Investor Rationality: An Analysis of NCREIF Commercial Property Data*

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1. 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.[1] Real property cash flows per unit space have been shown to be mean reverting in the U.S. (Wheaton and Torto, 1994), as well as many other countries.[2] However, Sivitanides et al (2001) argue, based on panel estimation of NCREIF data, that U.S. investors have not built this "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 them at cyclical troughs.[3] In contrast, Hendershott and MacGregor (2003) analyze UK office and retail capitalization rates and find investors to have built mean reversion into their forecasts and thus to have behaved rationally.

The present paper takes another look at the NCREIF data, building different data panels and using different modelling and estimation frameworks. The paper is an effort to determine whether the differences in the US and UK results can be attributed to differences in data, in modeling, or in estimation methodology, rather than differences in the rationality of investors in the two countries. Section 2 reviews the Sivitanides et al methodology and empirical results.

Section 3 describes the NCREIF cap rate and real rent data we use. The data seem to be of rather low quality. More specifically, the capitalization rates are extremely volatile, and numerous outlandishly large (in absolute value) quarterly NOI growth rates are observed.

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[1] 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).

[2] See Hendershott (1996) on Australia and Hendershott and MacGregor (2003) on the UK.

[3] Valuation is also believed to have been inappropriate in Australia (Hendershott, 1996 and 2000), Sweden (Bjorklund and Soderberg, 1999) and Hong Kong, Singapore and Jakarta (Quigley, 1999).

MSA property level data seem to be unuseable prior to 1985 (industrial) or 1986 (retail and office), and we can identify only six retail and office MSAs of plausible quality after 1985.

Section 4 describes our modelling framework that links property cap rates to stock market cap rates, and section 5 reports results for the industrial, office and retail markets. Unfortunately, our results are fully consistent with Sivitanides et al; 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 high at rental peaks and low at rental troughs.

One possible cause of this empirical irrationality result is that the mean reversion proxies employed are not good predictors of future real NOI growth. Thus in section 6 we correlate five-year forward real NOI cash-flow growth with the proxies. In the UK study, the correlation was extremely high and negative; the greater was current real cash flow relative to its mean, the lower was ex post future real cash-flow growth. In the US, too, the proxies are significantly negatively correlated with ex post NOI growth. That is, bad proxies are not the source of the irrationality result. Section 7 summarizes our findings

2. The Sivitanides et al study

Sivitanides *et al*. (2001) examine NCREIF cap rate data. For office and industrial properties, data are from 14 metropolitan markets for the 1984-2000 period; for retail data are from 9 markets for the 1983-2000 period. No information is given on the minimum or average number of properties over which the cap rates are computed. Annual averages of quarterly data are employed.

The primary economic determinants of cap rates are two real rent series that proxy for the expected real growth rate in rents: the ratio of real rent to its average over the 1980-99 period and the previous year growth rate in real rent. Actually, the annual growth rate is lagged one year and the rent ratio is lagged two years. The real rent series are from Torto-Wheaton; presumably they are based on area specific CPIs. While the growth in real rents works as expected, the real rent level variable has a negative coefficient, which is inconsistent with an expectation of mean reversion in real rents.

This conclusion is tempered by the fact that 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 negative coefficient. If, to illustrate, the rent cycle were two years, forward-looking expectations would *require* that the lagged two-year ratio have a *positive* coefficient. Of course, the cycle is far longer than two years.

The real bond rate is captured by the Treasury bond rate and the CPI inflation rate. The authors do not report a link to the equity market.

A partial adjustment equation is specified

$$\frac{C_t}{C_{t-l}} = [\frac{C_t^e}{C_{t-1}}]^{\gamma}$$

to allow for sluggish adjustment of the capitalization rate to its determinants. The equation is estimated in log form.

3. Our NCREIF Data

Like Sivitanides et al (2001), our property data are from the NCREIF database. They include both capitalization rates and real rent or NOI series. The data are quarterly averages across properties of a given type in a given MSA or combinations of common MSAs. The cap rate and rent data are discussed in turn.

Capitalization Rates

Capitalization rates are computed as the ratio of a four-quarter average of aggregate property NOIs to 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 quite volatile (see below). However, even the smoothed data hardly give smooth cap rates.

Unlike Sivitanides et al, "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.

We determine our panels in a multi-step process. We begin by imposing 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. With these two rules, we obtain only four cities for retail (Atlanta, Baltimore, Chicago and LA) and seven cities for office Boston, Chicago, Dallas, DC, LA, Minneapolis and NY). In order to obtain larger retail and office panels and to get larger numbers of properties, especially in the early years, we have aggregated across some common or close MSAs. The aggregations are:

Baltimore/DC (to get retail)
Kansas City/St Louis (to get retail)
New York/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)

Table 1 indicates the resulting 14 cities (MSAs), the NCREIF codes for each, and the year the series begins. The main difference from Sivitanides et al is that they include Denver and Houston, while we include Phoenix-Tucson, Seattle and South Florida in some panels.

Further, they include DC, NY, Oakland, LA and Orange County separately, while we aggregate them, respectively, with Baltimore, Newark, Northern CA and Southern CA.

Industrial properties are most heavily represented in the NCREIF database and we have 12 potential cities beginning in 1980-82. We have 9 and 8 potential cities for office and retail, beginning in 1981-83 and 1982-84, respectively. We say potential because the questionable quality of the NOI data causes us to delete some of these series from our panels.

Table 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 each property type are: end 1985 (office), end 1987 (industrial) and end 1988 (retail). As can be seen, the early samples for office and retail have less than ten properties on average, while that for industrial is 22. There are more than twice as many properties in office and retail during the later years, with only one category, KC/StL retail, averaging less than 12.

Figure 1 plots the office cap rates. These rates declined gently throughout most of the 1980s, troughing in 1990 or early 1991. They then rose by two to three percentage points through the middle 1990s (KC though the middle 1990s). Nearly all then declined through 1998 (DC/Balt and KC/St.L being the exceptions). After that point some remained roughly flat (DC/Balt, KC/St.L, NY and Southern CA), while others rose by a percentage point or two (Boston, Chicago, Dallas, Minneapolis, and Northern CA).

The retail cap rates are in Figure 2. 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, Phoenix and South Florida reversed sharply in 1999-2000.

The industrial cap rates are in Figure 3. The rates for most cities – those in panel (a) – are roughly flat from 1981 to 1991 at 7.5 to 8 percent, jump in the next two years, and are then flat for the 1993-2002 period at 9 to 9.5 percent. The exceptions are Boston, Chicago, DC/Balt, and Seattle, where the rates are relatively stable throughout the entire 20-year period.

NOI or Rent Data

Our real rental (NOI) growth expectations variables (recent growth and the level of real rent relative to trend) require the calculation of real rent indices. We obtain nominal indices by moving rent forward each quarter by the nominal growth rate in NOI. These growth rates were provided by Jeff Fisher. For each MSA and property type, he aggregated the NOI on all properties that existed in each pair of adjacent quarters (and whose characteristics did not change between the quarters) and then divided the change in the NOI by the initial NOI. Real rent or NOI indices are obtained by deflating the nominal series by area specific CPI indices (equal to 1 in 1982-84).

These inflation series are obtained from www.econmagic.com. Series are available for all but three of our areas. For DC/Baltimore, a series is available only after 1996. Prior to that we use the South Size A series, rescaling the city specific series to equal the South Size A index in 1996.1. For KC/StLouis, we use Midwest Size A, and for Phoenix/Tucson, we use West Size A. For some series for some periods, the deflators are available only every other month. We use the average of all months available in the relevant quarter.

The inflation 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 percent for Atlanta, Dallas, DC/Baltimore and Kansas City/St.Louis to 82 to 84 percent in New York, Northern CA, and Seattle, to 88 percent in Boston. That is, Boston experienced a third more inflation than the first set of cities, and NY, N. CA and Seattle experienced a quarter more.

The underlying nominal rent series exhibit extreme volatility, which has caused us to explore outliers. More specifically, we concentrate on quarterly nominal rental growth rates of greater than 25 percent in absolute value. We find 48 quarters with negative growth rates greater than 25 percent and 113 quarters with positive growth rates greater than 25 percent. Together the outliers constitute four percent of the total industrial quarters and eight percent each of the office and retail quarters. Moreover, 1.5 percent of the total retail and office quarters have growth rates greater than 50 percent in absolute value, with 149 percent being the maximum. As one might expect, there is a negative correlation between outliers and the following or preceding observations. This is obvious in the scatter diagram of current nominal NOI growth against next period NOI growth in Figure 4a.

Table 3 lists the number of outliers by city, property, and magnitude. Absolute values between 25 and 33.3 percent, 33.3 and 50 percent, 50 and 100 percent and above 100 percent are listed. As can be seen in the average-per-MSA row, outliers are almost twice as likely for office and retail than for industrial (recall that industrial data start a year earlier than office and two years earlier than retail). Moreover, all four of the over 100 percent absolute rental changes and three-quarters of changes between 75 and 100 percent are in office or retail. Because the numbers of properties in retail and office are less than half as many than those in industrial, this suggests, as we would expect, that outliers are concentrated in periods/MSAs where there are relatively fewer properties.

To check this, we show in Table 4 the cumulative percentage of quarters in our total sample with numbers of properties less than different thresholds, as well as the percentage of outliers of different magnitudes with similar numbers.[4] As can be seen, only 20 percent of the total sample quarters have fewer properties than 10, while 37 to 75 percent of the outliers do, with the percentage rising with the size of the outlier. And while 75 percent of the total sample quarters have less than 30 properties, 95 percent of the outlier quarters do.

The outliers also twice as likely to occur in the early years of our 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 percent of the sample. Similarly, 44 percent of office outliers occur in the earliest 18 percent of the observations, and 26 percent of retail outliers occur in the earliest 14 percent of the observations.

This concentration in early quarters has led us to begin our panels later than 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. Even with this latter start, a number of MSAs continue to have enough outliers (over five) to make us uncomfortable. 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 N. California 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.

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

Table 5 shows that dropping a few MSAs and starting the panels a bit later eliminates all the outliers with growth rates over 100 percent in absolute value, 88 percent of the outliers between 50 and 100 percent, 78 percent of those between 33.3 and 50 percent, and 61 percent of those with absolute growth rates between 25 and 33.3 percent. Figure 4b 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.

Figures 5-7 plot the real rent series for the MSAs and years in the final data set. Of the six office MSAs, all experienced a 25 to 50 percent decline in real rents through the middle 1990s and then all except Boston reversed and recovered most of the loss. Boston real rents initially declined by 65 percent, falling all the way through 1997, and were then flat.

In contrast to real office rents, real retail rents neither fell sharply in the late 1980s and first half of the 1990s nor rebounded after that. KC/StL rents did decline by 30 percent in the late 1980s and stayed at that lower level, but DC/Balt and Chicago both experienced 25 to 40 percent real increases over the entire period. Southern CA and Southern Florida were basically flat. A 30 decline in Northern CA real rents in the late 1980s was offset by a sharp increase during the 2000-02 period (the aftermath of the dot.com boom). While all real retail rent series are volatile, the California series are particularly so.

Most industrial real rent series exhibited a 20 to 50 percent decline from the mid1980s through 1993 or 1994. Exceptions are DC/Balt and KC/StL, where real rents were basically flat (KC had a 1985-88 blip and then reversal). The largest declines were for Dallas and Philadelphia. After 1993-94, real rents in six of the ten MSAs were roughly flat through 2002. DC/Balt and Northern CA experienced huge increases (60 to 100 percent), while Chicago, Minneapolis and KC/StL had large declines (about 30 percent). In 2002, real Chicago, KC/Balt, Minneapolis and Seattle industrial rents were 40 to 50 percent below their mid 1980s levels. In contrast, DC/Balt and Northern CA real rents were 30 to 60 percent higher.

Table 6 gives the correlation coefficients between our real NOI series and the deflated Torto-Wheaton rent series for the 1985.1 (industrial) or 1986.1 (office and retail) to 2003.1 period. There are a number of reasons for the NCREIF and TW series to move differently. Conceptually, our NOIs refer to existing contract rents while the TW series represent newly-written leases or market rents. Also, in some cases we have aggregated MSAs (e.g., DC and Baltimore), while TW has not. Empirically, the NOI series exhibit what seems to be extreme volatility, while the TW retail rent series, in particular, has low volatility because quarterly data have been interpolated from annual data. These differences in volatility reduce the correlations.

Half the office correlations are 0.8 or higher, and the modest KC correlation can be explained by our including St. Louis. Half the industrial correlations are 0.7 or higher, and the "zero" DC and KC 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 percent decline in the NCREIF series between 1992 and 2000 versus a 70 percent 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 1988-94 period. In Chicago, NCREIF NOI was flat, while TW rent fell by 20 percent, and in DC (and Baltimore) NCREIF NOI rose by 40 percent versus a 30 percent decline in the TW data.

In spite of dropping the MSAs with the most volatile real NOIs and the most volatile early years, an overriding concern is the great volatility still remaining. This is especially true for retail and for Northern CA within this group. Office rents are also quite volatile with KC/StL being the most suspicious. Simply put, the volatility in these real NOI series stretches credibility.

4. Modelling the capitalization rate

We motivate our empirical estimation with a derivation based on the simple Gordon growth model. If net rents are expected to grow at a constant rate G_p, R_p is the (constant) required rate of return on property, and rents adjust annually,

$$K_p = R_p - g_p - \pi . \qquad (1)$$

where we have expressed the growth rate as the sum of expected general inflation π and the expected growth in real rent on the property type g_p.

With a simplified CAPM, we specify the required return on property as the risk-free rate plus a constant time the difference between the market return (taken to be the required return on stocks R_s) and the risk-free rate

$$R_p = RR_b + \pi + w(R_s - (RR_b + \pi)) \qquad (2)$$

where w is the property beta and RR_b is the real risk-free rate.

Assuming constant growth in real dividends and a constant required equity return, the required equity return can be expressed as the sum of the cap rate for corporate stocks (the dividend/price ratio) and the expected growth rate in dividends. Again partitioning the growth rate into general inflation and real growth,

$$R_s = K_s + g_s + \pi \tag{3}$$

Substituting (3) into (2), the result into equation (1), and cancelling the inflation terms, we obtain:

$$K_p = wK_s + wg_s + (1-w)RR_b - g_p \tag{4}$$

Leases are longer than one period and rarely would one expect future discount rates and real cash flow growth rates to be constant. Thus equation (4) is a conceptual abstraction. It does, however, suggest the following general relationship where the signs over the variables indicate the signs of partial derivatives with respect to the variables.

$$K_p = K_p(\overset{+}{K_s}, \overset{+}{g_s}, \overset{+}{RR_b}, \overset{-}{g_p}, \overset{+}{w}) \tag{5}$$

Unfortunately, only one of the five variables in this equation, the dividend/price ratio, is observed. Hendershott and MacGregor ended up treating the real interest rate as a constant, and we do likewise here.

In Hendershott and MacGregor, the capitalization rates and the real rental cash flows are those for newly leased properties. The key variables explaining the cap rates are the expected growth rates in real cash flows, both dividends and rents. Like Sivitandes et al, Hendershott and MacGregor consider expectations as consisting of extrapolative and regressive components, specifying the g's as functions of both the percentage change in real cash flow during the previous year (%ΔCF) and the ratio of current (annual average) market real cash flow to its trend value (CFM/CFT).

As noted above, the NCREIF capitalization rates are the ratio of four-quarter averages of actual real cash flow to appraised value, and the relevant rental cash flow is the actual (or contract as opposed to market) real NOI on NCREIF properties. Thus there are two potential cash flow adjustments, the movement of contract cash flow to newly-let or market cash flow and the movement of market cash flow to long-run equilibrium. To reflect this, we write:

$$g_p = g_p(\overset{+}{\%\Delta CF}, \overset{-}{CF/CFM}, \overset{-}{CFM/CFT}) \qquad (6)$$

We planned on estimating an error correction model (ECM) on panel data, similar to our explanation of UK regional rents (Hendershott, MacGregor and White, 2002). The long-run relationship is a time-varying equilibrium to which the system tends. It is based on the substitution of equation (6) into equation (5) and linearization. An ECM comprises both the long-run relationship and the short-run transitory relationship that describes how the long-run solution is achieved through negative feedback and error correction. Unfortunately the quality of the long-run relationship does not merit reporting short-run adjustments to it. Thus only the long-run results are presented below.

5. Capitalization Rate Results

The empirical results are extremely discouraging, although fully consistent with Sivitandes et al. The stock market variables always enter with unexpected signs and sometimes significantly, so they have not been included in the reported estimations. Table 7 contains two equations for each property type. The first is the long run equation including the three expected real rental cash-flow growth rate proxies in equation (6). The second is the Sivitandes et al adjustment equation, i.e., the lagged capitalization rate has been added to the other variables. A number of variants of these equations have been estimated, but the basic story remains the same and thus we do not report them.

In all except one equation the recent growth variable enters positively and the TW mean reversion variable enters negatively. And these are generally 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 rents above their long run value should lead to expectations of slower future rental 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 rental growth and thus lead to higher capitalization rates.

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 real cash flows and market or equilibrium values, the more do investors seem to expect them to diverge.

6. The Validity of the Mean Reversion Proxies

One possible explanation for the irrationality result is that our proxies for mean reversion are flawed. We investigate this possibility in two ways. First, we correlate actual real NOI growth over the next five years with two measures of the divergence of real NOIs from trend values. The two measures are the log deviation of real NOI from its trend value and the ratio of TW real rent to mean real rent. 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). We expect a negative correlation: the more positive is the deviation or the ratio, the lower should future growth be.

The results are in Table 8. In the first row we list the average correlation coefficient for the property types (average of six MSAs for offices and retail and ten for industrial). In the second row we report the lowest correlation of the top half of the correlations. The correlations are negative, and they are similar for the two measures of divergence. The strongest mean negative correlation is -0.71 for offices with half of the individual MSA correlations being above 0.8 in absolute value. The correlations are about -0.6 for retail and industrial. While these correlations are lower in absolute value than the -0.87 Hendershott and MacGregor found for UK office and retail, the NCREIF NOI data are far more volatile than the Hillard-Parker UK data and thus lower correlations are to be expected. To summarize, the failure of the reversion proxies to work as expected in the capitalization rate equations is not because the proxies are incorrectly correlated with future actual real cash flows.

Our second exercise is to run our panel regressions of capitalization rates on actual future five-year real NOI growth over the 1986.1-1998.1. 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 Table 9 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 more for a dollar of cash flow when that flow is going to erode in the future than they pay when the flow is going to increase. Again, irrationality is supported by the data.

7. Summary

We have attempted to overturn the irrationality result of Sivitanides et al (2001) in a variety of ways. In spite of using supposedly better capitalization rates (deleting those based on stale appraisals) and analyzing supposedly better panels of data and deleting early observations (both to reduce NOI growth outliers), we have been unsuccessful. Based on the NCREIF data, US investors appear to have behaved irrationally in that they have not factored expectations of mean 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 reversion expectations proxies. Actual real NOI growth over the next five years is negatively correlated with our two measures of the divergence of real NOIs from trend values. Further, panel regressions of current NOI capitalization rates on actual real NOI growth over the next five years yield positive coefficients. 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 we close with three (actually six) pictures for Southern CA, Northern CA, and Chicago (one each for office and industrial). In these figures we have plotted 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 we should expect it to grow and thus the less we should be willing to pay for a dollar of it (the higher should capitalization rates be).

Figure 8 illustrates the overall inconsistency of the data with rationality for Southern California. The relation is consistently negative, not positive. Figure 9 illustrates in addition the 1997-99 “bubble” in Northern California; note the sharper declines in the cap rates between 1996 and 1998 relative to Southern California and the rebounds between 2000 and 2002. Figure 10 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 investors have learned about mean reversion.

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Table 1: MSAs or Aggregates Used in the Analyses

		Initial year			CPI availability
City	**MSAs**	**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
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 til 1987
Minneapolis	5120	80	81		Even only until 1986
New York/ 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 that the base for DC is 1996=100, while South Size A it is the usual 1982-84 = 100.

Table 2: Average Number of Properties Included in Cap Rate Series for Selected Sub-periods

	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		
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/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.

Table 3: Number of Quarters with Absolute Values of Percentage Change in Nominal Rental Growth within Indicated Ranges

		Absolute values														
Range		**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**	
KC/St Louis	3760	2	2	2	1	3	2	1	5	0	0	0	0	**4**	**10**	**4**
S. Ca.	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**	
NY/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. Ca.	7360	0	4	6	1	1	1	0	1	1	0	1	0	**1**	**7**	**8**
Seattle	7600	3			0			0			0			**3**		
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 Table 1 until 2003.1.

Table 4: Cumulative Percentage of Quarterly Nominal Rental Growth in Specified Ranges by Number of Properties used in Calculation (based on Table 1 starting dates)

Number of Properties	**<10**	**<15**	**<20**	**<30**	**<200**	**Number of observations**
Percentage of total sample	**20**	**40**	**57**	**75**	**100**	**1640**
%Rental growth range (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

Table 5: Number of Quarters with Absolute Values of Percentage Change in Nominal Rent within Indicated Ranges – Revised Sample (Industrials starting 1985; Office and Retail in 1986)

		Absolute values														
Range		**25 to 33.3**			**33.3 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			1			0			0			**3**		**0**
Boston	1123		0			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		**0**	**0**	
KC/St Louis	3760	2	1	2	1	2	2	1	0	0	0	0	0	**4**	**3**	**4**
S. Ca.	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		**0**	**0**	
NY/Newark	5600		1			1			0			0			**2**	
Philadelphia	6160	1			0			0			0			**1**		
Phoenix/Tucson	6200															
N. Ca.	7360	0		4	1		0	0		1	0		0	**1**	**0**	**5**
Seattle	7600	1			0			0			0			**1**		
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**

Table 6: Correlation of NCREIF Real Rent NOI Levels with TW Real Rent Levels

	Office	Retail	Industrial
Atlanta			0.85
Boston	0.18		
Chicago	0.55	-0.33	0.53
Dallas			0.75
Washington DC/Baltimore	0.85	-0.52	-0.11
Kansas City/St. Louis	0.34	0.65	0.09
Minneapolis			0.11
Northern California		0.07	0.54
Philadelphia	0.80		0.78
Southern California	0.88	0.43	0.88
Seattle			0.70
Southern Florida		0.35	

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

Table 7: Capitalization Rate Regressions

	Industrial		Office		Retail	
%ΔNOI	0.0444 (6.5)	0.0188 (4.8)	0.0314 (3.2)	0.0090 (1.5)	0.0133 (1.1)	-0.0022 (-0.4)
NOI/TW	-0.00036 (-8.5)	-0.00001 (-3.1)	-0.00426 (-2.6)	-0.00020 (-0.2)	0.0186 (4.7)	0.00339 (2.0)
TW/Mean	-0.0345 (-19.5)	-0.0082 (-6.8)	-0.0256 (-11.3)	-0.0063 (-4.0)	-0.0250 (-4.4)	-0.0041 (-2.0)
Cap Rate (-1)		0.791 (37.7)		0.783 (25.6)		0.829 (42.5)
R^2	0.429	0.820	0.378	0.771	0.279	.877

Note: Estimation for Industrials: 85.1-03.1; Retail and Offices 86.1-03.1. Figures in parentheses are t-statistics.

Table 8: Correlation of Mean-Revision Proxies with Five-Year Future Actual NOI Growth Rates

	Our NOI Residual(1)			Wheaton Rent Ratio(2)		
	Office	**Retail**	**Industrial**	**Office**	**Retail**	**Industrial**
Mean correlation	-0.71	-0.60	-0.57	-0.71	-0.67	-0.48
Half at or above	-0.80	-0.66	-0.74	0.86	-0.73	-0.73

Notes:
1. Residual of regression of log NOI on time.
2. TW Rent/TWMean Rent.
Industrials: 85.1-98.1; Retail and Offices 86.1-98.1

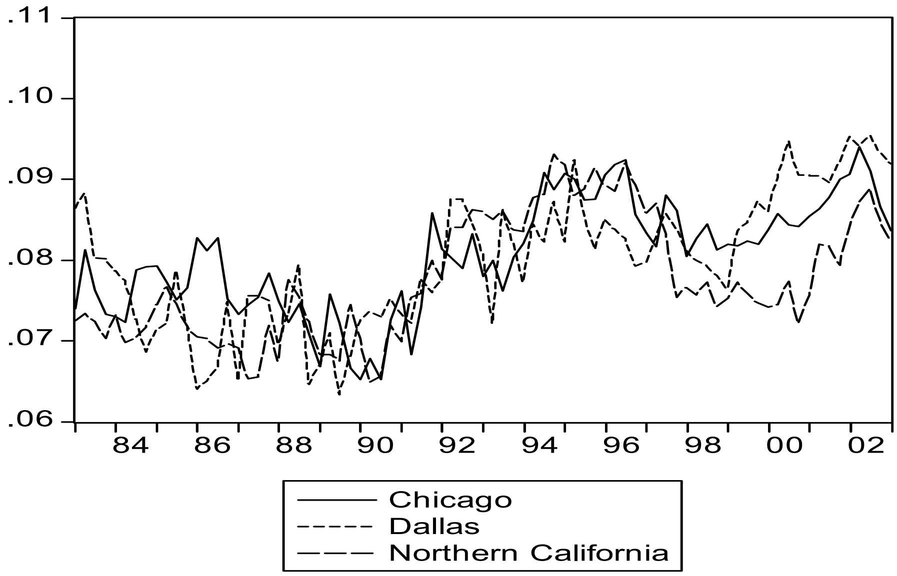
Table 9: Panel Regression of NCREIF Cap Rates on Actual Five-Year Forward NOI Quarterly Growth Rates

Property Type	Regression coefficient (Standard Error)	Adjusted R^2
Office	0.274 (0.031)	0.332
Retail	0.209 (0.058)	0.141
Industrial	0.254 (0.026)	0.190

Note Industrials: 85.1-98.1; Retail and Offices 86.1-98.1. The constant varies by MSA.

Figure 1: Office cap rates

(a)



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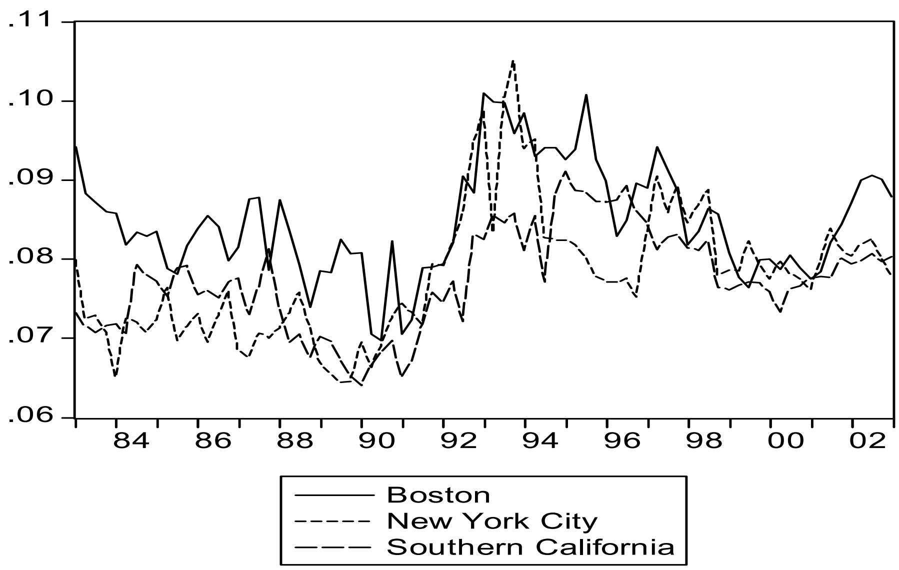

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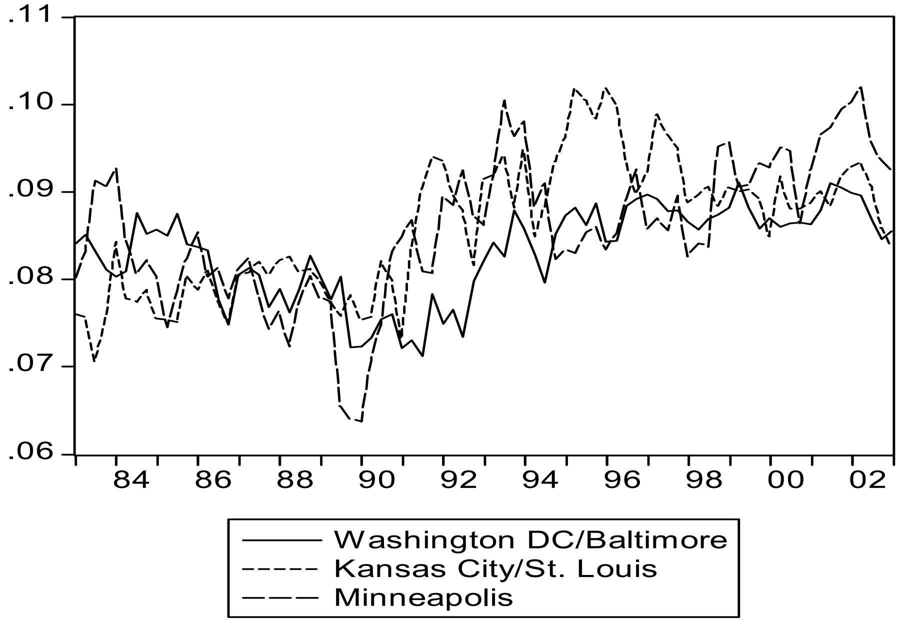
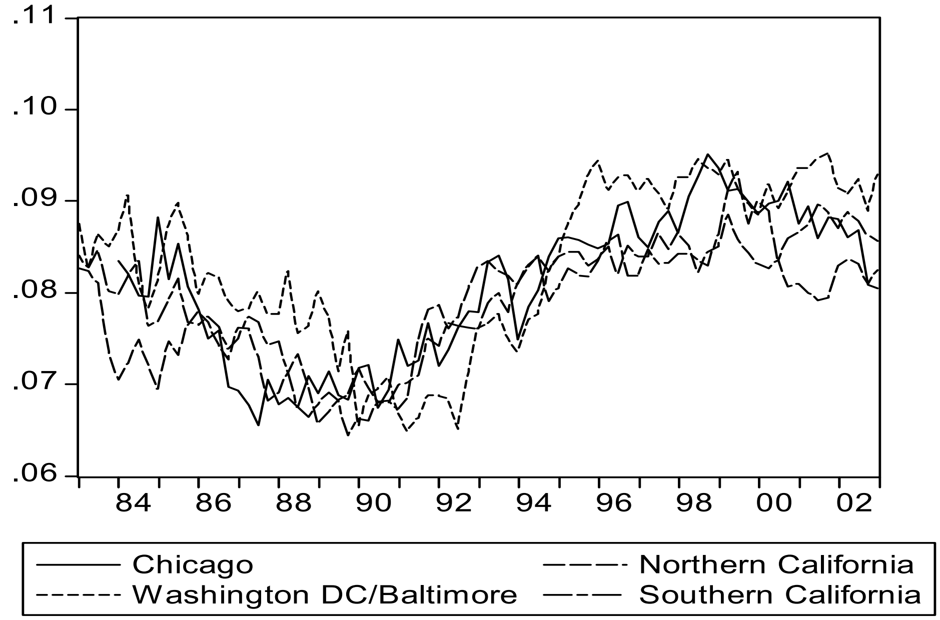

.11
.10
.09
.08
.07
.06
84
86
88
90
92
94
96
98
00
02
Washington DC/Baltimore
Kansas City/St. Louis
Minneapolis

Figure 2: Retail cap rates

(a)



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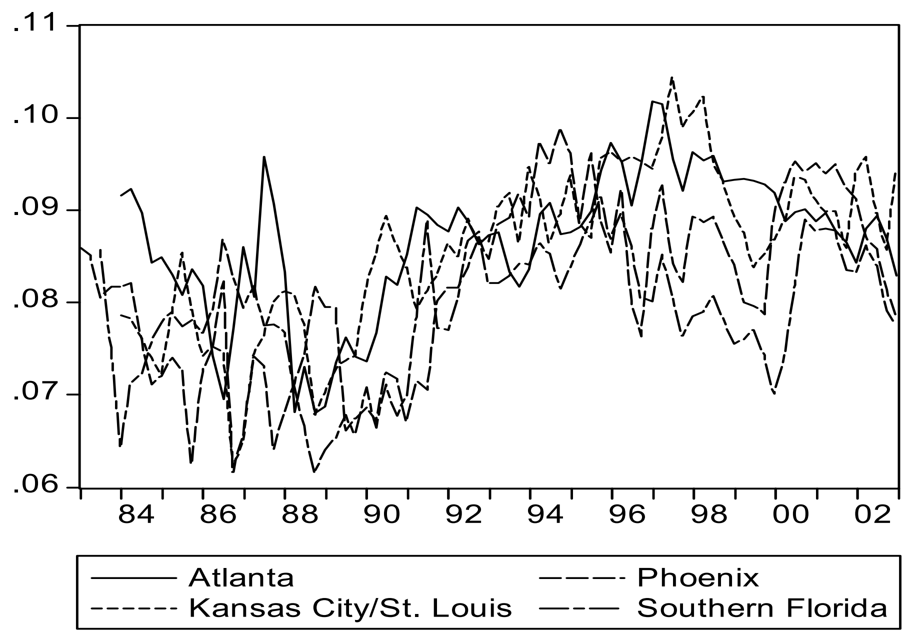
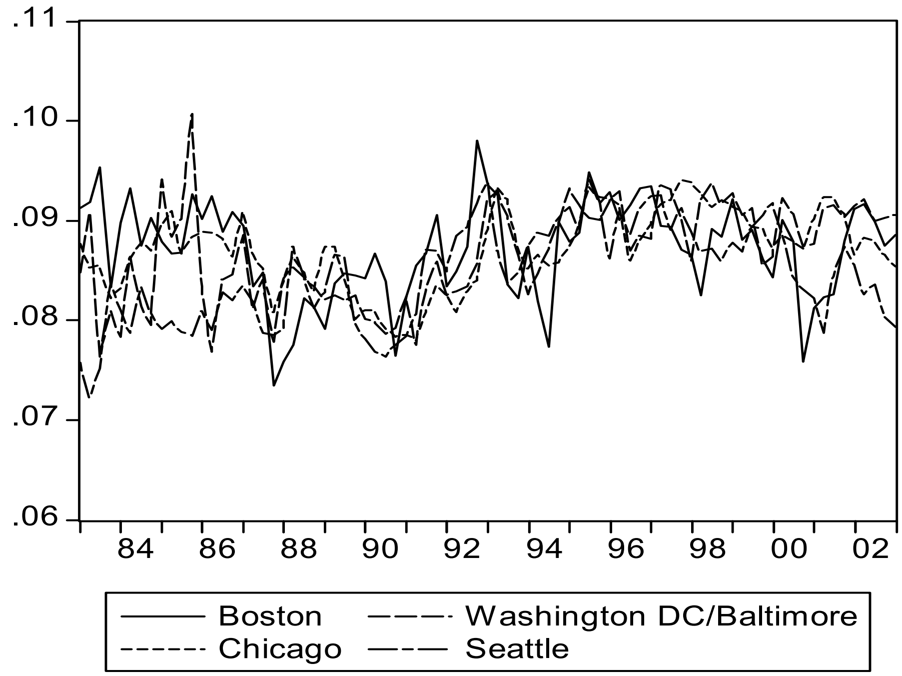


Figure 3: Industrial cap rates

(a)



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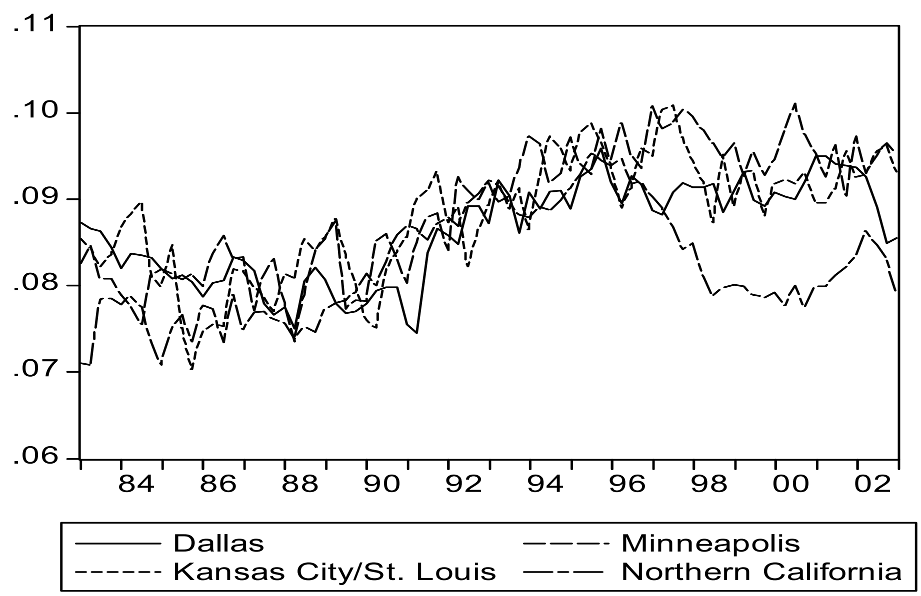
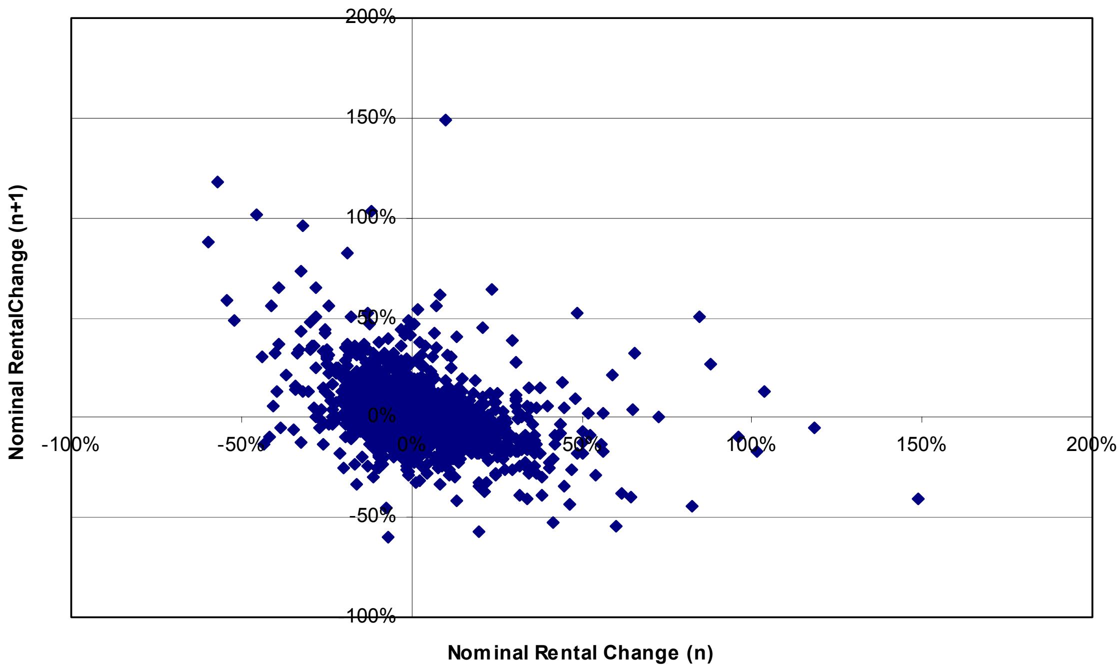


Figure 4: Nominal Rental Change: Current Quarter vs Next Quarter

(a) Full Sample



(b) Reduced Sample

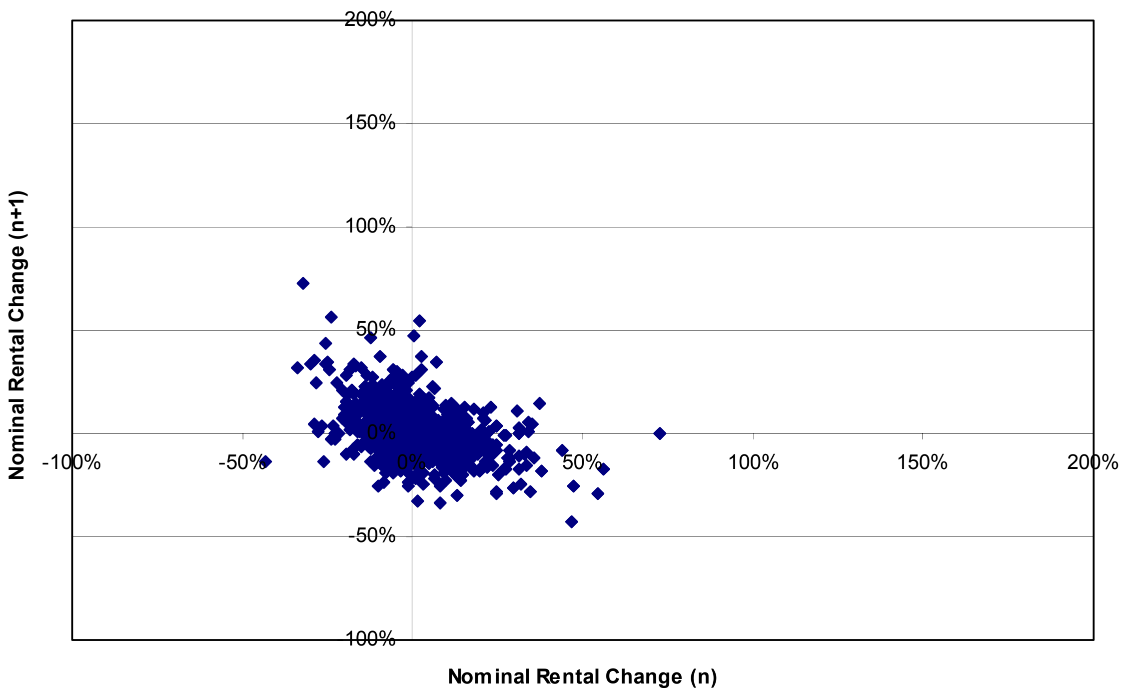
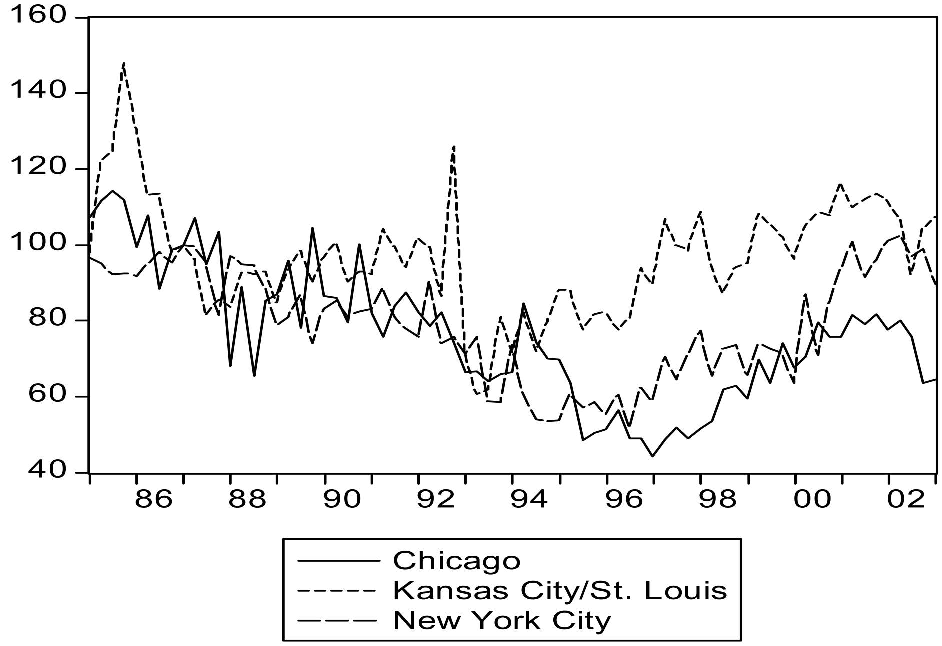


Figure 5: Real office rents

(a)



(b)

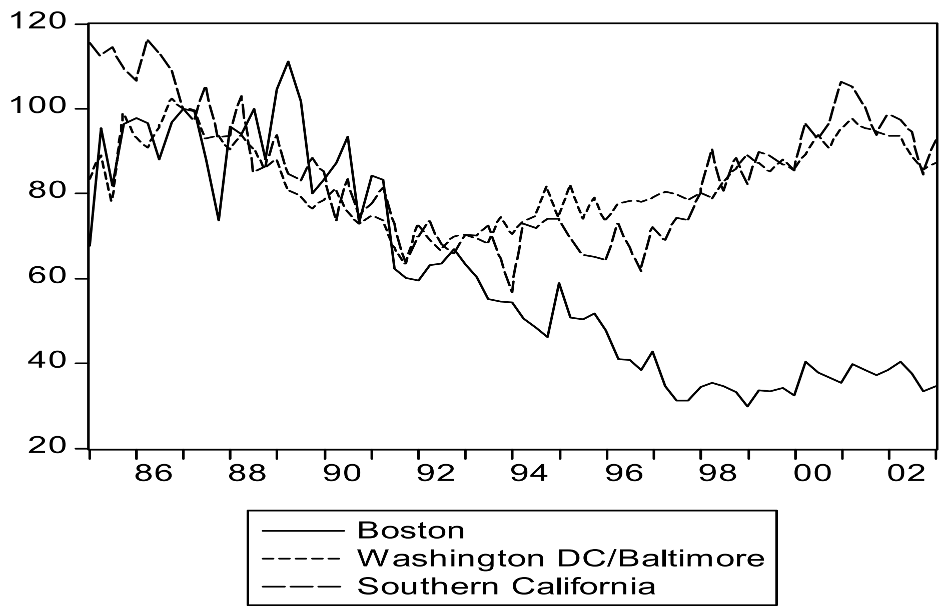
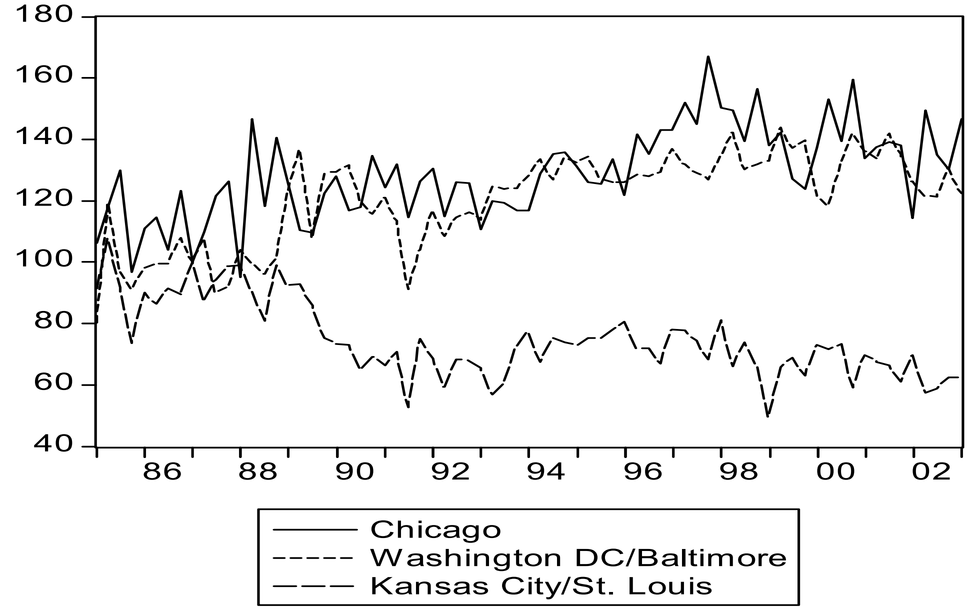


Figure 6: Real retail rents

(a)



(b)

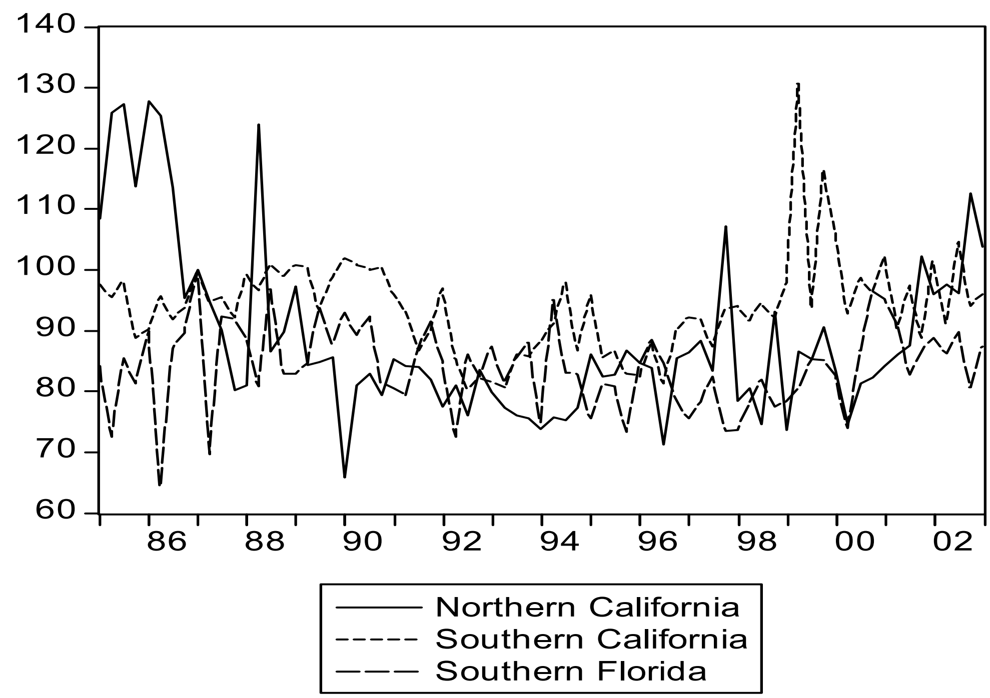
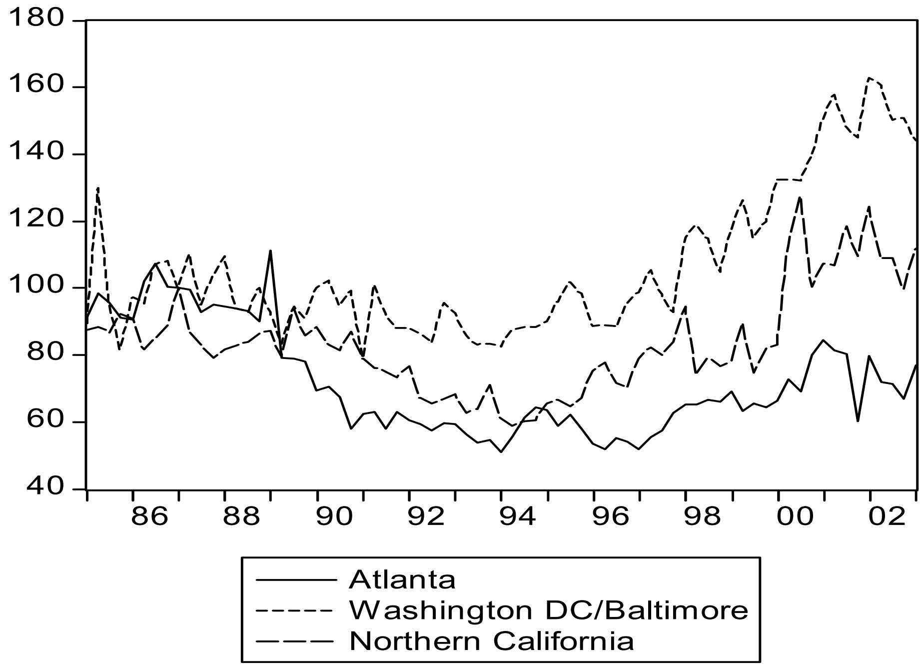


Figure 7: Real industrial rents

(a)



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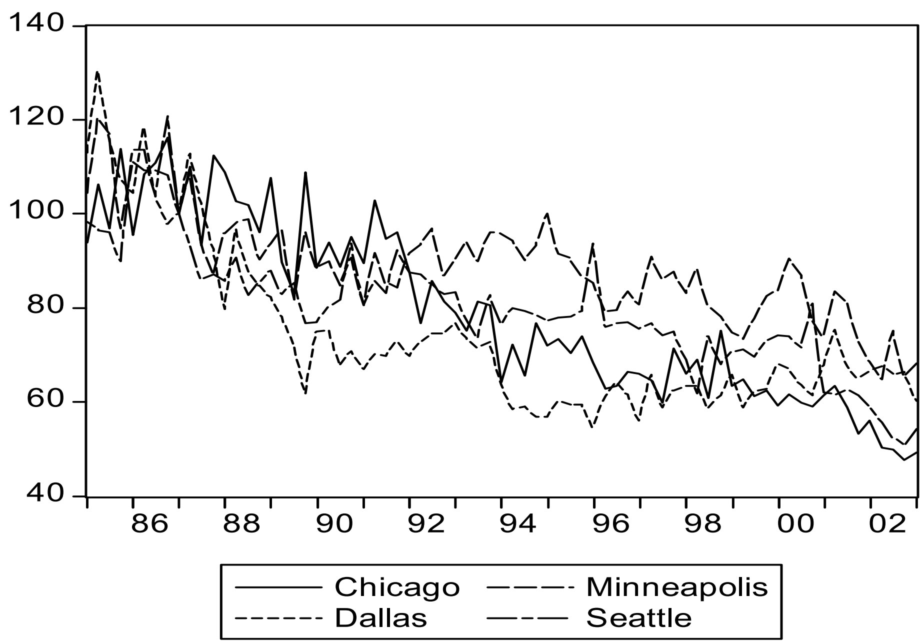
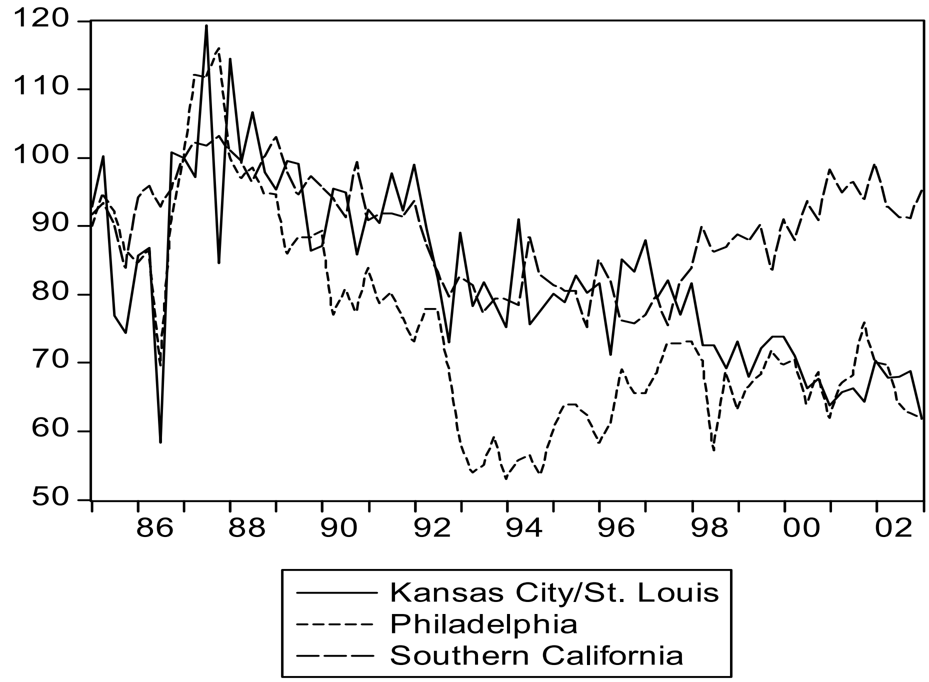


(c)



120
110
100
90
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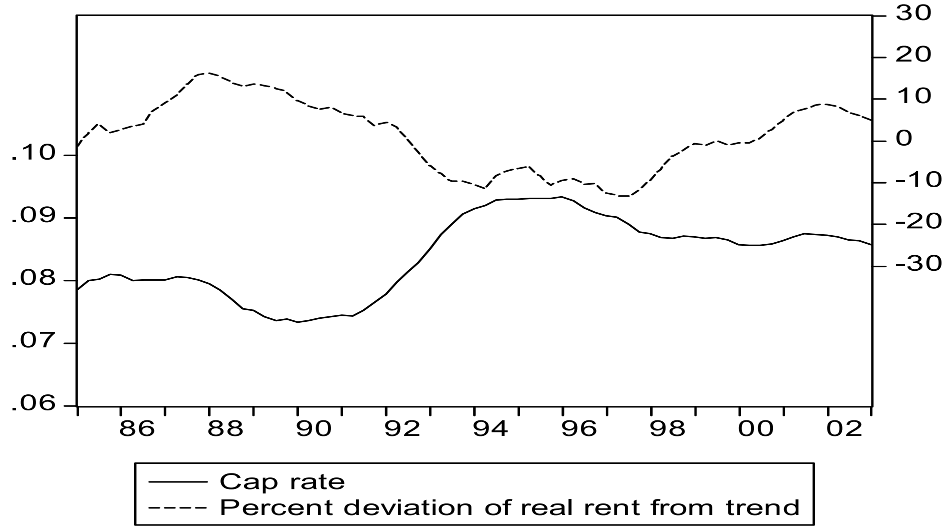
50
86
88
90
92
94
96
98
00
02
Kansas City/St. Louis
Philadelphia
Southern California

Figure 8: Cap rates and real rent deviation - Southern California

(a) Industrial



(b) Offices

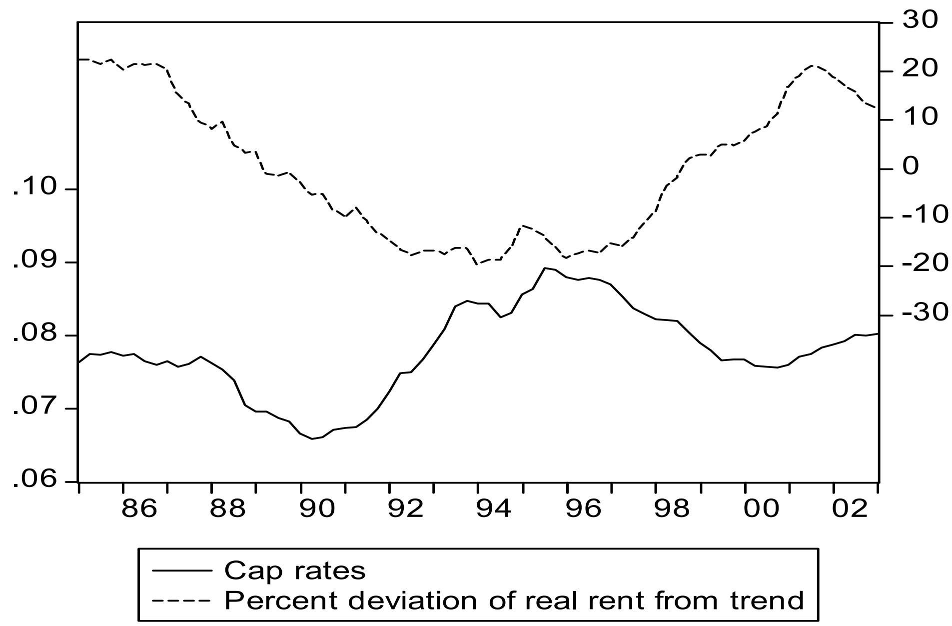
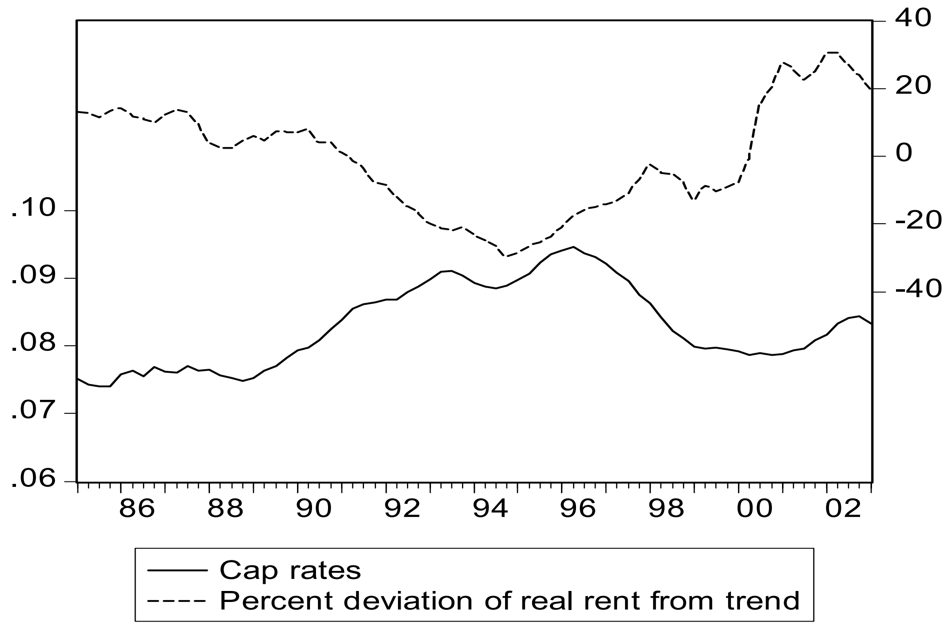


Figure 9: Cap rates and real rent deviation - Northern California

(a) Industrials



(b) Offices

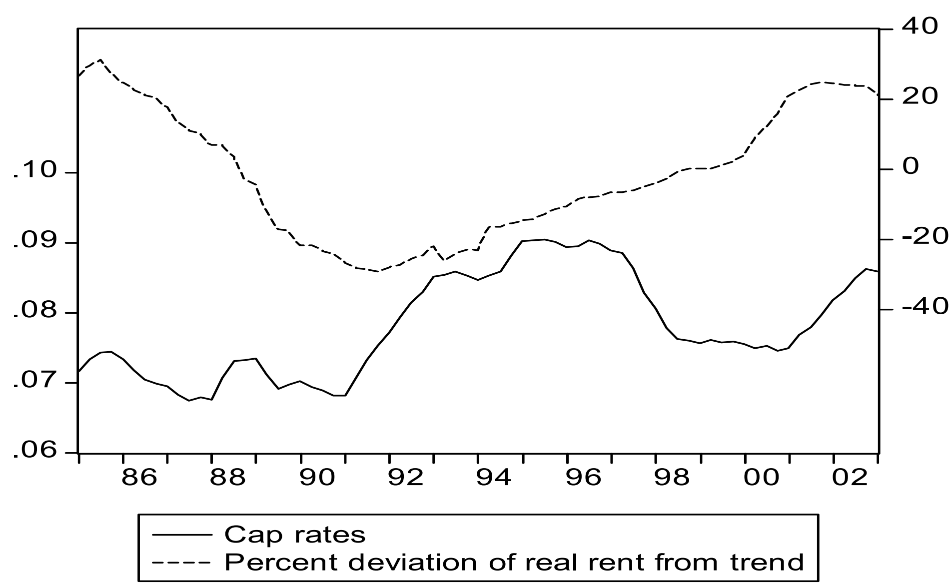
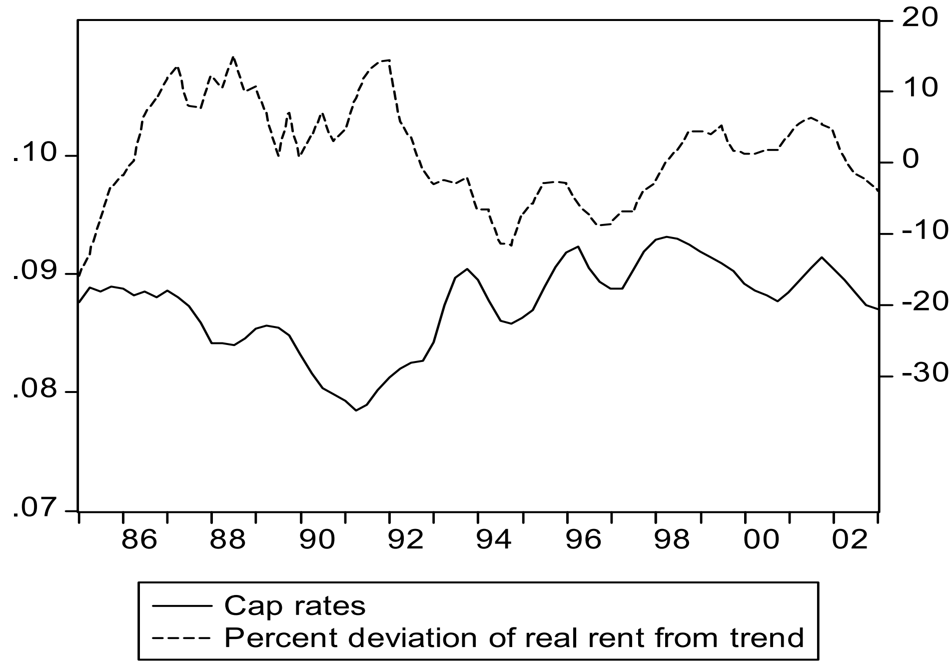


Figure 10: Cap rates and real rent deviation - Chicago

(a) Industrial



(b) Offices