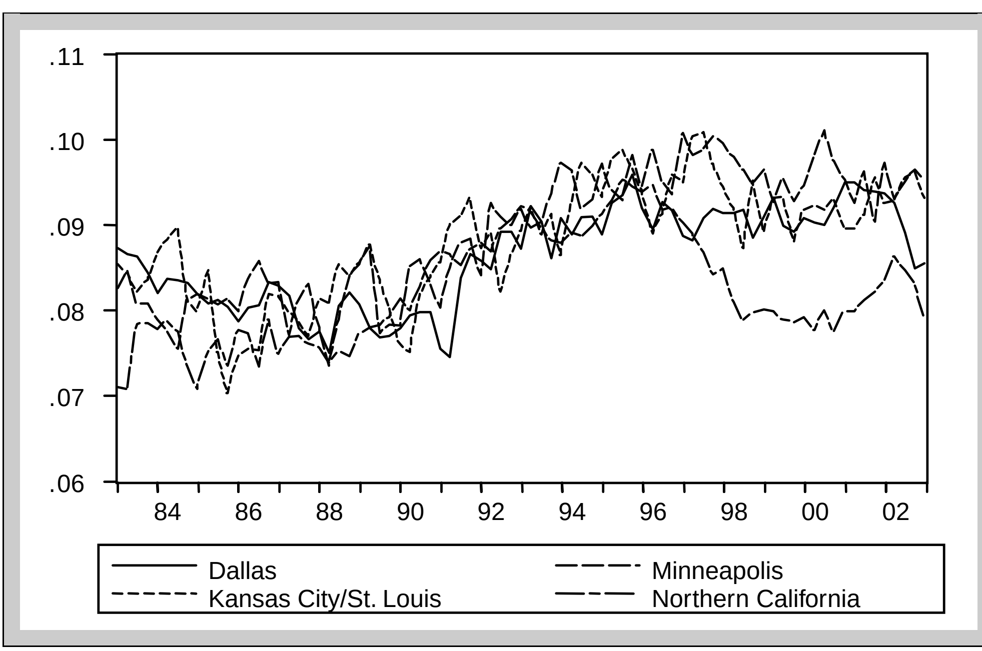


Exhibit 9 | Industrial Cap Rates

Panel A



Panel B



Exhibits 10–12 plot the real NOI series for the MSAs and years in the final data set. Of the six office MSAs, all experienced a 25% to 50% decline in real NOI through the middle 1990s and then all except Boston reversed and recovered most of the loss. Boston real rents initially declined by 50%, falling all the way through 1997, and were then flat.

In contrast to real office NOIs, real retail NOIs neither fell sharply in the late 1980s and first half of the 1990s nor rebounded after that, with two exceptions: KC/St.L and Northern CA real NOIs did decline by 30% in the late 1980s and stayed at that lower level, but Washington DC/Baltimore and Chicago both experienced 25% to 40% real increases over the entire period; Southern CA and South Florida were basically flat. While all real retail NOI series are volatile, the California series are particularly so.

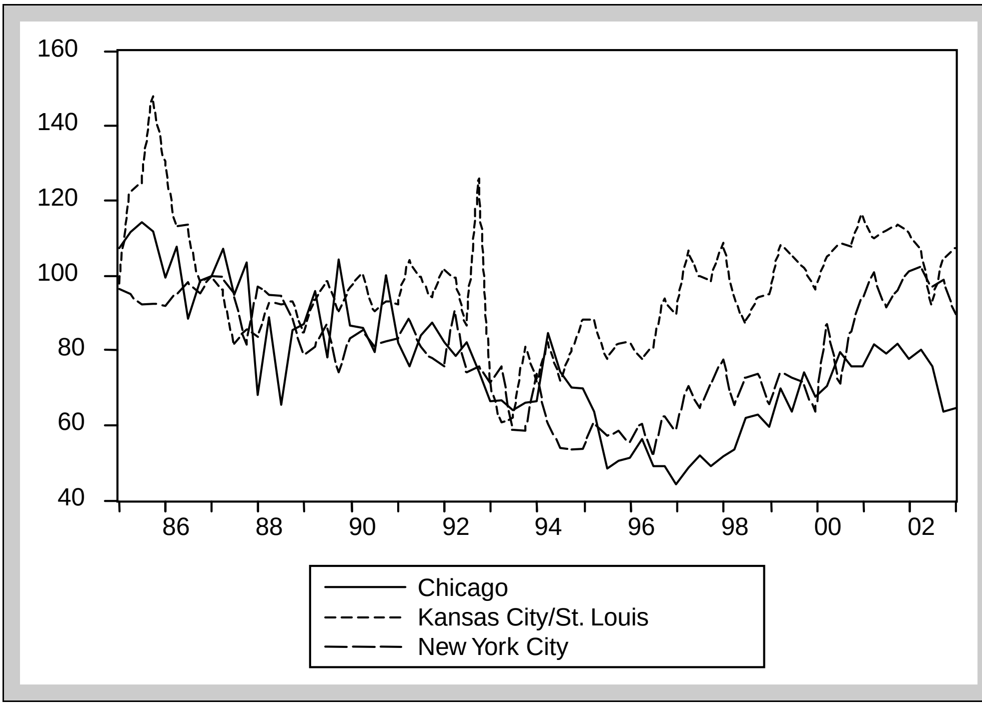
Most industrial real rent series declined by 20% to 50% from the mid 1980s through 1993 or 1994. Exceptions are Washington DC/Baltimore, KC/St.L, Minneapolis and Southern CA, where real NOIs were basically flat (KC/St.L had a 1985–1988 blip and then reversal). The largest declines were for Dallas and Philadelphia. After 1993–1994, real NOIs in six of the ten MSAs were roughly flat through 2002. Washington DC/Baltimore and Northern CA experienced huge increases (60% to 100%), while Chicago, Minneapolis and KC/St.L had about 30% declines. In 2002, real industrial NOIs were 30% to 50% below their mid1980s levels in all cities except Washington DC/Baltimore and Southern CA. The former were flat, while the latter were 50% higher.

Exhibit 13 reports both the correlations between the real NOI series reported here and the comparable Torto-Wheaton rent series and the ratios of their standard deviations (in parentheses). The series are for the 1985.1 (industrial) or 1986.1 (office and retail) to 2002.4 period. There are two obvious reasons for the NCREIF and TW series to move differently. First, the NOIs refer to cash flows from sitting tenants while the TW series represent newly-written leases or market rents on fully occupied properties. Second, in some cases the aggregated MSAs have been aggregated (*e.g.*, Washington DC and Baltimore), while in the TW series they were not.

Half the office correlations are 0.8 or higher, and the modest Kansas City correlation can be explained by including St. Louis. Half the industrial correlations are 0.7 or higher, and the ‘‘zero’’ Washington DC and Kansas City correlations are at least partially explained by MSA coverage differences. Nonetheless, there are some surprising low correlations caused by rather fundamentally different movements in the series. To illustrate, the low Boston office correlation reflects a 33% decline in the NCREIF series between 1992 and 2000 versus a 70% rise in the TW series. And the negative correlations for Chicago (−0.33) and DC (−0.52) retail are due to sharp divergences in the series in the 1988–1994 period. In Chicago, NCREIF NOI was flat, while TW rent fell by 20%, and in Washington DC (and Baltimore), NCREIF NOI rose by 40% versus a 30% decline in the TW data.

Exhibit 10 | Real Office NOI

Panel A



Panel B

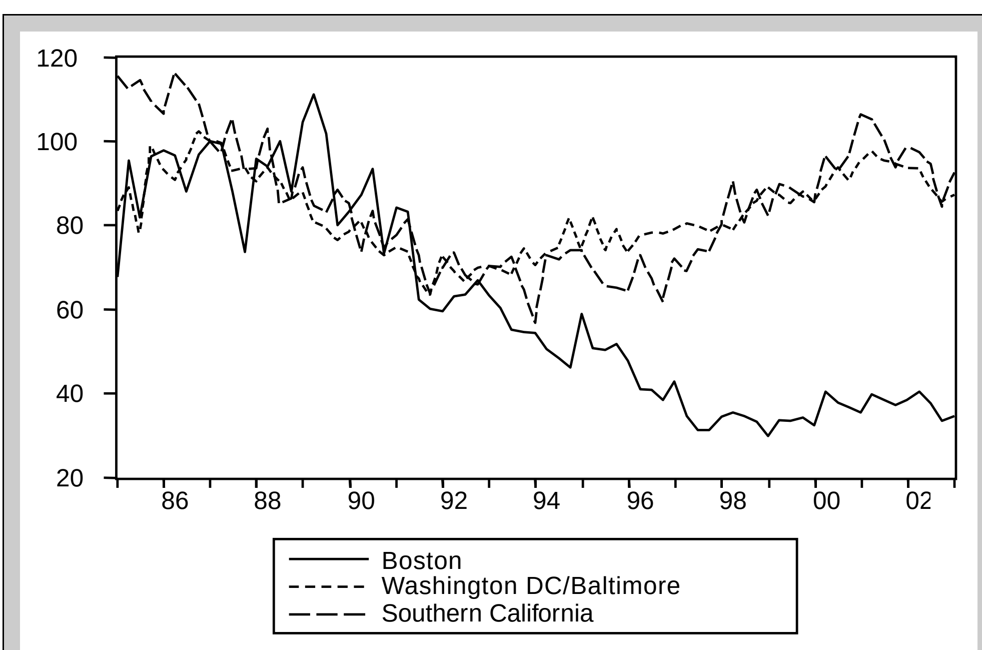
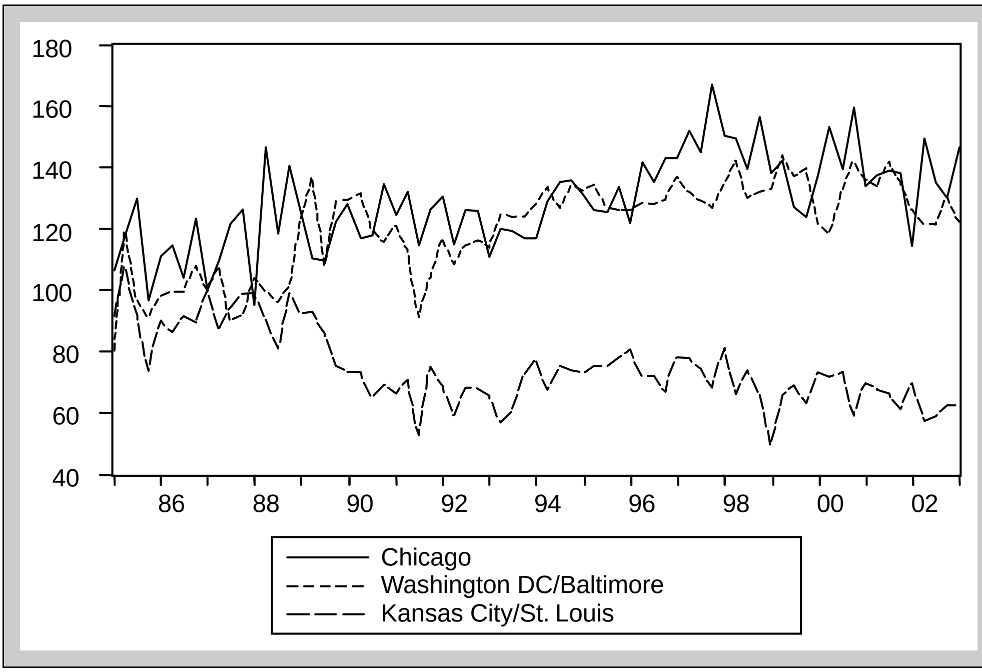


Exhibit 11 | Real Retail NOI

Panel A



Panel B

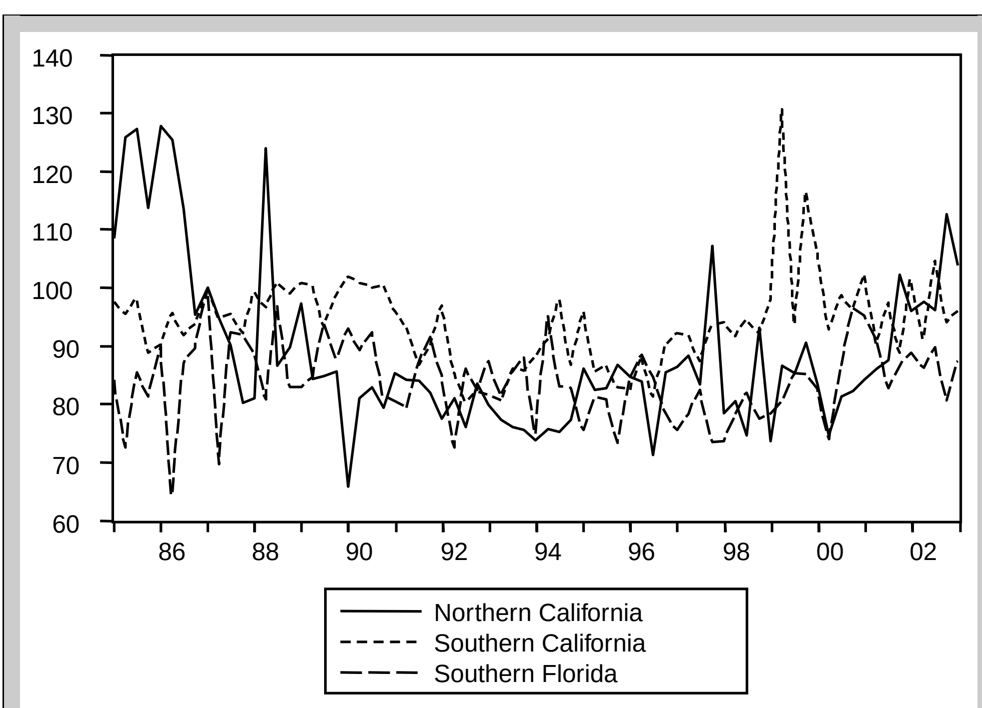
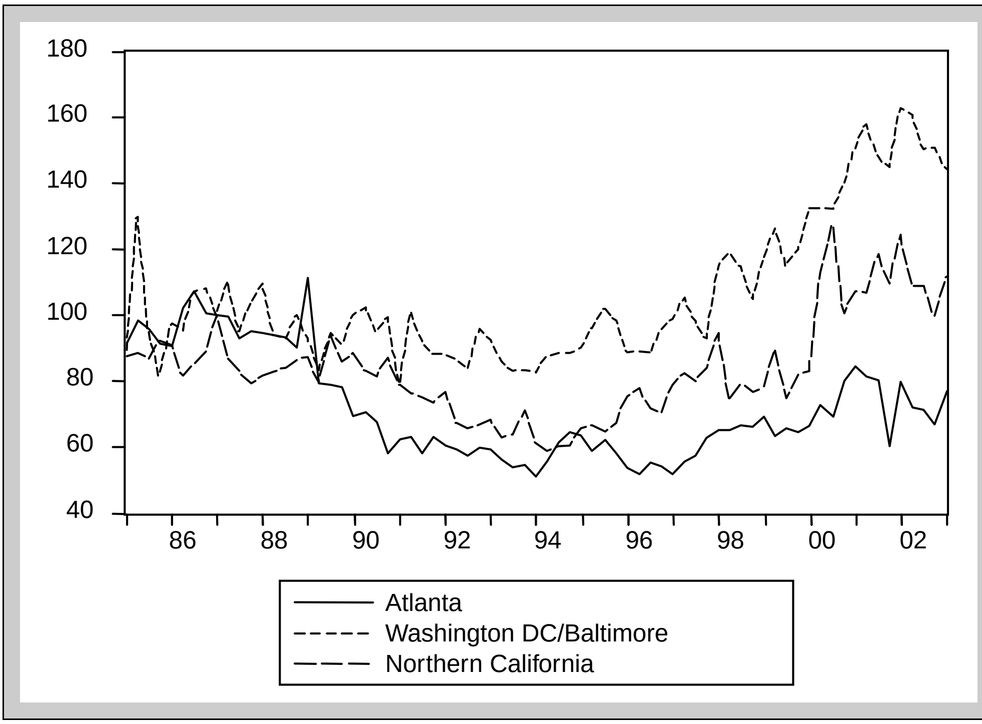


Exhibit 12 | Real Industrial NOI

Panel A



Panel B

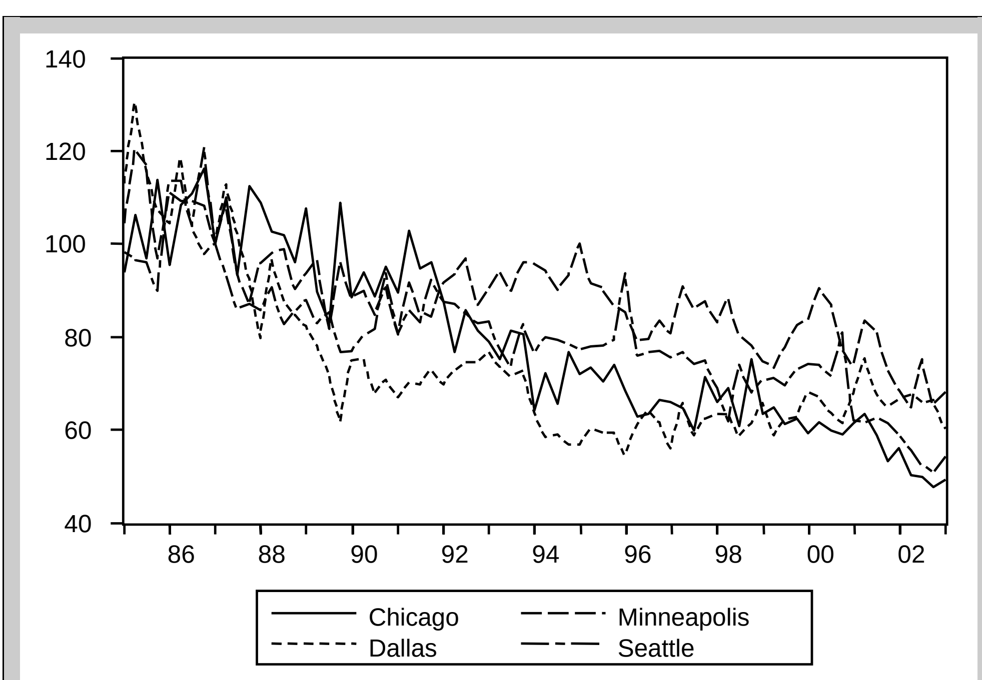
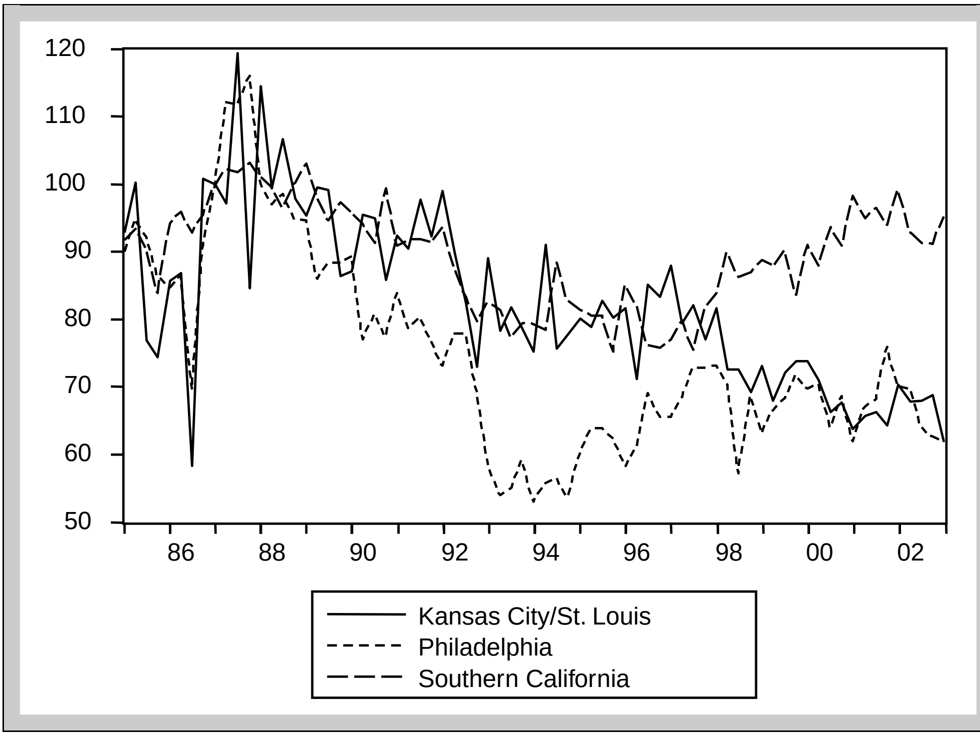


Exhibit 12 | (continued)

Real Industrial NOI

Panel C



Despite dropping the MSAs with the most volatile real NOI growth and data from the more volatile early years, an overriding concern is the substantial volatility still remaining. On average, the standard deviations of the office and industrial real NOI series are 4.5 times greater than those of the TW real rent series.[6] The standard deviation for the retail sector is 11 times greater (TW interpolated annual data to obtain quarterly rent series). While the NCREIF NOI data would be expected to be more volatile owing to changes in occupancy rates, rental rates on existing contracts should move sluggishly relative to those on new contracts. Simply put, the volatility in these real NOI series stretches credibility. And this volatility is undoubted a source of the volatility in the capitalization rates.

The Validity of the Mean or Trend Reversion Proxies

The validity of the mean or trend reversion proxies for the expected rate of growth in real NOI is examined by correlating actual real NOI growth over the next five years with two measures of the divergence of real NOIs from trend values. The

Exhibit 13 | Correlation of NCREIF Real NOI Levels with TW Real Rent Levels and Ratio of Standard Deviation of Quarterly Growth Rates (in parentheses)

	Office	Retail	Industrial
Atlanta			0.85 (4.6)
Boston	0.18 (2.6)		
Chicago	0.55 (6.4)	−0.33 (16.7)	0.53 (6.8)
Dallas			0.75 (3.5)
Washington DC / Baltimore	0.85 (2.2)	−0.52 (6.0)	−0.11 (4.9)
Kansas City / St. Louis	0.34 (4.1)	0.65 (10.4)	0.09 (5.4)
Minneapolis			0.11 (6.2)
Northern California	0.80 (5.5)	0.07 (10.6)	0.54 (3.8)
Philadelphia			0.78 (3.5)
Southern California	0.88 (5.2)	0.43 (11.6)	0.88 (3.3)
Seattle			0.70 (1.2)
Southern Florida		0.35 (10.7)	

Note: Estimation for Industrials: 85.1-03.1; Retail and Offices 86.1-03.1.

two measures are the log deviation of real NOI from its trend value and the ratio of real NOI to its mean. The correlations are for 1986.1–1998.1 (the last five years of observations are lost because five years of future cash flows are needed). A negative correlation is expected: the more positive is the deviation or the ratio, the lower should future growth be.

The results are in Exhibit 14. The correlations are strongly negative, and they are similar for the two measures of divergence. The average correlation coefficient for the property types (average of six MSAs for offices and retail and ten for industrial) are listed at the bottoms of the panels. The strongest mean negative correlation is −0.71 for offices; the correlations are about −0.6 for retail and industrial. While these correlations are lower in absolute value than the −0.87

Exhibit 14 | Correlation of Proxies for Expected Real NOI Growth with Actual Five-Year Forward Real Growth

	RES[a]	NOI / NOI Mean
Panel A: Office		
Boston	−0.54	−0.53
Chicago	−0.68	−0.63
Washington DC / Baltimore	−0.94	−0.91
Kansas City / St Louis	−0.44	−0.44
New York City	−0.80	−0.86
Southern California	−0.86	−0.89
Average	−0.71	−0.71
Panel B: Retail		
Chicago	−0.58	−0.49
Washington DC / Baltimore	−0.68	−0.83
Kansas City / St. Louis	−0.64	−0.58
Northern California	−0.45	−0.52
Southern California	−0.75	−0.72
Southern Florida	−0.51	−0.52
Average	−0.60	−0.61
Panel C: Industrial		
Atlanta	−0.76	−0.89
Chicago	−0.38	−0.06
Dallas	−0.16	−0.79
Washington DC / Baltimore	−0.73	−0.42
Kansas City / St. Louis	−0.40	−0.24
Minneapolis	−0.57	−0.08
Northern California	−0.84	−0.77
Philadelphia	−0.90	−0.87
Seattle	−0.43	−0.05
Southern California	−0.92	−0.92
Average	−0.61	−0.51

Notes: The period for Industrials is 85.4-98.1, for Offices is 86.4-98.1 and for Retail is 87.4-98.1 (as full Southern Florida data start in 87.1). Four quarters are needed to start the moving averages and five years at the end for the five-year actual future NOI. The ratio of real NOI to its mean is for the maximum period possible (as in the regressions).

[a] RES is a four-quarter moving average of the residual from a regression of the log of real NCREIF NOI on a time trend. NOI / NOI mean is also a four-quarter moving average.

Hendershott and MacGregor (2005) found for U.K. office and retail, the NCREIF NOI data are far more volatile than the Hillier-Parker U.K. data the latter employed and thus lower correlations are to be expected.

Capitalization Rate Results

The empirical results for the capitalization rates are fully consistent with SSTW (2001) and CHN (2004). Exhibit 15 contains the estimated coefficients on the three proxies for expected real cash-flow growth rate in Equation (2) for two different equations for each of the three property types. The difference between the equations is that the lagged capitalization rate has been added to the other variables in the second estimation. A number of variants of these equations have been estimated, but the basic story remains the same and thus are not reported here.[7] Varying MSA-specific intercepts (fixed effects) are estimated.

In all except one equation, the recent growth variable enters positively, and the TW mean reversion variable enters negatively in all equations. And the mean reversion coefficients, in particular, are highly significant. These signs are, of course, inconsistent with rationality. More rapid recent growth should cause expectations of higher future growth and thus lower cap rates, and real cash flows above their long run value should lead to expectations of slower future real growth and thus to higher cap rates. In addition, the ratio of existing contract rents (NOI) to new contract (market) rents has a statistically significant negative impact in the office and industrial equations. Again, this is inconsistent with rationality; contract rents above market rents should generate expectations of lower cash flow growth and thus lead to higher capitalization rates. This is particularly disappointing as,

Exhibit 15 | Coefficients from the Panel for Capitalization Rate Regressions

	Office		Retail		Industrial	
%ΔNOI	0.026	0.009	−0.003	−0.007	0.041	0.018
	2.7	*1.5*	*−0.3*	*−1.4*	*6.0*	*4.7*
NOI/TW	−0.001	−0.0001	0.001	0.0001	−0.0003	−0.0001
	−2.1	*−0.3*	*2.2*	*0.8*	*−7.4*	*−2.9*
TW/TW mean	−0.026	−0.006	−0.039	−0.008	−0.034	−0.008
	−11.2	*−4.0*	*−6.4*	*−2.9*	*−19.3*	*−6.7*
Cap rate (−1)		0.782		0.883		0.801
		25.7		*41.4*		*38.9*
Adj. R^2	0.374	0.771	0.293	0.872	0.413	0.818

Notes: All cash flow variables are real and are four-quarter moving averages. Values in italics are *t*-Statistics. Estimation for Industrials: 85.4-02.4 and for Retail and Offices 86.4-02.4 (except Southern Florida Retail, which is 87.4-02.4).

Exhibit 16 | Panel Regression of NCREIF Cap Rates on Actual Five-Year Forward Real NOI Quarterly Growth Rates

Property Type	Regression Coefficient	Adj.R^2
Office	0.274 *8.8*	0.332
Retail	0.209 *3.6*	0.141
Industrial	0.254 *9.8*	0.190

Notes: *t*-Statistics are in italics. Industrials: 85.1-98.1; Offices and Retail 86.1-98.1. The constant varies by MSA.

as was shown above, there are good proxies for future real cash-flow growth. It would appear that the market is not using this information to rationally price property.

Finally, panel regressions of capitalization rates are run on actual future five-year real NOI growth over the 1986.1–1998.1 period. The higher is ex post real growth, the greater should expected growth have been and thus the lower should the capitalization rate be. The results are in Exhibit 16 for the three property types. Rather than negative, the coefficients are positive and the *t*-ratios range from 6 to 10. That is, capitalization rates are higher the faster future rental growth will be; investors pay less for a dollar of cash flow when that flow is going to increase than they pay when the flow is expected to erode. Again, irrationality is implied by the data.

To summarize, there is minimal evidence that investors rationally expect the reversion of real cash flows to either current market rents or to long run equilibrium rents. In fact, the greater the gap between current real cash flows and their market or equilibrium values, the greater do investors seem to expect the gap to get.

Conclusion

Given the conflicting evidence that U.K. investors have rationally built mean or tread reversion into their forecasts of real cash flows and thus property prices (Hendershott and MacGregor, 2005) but U.S. investors have not (SSTW, 2001), this paper has investigated carefully constructed U.S. NCREIF data using the methodology we applied to the U.K. data. The findings indicate supposedly better capitalization rates by deleting properties based on stale appraisals from the calculations. And expected real cash flow growth is proxied by gaps between actual property NOI data and Torto-Wheaton market rent data, as well as between the TW market data and mean or trend real rents. Because early MSA level NOI data are based on so few properties and are so volatile, the study was restricted (and others should do likewise) to industrial data after 1984 and to retail and office data after 1985. Even so, panels can be formed of only six retail and office MSAs with plausible real NOI data, and this requires aggregating a number of MSAs in close geographic proximity.

Nonetheless, the SSTW (2001) results stand. Based on this NCREIF data, U.S. investors behaved irrationally in that they did not factor expectations of mean or trend reversion of real cash flows into their asset pricing (as reflected in capitalization rates). In fact, investors appear to pay more for a dollar of cash flow when that flow is rationally expected to erode in the future than they pay when the flow is rationally expected to increase.

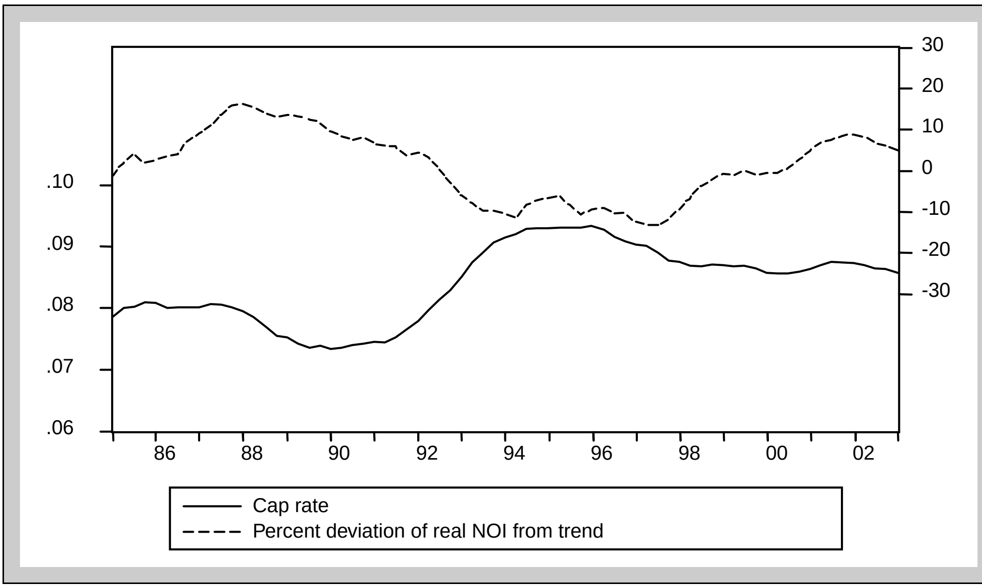
And this result is not due to an inadequacy of the mean or trend reversion expectations proxies. Actual real NOI growth over the next five years is strongly negatively correlated with the two measures of the divergence of real NOIs from trend values (just as was the case with the U.K. data). Further, panel regressions of current NOI capitalization rates on actual real NOI growth over the next five years yield positive coefficients. That is, the higher is future real cash flow growth, the higher are capitalization rates (the lower are asset prices).

It is sometimes said that a picture is worth a thousand words, so four pictures for southern California (Exhibit 17) and Chicago (Exhibit 18) (one each for office and industrial) are presented. These figures plot NCREIF capitalization rates against the deviations of real NOI from trend. Rationality suggests a positive relation. That is, the further real NOI is above trend, the less rapidly should it be expected to grow and thus the less someone should be willing to pay for a dollar of it (the higher should capitalization rates be).

Exhibit 17 illustrates the overall inconsistency of the data with rationality for Southern CA. The relation is consistently negative, not positive. Exhibit 18 for Chicago provides a modicum of hope for rationality. While the series are negatively correlated between 1985 and 1992 or 1993, they are positively (especially industrials) correlated after that. Perhaps the late 1980s and early 1990s cycle taught Chicago investors about mean reversion.

Exhibit 17 | Cap Rates and Real NOI Deviation: Southern California

Panel A: Industrial



Panel B: Offices

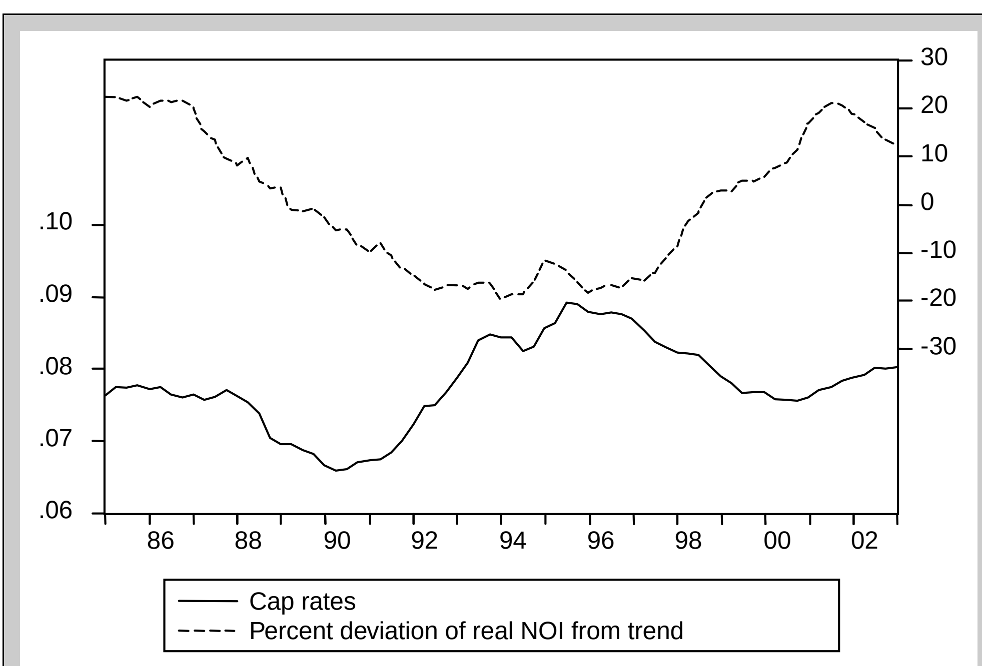
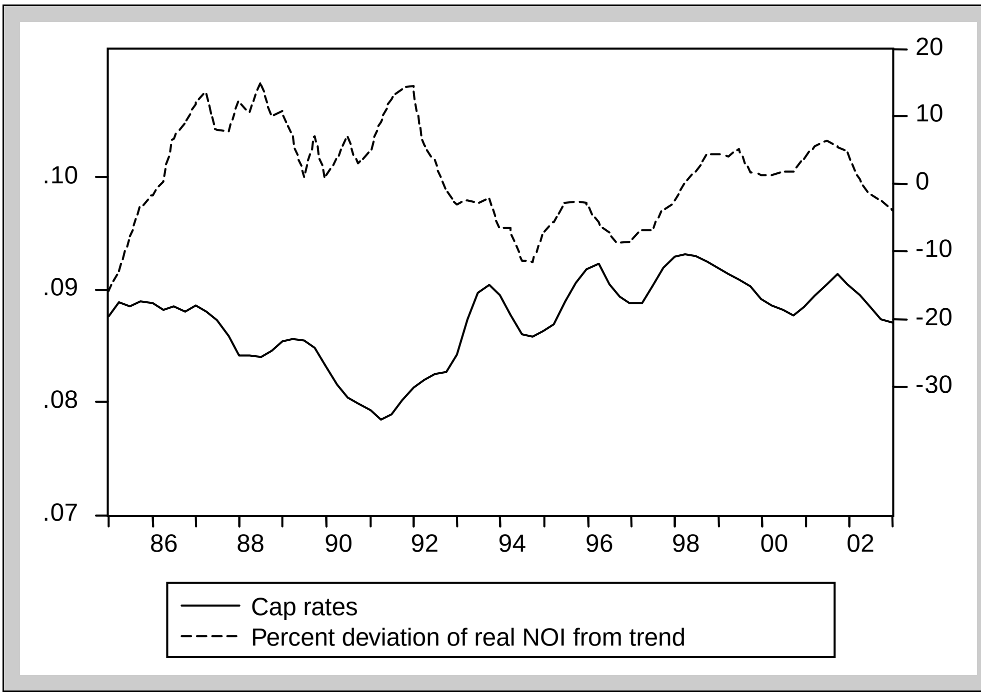
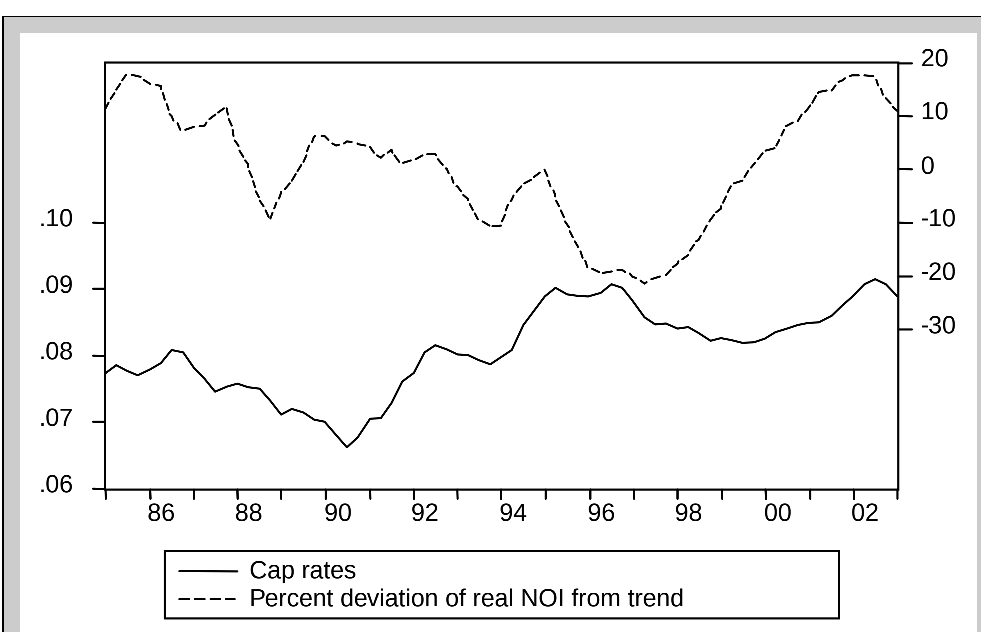


Exhibit 18 | Cap Rates and Real NOI Deviation: Chicago

Panel A: Industrial



Panel B: Offices



Endnotes

[1] See Hendershott (1996) on Australia and Hendershott and MacGregor (2005) on the U.K.

[2] More generally, how real cash flow growth expectations are formed is crucial to the rationality of any market. For a discussion of the U.S. equity market in this context, see Hall (2001).

[3] Valuation is also believed to have been too high at the peak of the late 1980s/early 1990s cycle in Australia (Hendershott, 1996, 2000), Sweden (Bjorklund and Soderberg, 1999) and some Asian cities (Quigley, 1999).

[4] CHN (2004) also analyze an office panel of fourteen MSAs, thirteen of which are the same as (or quite similar to) those of Sivitanides, Southard, Torto and Wheaton (2001); they use data for the 1982–2002 period.

[5] The numbers of properties refer to those used in computing the capitalization rates, not the NOI growth rates. Because all properties, not just those with current appraisals, were used in computing the NOI series, the numbers of properties used in the NOI calculations are roughly twice those discussed in the text.

[6] The TW standard deviation for Seattle industrials is 2.5 times greater than that of any other MSA.

[7] As noted above, links to the stock market were tested. The stock market variables always enter with unexpected signs and sometimes significantly. Thus they have not been included in the reported estimations.

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